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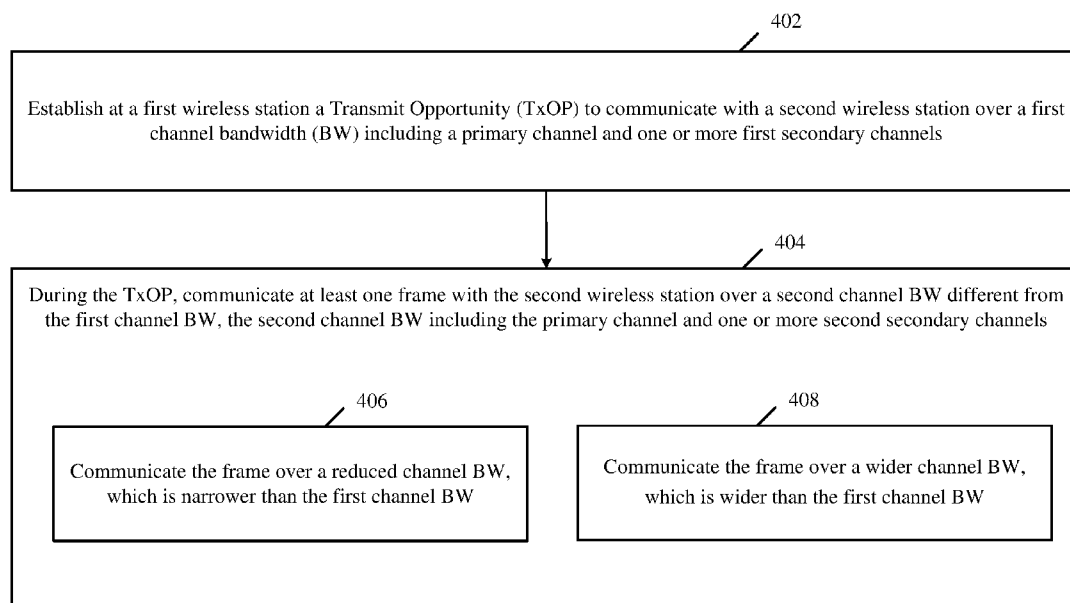


Fig. 4

(57) Abstract: Some demonstrative embodiments include apparatus, system and method of modifying a channel bandwidth during a transmit opportunity (TxOP). For example, an apparatus may include logic and circuitry configured to cause a first wireless station to establish a TxOP to communicate with a second wireless station over a first channel bandwidth (BW) including a primary channel and one or more first secondary channels; and during the TxOP, to communicate at least one frame with the second wireless station over a second channel BW different from the first channel BW, the second channel BW including the primary channel and one or more second secondary channels.

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APPARATUS, SYSTEM AND METHOD OF MODIFYING A CHANNEL BANDWIDTH DURING A TRANSMIT OPPORTUNITY (TXOP)

CROSS REFERENCE

[001] This Application claims the benefit of and priority from US Provisional Patent
5 Application No. 62/442,034 entitled “APPARATUS, SYSTEM AND METHOD OF
MODIFYING A CHANNEL WIDTH DURING A TXOP”, filed January 4, 2017, the
entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

10 [002] Embodiments described herein generally relate to modifying a channel
bandwidth during a transmit opportunity (TxOP).

BACKGROUND

[003] A wireless communication network in a millimeter-wave band may provide
15 high-speed data access for users of wireless communication devices.

[004] According to some Specifications and/or Protocols, devices may be configured
to perform all transmissions and receptions over a single channel bandwidth (BW).

BRIEF DESCRIPTION OF THE DRAWINGS

[005] For simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity of presentation.

5 Furthermore, reference numerals may be repeated among the figures to indicate corresponding or analogous elements. The figures are listed below.

[006] Fig. 1 is a schematic block diagram illustration of a system, in accordance with some demonstrative embodiments.

10 [007] Fig. 2 is a schematic illustration of communications over a channel bandwidth, which may be implemented in accordance with some demonstrative embodiments.

[008] Fig. 3 is a schematic illustration of communications and operations over a primary channel, and first and second secondary channels, in accordance with some demonstrative embodiments.

15 [009] Fig. 4 is a schematic flow-chart illustration of a method of modifying a channel bandwidth during a transmit opportunity (TxOP), in accordance with some demonstrative embodiments.

20 [0010] Fig. 5 is a schematic flow-chart illustration of a method of modifying a channel bandwidth during a TxOP, in accordance with some demonstrative embodiments.

[0011] Fig. 6 is a schematic illustration of a product of manufacture, in accordance with some demonstrative embodiments.

DETAILED DESCRIPTION

[0012] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of some embodiments. However, it will be understood by persons of ordinary skill in the art that some embodiments may be practiced without these specific details. In other instances, well-known methods, procedures, components, units and/or circuits have not been described in detail so as not to obscure the discussion.

[0013] Discussions herein utilizing terms such as, for example, “processing”, “computing”, “calculating”, “determining”, “establishing”, “analyzing”, “checking”, or the like, may refer to operation(s) and/or process(es) of a computer, a computing platform, a computing system, or other electronic computing device, that manipulate and/or transform data represented as physical (e.g., electronic) quantities within the computer’s registers and/or memories into other data similarly represented as physical quantities within the computer’s registers and/or memories or other information storage medium that may store instructions to perform operations and/or processes.

[0014] The terms “plurality” and “a plurality”, as used herein, include, for example, “multiple” or “two or more”. For example, “a plurality of items” includes two or more items.

[0015] References to “one embodiment”, “an embodiment”, “demonstrative embodiment”, “various embodiments” etc., indicate that the embodiment(s) so described may include a particular feature, structure, or characteristic, but not every embodiment necessarily includes the particular feature, structure, or characteristic. Further, repeated use of the phrase “in one embodiment” does not necessarily refer to the same embodiment, although it may.

[0016] As used herein, unless otherwise specified the use of the ordinal adjectives “first”, “second”, “third” etc., to describe a common object, merely indicate that different instances of like objects are being referred to, and are not intended to imply that the objects so described must be in a given sequence, either temporally, spatially, in ranking, or in any other manner.

[0017] Some embodiments may be used in conjunction with various devices and systems, for example, a User Equipment (UE), a Mobile Device (MD), a wireless station (STA), a Personal Computer (PC), a desktop computer, a mobile computer, a

laptop computer, a notebook computer, a tablet computer, a server computer, a handheld computer, a handheld device, a wearable device, a sensor device, an Internet of Things (IoT) device, a Personal Digital Assistant (PDA) device, a handheld PDA device, an on-board device, an off-board device, a hybrid device, a vehicular device, a non-vehicular device, a mobile or portable device, a consumer device, a non-mobile or non-portable device, a wireless communication station, a wireless communication device, a wireless Access Point (AP), a wired or wireless router, a wired or wireless modem, a video device, an audio device, an audio-video (A/V) device, a wired or wireless network, a wireless area network, a Wireless Video Area Network (WVAN), a Local Area Network (LAN), a Wireless LAN (WLAN), a Personal Area Network (PAN), a Wireless PAN (WPAN), and the like.

[0018] Some embodiments may be used in conjunction with devices and/or networks operating in accordance with existing IEEE 802.11 standards (including IEEE 802.11-2016 (*IEEE 802.11-2016, IEEE Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, December 7, 2016*); and/or IEEE 802.11ay (*P802.11ay Standard for Information Technology--Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks--Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications--Amendment: Enhanced Throughput for Operation in License-Exempt Bands Above 45 GHz*)) and/or future versions and/or derivatives thereof, devices and/or networks operating in accordance with existing WiFi Alliance (WFA) Peer-to-Peer (P2P) specifications (including *WiFi P2P technical specification, version 1.5, August 4, 2015*) and/or future versions and/or derivatives thereof, devices and/or networks operating in accordance with existing Wireless-Gigabit-Alliance (WGA) specifications (including *Wireless Gigabit Alliance, Inc WiGig MAC and PHY Specification Version 1.1, April 2011, Final specification*) and/or future versions and/or derivatives thereof, devices and/or networks operating in accordance with existing cellular specifications and/or protocols, e.g., 3rd Generation Partnership Project (3GPP), 3GPP Long Term Evolution (LTE) and/or future versions and/or derivatives thereof, units and/or devices which are part of the above networks, and the like.

[0019] Some embodiments may be used in conjunction with one way and/or two-way radio communication systems, cellular radio-telephone communication systems, a mobile phone, a cellular telephone, a wireless telephone, a Personal Communication Systems (PCS) device, a PDA device which incorporates a wireless communication device, a mobile or portable Global Positioning System (GPS) device, a device which incorporates a GPS receiver or transceiver or chip, a device which incorporates an RFID element or chip, a Multiple Input Multiple Output (MIMO) transceiver or device, a Single Input Multiple Output (SIMO) transceiver or device, a Multiple Input Single Output (MISO) transceiver or device, a device having one or more internal antennas and/or external antennas, Digital Video Broadcast (DVB) devices or systems, multi-standard radio devices or systems, a wired or wireless handheld device, e.g., a Smartphone, a Wireless Application Protocol (WAP) device, or the like.

[0020] Some embodiments may be used in conjunction with one or more types of wireless communication signals and/or systems, for example, Radio Frequency (RF), Infra Red (IR), Frequency-Division Multiplexing (FDM), Orthogonal FDM (OFDM), Orthogonal Frequency-Division Multiple Access (OFDMA), FDM Time-Division Multiplexing (TDM), Time-Division Multiple Access (TDMA), Multi-User MIMO (MU-MIMO), Spatial Division Multiple Access (SDMA), Extended TDMA (E-TDMA), General Packet Radio Service (GPRS), extended GPRS, Code-Division Multiple Access (CDMA), Wideband CDMA (WCDMA), CDMA 2000, single-carrier CDMA, multi-carrier CDMA, Multi-Carrier Modulation (MDM), Discrete Multi-Tone (DMT), Bluetooth®, Global Positioning System (GPS), Wi-Fi, Wi-Max, ZigBee™, Ultra-Wideband (UWB), Global System for Mobile communication (GSM), 2G, 2.5G, 3G, 3.5G, 4G, Fifth Generation (5G), or Sixth Generation (6G) mobile networks, 3GPP, Long Term Evolution (LTE), LTE advanced, Enhanced Data rates for GSM Evolution (EDGE), or the like. Other embodiments may be used in various other devices, systems and/or networks.

[0021] The term “wireless device”, as used herein, includes, for example, a device capable of wireless communication, a communication device capable of wireless communication, a communication station capable of wireless communication, a portable or non-portable device capable of wireless communication, or the like. In some demonstrative embodiments, a wireless device may be or may include a

peripheral that is integrated with a computer, or a peripheral that is attached to a computer. In some demonstrative embodiments, the term “wireless device” may optionally include a wireless service.

[0022] The term “communicating” as used herein with respect to a communication
5 signal includes transmitting the communication signal and/or receiving the communication signal. For example, a communication unit, which is capable of communicating a communication signal, may include a transmitter to transmit the communication signal to at least one other communication unit, and/or a communication receiver to receive the communication signal from at least one other
10 communication unit. The verb communicating may be used to refer to the action of transmitting or the action of receiving. In one example, the phrase “communicating a signal” may refer to the action of transmitting the signal by a first device, and may not necessarily include the action of receiving the signal by a second device. In another example, the phrase “communicating a signal” may refer to the action of receiving the
15 signal by a first device, and may not necessarily include the action of transmitting the signal by a second device. The communication signal may be transmitted and/or received, for example, in the form of Radio Frequency (RF) communication signals, and/or any other type of signal.

[0023] As used herein, the term “circuitry” may refer to, be part of, or include, an
20 Application Specific Integrated Circuit (ASIC), an integrated circuit, an electronic circuit, a processor (shared, dedicated, or group), and/or memory (shared, dedicated, or group), that execute one or more software or firmware programs, a combinational logic circuit, and/or other suitable hardware components that provide the described functionality. In some embodiments, the circuitry may be implemented in, or
25 functions associated with the circuitry may be implemented by, one or more software or firmware modules. In some embodiments, circuitry may include logic, at least partially operable in hardware.

[0024] The term “logic” may refer, for example, to computing logic embedded in circuitry of a computing apparatus and/or computing logic stored in a memory of a
30 computing apparatus. For example, the logic may be accessible by a processor of the computing apparatus to execute the computing logic to perform computing functions and/or operations. In one example, logic may be embedded in various types of memory and/or firmware, e.g., silicon blocks of various chips and/or processors.

Logic may be included in, and/or implemented as part of, various circuitry, e.g. radio circuitry, receiver circuitry, control circuitry, transmitter circuitry, transceiver circuitry, processor circuitry, and/or the like. In one example, logic may be embedded in volatile memory and/or non-volatile memory, including random access memory, read only memory, programmable memory, magnetic memory, flash memory, persistent memory, and the like. Logic may be executed by one or more processors using memory, e.g., registers, stuck, buffers, and/or the like, coupled to the one or more processors, e.g., as necessary to execute the logic.

[0025] Some demonstrative embodiments may be used in conjunction with a WLAN, e.g., a WiFi network. Other embodiments may be used in conjunction with any other suitable wireless communication network, for example, a wireless area network, a “piconet”, a WPAN, a WVAN and the like.

[0026] Some demonstrative embodiments may be used in conjunction with a wireless communication network communicating over a frequency band above 45 Gigahertz (GHz), e.g., 60GHz. However, other embodiments may be implemented utilizing any other suitable wireless communication frequency bands, for example, an Extremely High Frequency (EHF) band (the millimeter wave (mmWave) frequency band), e.g., a frequency band within the frequency band of between 20Ghz and 300GHz, a frequency band above 45GHz, a frequency band below 20GHz, e.g., a Sub 1 GHz (S1G) band, a 2.4GHz band, a 5GHz band, a WLAN frequency band, a WPAN frequency band, a frequency band according to the WGA specification, and the like.

[0027] The term “antenna”, as used herein, may include any suitable configuration, structure and/or arrangement of one or more antenna elements, components, units, assemblies and/or arrays. In some embodiments, the antenna may implement transmit and receive functionalities using separate transmit and receive antenna elements. In some embodiments, the antenna may implement transmit and receive functionalities using common and/or integrated transmit/receive elements. The antenna may include, for example, a phased array antenna, a single element antenna, a set of switched beam antennas, and/or the like.

[0028] The phrases “directional multi-gigabit (DMG)” and “directional band” (DBand), as used herein, may relate to a frequency band wherein the Channel starting frequency is above 45 GHz. In one example, DMG communications may involve one

or more directional links to communicate at a rate of multiple gigabits per second, for example, at least 1 Gigabit per second, e.g., at least 7 Gigabit per second, at least 30 Gigabit per second, or any other rate.

[0029] Some demonstrative embodiments may be implemented by a DMG STA (also referred to as a “mmWave STA (mSTA)”), which may include for example, a STA having a radio transmitter, which is capable of operating on a channel that is within the DMG band. The DMG STA may perform other additional or alternative functionality. Other embodiments may be implemented by any other apparatus, device and/or station.

10 [0030] Reference is made to Fig. 1, which schematically illustrates a system 100, in accordance with some demonstrative embodiments.

[0031] As shown in Fig. 1, in some demonstrative embodiments, system 100 may include one or more wireless communication devices. For example, system 100 may include a wireless communication device 102, a wireless communication device 140, and/or one more other devices.

[0032] In some demonstrative embodiments, devices 102 and/or 140 may include a mobile device or a non-mobile, e.g., a static, device.

[0033] For example, devices 102 and/or 140 may include, for example, a UE, an MD, a STA, an AP, a PC, a desktop computer, a mobile computer, a laptop computer, an UltrabookTM computer, a notebook computer, a tablet computer, a server computer, a handheld computer, an Internet of Things (IoT) device, a sensor device, a handheld device, a wearable device, a PDA device, a handheld PDA device, an on-board device, an off-board device, a hybrid device (e.g., combining cellular phone functionalities with PDA device functionalities), a consumer device, a vehicular device, a non-vehicular device, a mobile or portable device, a non-mobile or non-portable device, a mobile phone, a cellular telephone, a PCS device, a PDA device which incorporates a wireless communication device, a mobile or portable GPS device, a DVB device, a relatively small computing device, a non-desktop computer, a “Carry Small Live Large” (CSLL) device, an Ultra Mobile Device (UMD), an Ultra Mobile PC (UMPC), a Mobile Internet Device (MID), an “Origami” device or computing device, a device that supports Dynamically Composable Computing (DCC), a context-aware device, a video device, an audio device, an A/V device, a Set-

Top-Box (STB), a Blu-ray disc (BD) player, a BD recorder, a Digital Video Disc (DVD) player, a High Definition (HD) DVD player, a DVD recorder, a HD DVD recorder, a Personal Video Recorder (PVR), a broadcast HD receiver, a video source, an audio source, a video sink, an audio sink, a stereo tuner, a broadcast radio receiver,
5 a flat panel display, a Personal Media Player (PMP), a digital video camera (DVC), a digital audio player, a speaker, an audio receiver, an audio amplifier, a gaming device, a data source, a data sink, a Digital Still camera (DSC), a media player, a Smartphone, a television, a music player, or the like.

[0034] In some demonstrative embodiments, device 102 may include, for example,
10 one or more of a processor 191, an input unit 192, an output unit 193, a memory unit 194, and/or a storage unit 195; and/or device 140 may include, for example, one or more of a processor 181, an input unit 182, an output unit 183, a memory unit 184, and/or a storage unit 185. Devices 102 and/or 140 may optionally include other suitable hardware components and/or software components. In some demonstrative
15 embodiments, some or all of the components of one or more of devices 102 and/or 140 may be enclosed in a common housing or packaging, and may be interconnected or operably associated using one or more wired or wireless links. In other embodiments, components of one or more of devices 102 and/or 140 may be distributed among multiple or separate devices.

[0035] In some demonstrative embodiments, processor 191 and/or processor 181
20 may include, for example, a Central Processing Unit (CPU), a Digital Signal Processor (DSP), one or more processor cores, a single-core processor, a dual-core processor, a multiple-core processor, a microprocessor, a host processor, a controller, a plurality of processors or controllers, a chip, a microchip, one or more circuits,
25 circuitry, a logic unit, an Integrated Circuit (IC), an Application-Specific IC (ASIC), or any other suitable multi-purpose or specific processor or controller. Processor 191 may execute instructions, for example, of an Operating System (OS) of device 102 and/or of one or more suitable applications. Processor 181 may execute instructions, for example, of an Operating System (OS) of device 140 and/or of one or more
30 suitable applications.

[0036] In some demonstrative embodiments, input unit 192 and/or input unit 182 may include, for example, a keyboard, a keypad, a mouse, a touch-screen, a touch-pad, a track-ball, a stylus, a microphone, or other suitable pointing device or input

device. Output unit 193 and/or output unit 183 may include, for example, a monitor, a screen, a touch-screen, a flat panel display, a Light Emitting Diode (LED) display unit, a Liquid Crystal Display (LCD) display unit, a plasma display unit, one or more audio speakers or earphones, or other suitable output devices.

5 [0037] In some demonstrative embodiments, memory unit 194 and/or memory unit 184 includes, for example, a Random Access Memory (RAM), a Read Only Memory (ROM), a Dynamic RAM (DRAM), a Synchronous DRAM (SD-RAM), a flash memory, a volatile memory, a non-volatile memory, a cache memory, a buffer, a short term memory unit, a long term memory unit, or other suitable memory units. Storage
10 unit 195 and/or storage unit 185 may include, for example, a hard disk drive, a floppy disk drive, a Compact Disk (CD) drive, a CD-ROM drive, a DVD drive, or other suitable removable or non-removable storage units. Memory unit 194 and/or storage unit 195, for example, may store data processed by device 102. Memory unit 184 and/or storage unit 185, for example, may store data processed by device 140.

15 [0038] In some demonstrative embodiments, wireless communication devices 102 and/or 140 may be capable of communicating content, data, information and/or signals via a wireless medium (WM) 103. In some demonstrative embodiments, wireless medium 103 may include, for example, a radio channel, a cellular channel, an RF channel, a WiFi channel, an IR channel, a Bluetooth (BT) channel, a Global
20 Navigation Satellite System (GNSS) Channel, and the like.

[0039] In some demonstrative embodiments, WM 103 may include one or more directional bands and/or channels. For example, WM 103 may include one or more millimeter-wave (mmWave) wireless communication bands and/or channels.

[0040] In some demonstrative embodiments, WM 103 may include one or more
25 DMG channels. In other embodiments WM 103 may include any other directional channels.

[0041] In other embodiments, WM 103 may include any other type of channel over any other frequency band.

[0042] In some demonstrative embodiments, device 102 and/or device 140 may
30 include one or more radios including circuitry and/or logic to perform wireless communication between devices 102, 140 and/or one or more other wireless

communication devices. For example, device 102 may include at least one radio 114, and/or device 140 may include at least one radio 144.

[0043] In some demonstrative embodiments, radio 114 and/or radio 144 may include one or more wireless receivers (Rx) including circuitry and/or logic to receive
5 wireless communication signals, RF signals, frames, blocks, transmission streams, packets, messages, data items, and/or data. For example, radio 114 may include at least one receiver 116, and/or radio 144 may include at least one receiver 146.

[0044] In some demonstrative embodiments, radio 114 and/or radio 144 may include one or more wireless transmitters (Tx) including circuitry and/or logic to
10 transmit wireless communication signals, RF signals, frames, blocks, transmission streams, packets, messages, data items, and/or data. For example, radio 114 may include at least one transmitter 118, and/or radio 144 may include at least one transmitter 148.

[0045] In some demonstrative embodiments, radio 114 and/or radio 144,
15 transmitters 118 and/or 148, and/or receivers 116 and/or 146 may include circuitry; logic; Radio Frequency (RF) elements, circuitry and/or logic; baseband elements, circuitry and/or logic; modulation elements, circuitry and/or logic; demodulation elements, circuitry and/or logic; amplifiers; analog to digital and/or digital to analog converters; filters; and/or the like. For example, radio 114 and/or radio 144 may
20 include or may be implemented as part of a wireless Network Interface Card (NIC), and the like.

[0046] In some demonstrative embodiments, radios 114 and/or 144 may be configured to communicate over a directional band, for example, an mmWave band, and/or any other band, for example, a 2.4GHz band, a 5GHz band, a S1G band, and/or
25 any other band.

[0047] In some demonstrative embodiments, radios 114 and/or 144 may include, or may be associated with one or more, e.g., a plurality of, directional antennas.

[0048] In some demonstrative embodiments, device 102 may include one or more, e.g., a plurality of, directional antennas 107, and/or device 140 may include one or
30 more, e.g., a plurality of, directional antennas 147.

[0049] Antennas 107 and/or 147 may include any type of antennas suitable for transmitting and/or receiving wireless communication signals, blocks, frames,

transmission streams, packets, messages and/or data. For example, antennas 107 and/or 147 may include any suitable configuration, structure and/or arrangement of one or more antenna elements, components, units, assemblies and/or arrays. Antennas 107 and/or 147 may include, for example, antennas suitable for directional communication, e.g., using beamforming techniques. For example, antennas 107 and/or 147 may include a phased array antenna, a multiple element antenna, a set of switched beam antennas, and/or the like. In some embodiments, antennas 107 and/or 147 may implement transmit and receive functionalities using separate transmit and receive antenna elements. In some embodiments, antennas 107 and/or 147 may implement transmit and receive functionalities using common and/or integrated transmit/receive elements.

[0050] In some demonstrative embodiments, antennas 107 and/or 147 may include directional antennas, which may be steered to one or more beam directions. For example, antennas 107 may be steered to one or more beam directions 135, and/or antennas 147 may be steered to one or more beam directions 145.

[0051] In some demonstrative embodiments, antennas 107 and/or 147 may include and/or may be implemented as part of a single Phased Antenna Array (PAA).

[0052] In some demonstrative embodiments, antennas 107 and/or 147 may be implemented as part of a plurality of PAAs, for example, as a plurality of physically independent PAAs.

[0053] In some demonstrative embodiments, a PAA may include, for example, a rectangular geometry, e.g., including an integer number, denoted M , of rows, and an integer number, denoted N , of columns. In other embodiments, any other types of antennas and/or antenna arrays may be used.

[0054] In some demonstrative embodiments, antennas 107 and/or antennas 147 may be connected to, and/or associated with, one or more Radio Frequency (RF) chains.

[0055] In some demonstrative embodiments, device 102 may include a controller 124, and/or device 140 may include a controller 154. Controller 124 may be configured to perform and/or to trigger, cause, instruct and/or control device 102 to perform, one or more communications, to generate and/or communicate one or more messages and/or transmissions, and/or to perform one or more functionalities,

operations and/or procedures between devices 102, 140 and/or one or more other devices; and/or controller 154 may be configured to perform, and/or to trigger, cause, instruct and/or control device 140 to perform, one or more communications, to generate and/or communicate one or more messages and/or transmissions, and/or to perform one or more functionalities, operations and/or procedures between devices 102, 140 and/or one or more other devices, e.g., as described below.

[0056] In some demonstrative embodiments, controllers 124 and/or 154 may include, or may be implemented, partially or entirely, by circuitry and/or logic, e.g., one or more processors including circuitry and/or logic, memory circuitry and/or logic, Media-Access Control (MAC) circuitry and/or logic, Physical Layer (PHY) circuitry and/or logic, baseband (BB) circuitry and/or logic, a BB processor, a BB memory, Application Processor (AP) circuitry and/or logic, an AP processor, an AP memory, and/or any other circuitry and/or logic, configured to perform the functionality of controllers 124 and/or 154, respectively. Additionally or alternatively, one or more functionalities of controllers 124 and/or 154 may be implemented by logic, which may be executed by a machine and/or one or more processors, e.g., as described below.

[0057] In one example, controller 124 may include circuitry and/or logic, for example, one or more processors including circuitry and/or logic, to cause, trigger and/or control a wireless device, e.g., device 102, and/or a wireless station, e.g., a wireless STA implemented by device 102, to perform one or more operations, communications and/or functionalities, e.g., as described herein.

[0058] In one example, controller 154 may include circuitry and/or logic, for example, one or more processors including circuitry and/or logic, to cause, trigger and/or control a wireless device, e.g., device 140, and/or a wireless station, e.g., a wireless STA implemented by device 140, to perform one or more operations, communications and/or functionalities, e.g., as described herein.

[0059] In some demonstrative embodiments, device 102 may include a message processor 128 configured to generate, process and/or access one or more messages communicated by device 102.

[0060] In one example, message processor 128 may be configured to generate one or more messages to be transmitted by device 102, and/or message processor 128 may

be configured to access and/or to process one or more messages received by device 102, e.g., as described below.

[0061] In some demonstrative embodiments, device 140 may include a message processor 158 configured to generate, process and/or access one or messages
5 communicated by device 140.

[0062] In one example, message processor 158 may be configured to generate one or more messages to be transmitted by device 140, and/or message processor 158 may be configured to access and/or to process one or more messages received by device 140, e.g., as described below.

10 [0063] In some demonstrative embodiments, message processors 128 and/or 158 may include, or may be implemented, partially or entirely, by circuitry and/or logic, e.g., one or more processors including circuitry and/or logic, memory circuitry and/or logic, Media-Access Control (MAC) circuitry and/or logic, Physical Layer (PHY) circuitry and/or logic, BB circuitry and/or logic, a BB processor, a BB memory, AP
15 circuitry and/or logic, an AP processor, an AP memory, and/or any other circuitry and/or logic, configured to perform the functionality of message processors 128 and/or 158, respectively. Additionally or alternatively, one or more functionalities of message processors 128 and/or 158 may be implemented by logic, which may be executed by a machine and/or one or more processors, e.g., as described below.

20 [0064] In some demonstrative embodiments, at least part of the functionality of message processor 128 may be implemented as part of radio 114, and/or at least part of the functionality of message processor 158 may be implemented as part of radio 144.

[0065] In some demonstrative embodiments, at least part of the functionality of
25 message processor 128 may be implemented as part of controller 124, and/or at least part of the functionality of message processor 158 may be implemented as part of controller 154.

[0066] In other embodiments, the functionality of message processor 128 may be implemented as part of any other element of device 102, and/or the functionality of
30 message processor 158 may be implemented as part of any other element of device 140.

[0067] In some demonstrative embodiments, at least part of the functionality of controller 124 and/or message processor 128 may be implemented by an integrated circuit, for example, a chip, e.g., a System on Chip (SoC). In one example, the chip or SoC may be configured to perform one or more functionalities of radio 114. For example, the chip or SoC may include one or more elements of controller 124, one or more elements of message processor 128, and/or one or more elements of radio 114. In one example, controller 124, message processor 128, and radio 114 may be implemented as part of the chip or SoC.

[0068] In other embodiments, controller 124, message processor 128 and/or radio 114 may be implemented by one or more additional or alternative elements of device 102.

[0069] In some demonstrative embodiments, at least part of the functionality of controller 154 and/or message processor 158 may be implemented by an integrated circuit, for example, a chip, e.g., a System on Chip (SoC). In one example, the chip or SoC may be configured to perform one or more functionalities of radio 144. For example, the chip or SoC may include one or more elements of controller 154, one or more elements of message processor 158, and/or one or more elements of radio 144. In one example, controller 154, message processor 158, and radio 144 may be implemented as part of the chip or SoC.

[0070] In other embodiments, controller 154, message processor 158 and/or radio 144 may be implemented by one or more additional or alternative elements of device 140.

[0071] In some demonstrative embodiments, device 102 and/or device 140 may include, operate as, perform the role of, and/or perform one or more functionalities of, one or more STAs. For example, device 102 may include at least one STA, and/or device 140 may include at least one STA.

[0072] In some demonstrative embodiments, device 102 and/or device 140 may include, operate as, perform the role of, and/or perform one or more functionalities of, one or more DMG STAs. For example, device 102 may include, operate as, perform the role of, and/or perform one or more functionalities of, at least one DMG STA, and/or device 140 may include, operate as, perform the role of, and/or perform one or more functionalities of, at least one DMG STA.

[0073] In other embodiments, devices 102 and/or 140 may include, operate as, perform the role of, and/or perform one or more functionalities of, any other wireless device and/or station, e.g., a WLAN STA, a WiFi STA, and the like.

5 [0074] In some demonstrative embodiments, device 102 and/or device 140 may be configured operate as, perform the role of, and/or perform one or more functionalities of, an access point (AP), e.g., a DMG AP, and/or a personal basic service set (PBSS) control point (PCP), e.g., a DMG PCP, for example, an AP/PCP STA, e.g., a DMG AP/PCP STA.

10 [0075] In some demonstrative embodiments, device 102 and/or device 140 may be configured to operate as, perform the role of, and/or perform one or more functionalities of, a non-AP STA, e.g., a DMG non-AP STA, and/or a non-PCP STA, e.g., a DMG non-PCP STA, for example, a non-AP/PCP STA, e.g., a DMG non-AP/PCP STA.

15 [0076] In other embodiments, device 102 and/or device 140 may operate as, perform the role of, and/or perform one or more functionalities of, any other additional or alternative device and/or station.

20 [0077] In one example, a station (STA) may include a logical entity that is a singly addressable instance of a medium access control (MAC) and physical layer (PHY) interface to the wireless medium (WM). The STA may perform any other additional or alternative functionality.

[0078] In one example, an AP may include an entity that contains a station (STA), e.g., one STA, and provides access to distribution services, via the wireless medium (WM) for associated STAs. The AP may perform any other additional or alternative functionality.

25 [0079] In one example, a personal basic service set (PBSS) control point (PCP) may include an entity that contains a STA, e.g., one station (STA), and coordinates access to the wireless medium (WM) by STAs that are members of a PBSS. The PCP may perform any other additional or alternative functionality.

30 [0080] In one example, a PBSS may include a directional multi-gigabit (DMG) basic service set (BSS) that includes, for example, one PBSS control point (PCP). For example, access to a distribution system (DS) may not be present, but, for example, an intra-PBSS forwarding service may optionally be present.

[0081] In one example, a PCP/AP STA may include a station (STA) that is at least one of a PCP or an AP. The PCP/AP STA may perform any other additional or alternative functionality.

5 [0082] In one example, a non-AP STA may include a STA that is not contained within an AP. The non-AP STA may perform any other additional or alternative functionality.

[0083] In one example, a non-PCP STA may include a STA that is not a PCP. The non-PCP STA may perform any other additional or alternative functionality.

10 [0084] In one example, a non PCP/AP STA may include a STA that is not a PCP and that is not an AP. The non-PCP/AP STA may perform any other additional or alternative functionality.

[0085] In some demonstrative embodiments devices 102 and/or 140 may be configured to communicate over a Next Generation 60 GHz (NG60) network, an Enhanced DMG (EDMG) network, and/or any other network. For example, devices
15 102 and/or 140 may perform Multiple-Input-Multiple-Output (MIMO) communication, for example, for communicating over the NG60 and/or EDMG networks, e.g., over an NG60 or an EDMG frequency band.

[0086] In some demonstrative embodiments, devices 102 and/or 140 may be configured to operate in accordance with one or more Specifications, for example,
20 including one or more *IEEE 802.11 Specifications*, e.g., an *IEEE 802.11-2016 Specification*, an *IEEE 802.11ay Specification*, and/or any other specification and/or protocol.

[0087] Some demonstrative embodiments may be implemented, for example, as part of a new standard in an mmWave band, e.g., a 60GHz frequency band or any
25 other directional band, for example, as an evolution of an *IEEE 802.11-2016 Specification and/or an IEEE 802.11ad Specification*.

[0088] In some demonstrative embodiments, devices 102 and/or 140 may be configured according to one or more standards, for example, in accordance with an *IEEE 802.11ay Standard*, which may be, for example, configured to enhance the
30 efficiency and/or performance of an *IEEE 802.11ad Specification*, which may be configured to provide Wi-Fi connectivity in a 60 GHz band.

[0089] Some demonstrative embodiments may enable, for example, to significantly increase the data transmission rates defined in the *IEEE 802.11ad Specification*, for example, from 7 Gigabit per second (Gbps), e.g., up to 30 Gbps, or to any other data rate, which may, for example, satisfy growing demand in network capacity for new coming applications.

[0090] Some demonstrative embodiments may be implemented, for example, to allow increasing a transmission data rate, for example, by applying MIMO and/or channel bonding techniques.

[0091] In some demonstrative embodiments, devices 102 and/or 140 may be configured to communicate MIMO communications over the mmWave wireless communication band.

[0092] In some demonstrative embodiments, device 102 and/or device 140 may be configured to support one or more mechanisms and/or features, for example, channel bonding, Single User (SU) MIMO, and/or Multi-User (MU) MIMO, for example, in accordance with an *IEEE 802.11ay Standard* and/or any other standard and/or protocol.

[0093] In some demonstrative embodiments, device 102 and/or device 140 may include, operate as, perform a role of, and/or perform the functionality of, one or more EDMG STAs. For example, device 102 may include, operate as, perform a role of, and/or perform the functionality of, at least one EDMG STA, and/or device 140 may include, operate as, perform a role of, and/or perform the functionality of, at least one EDMG STA.

[0094] In some demonstrative embodiments, devices 102 and/or 140 may implement a communication scheme, which may include Physical layer (PHY) and/or Media Access Control (MAC) layer schemes, for example, to support one or more applications, and/or increased transmission data rates, e.g., data rates of up to 30 Gbps, or any other data rate.

[0095] In some demonstrative embodiments, the PHY and/or MAC layer schemes may be configured to support frequency channel bonding over a mmWave band, e.g., over a 60 GHz band, SU MIMO techniques, and/or MU MIMO techniques.

[0096] In some demonstrative embodiments, devices 102 and/or 140 may be configured to implement one or more mechanisms, which may be configured to

enable SU and/or MU communication of Downlink (DL) and/or Uplink frames (UL) using a MIMO scheme.

[0097] In some demonstrative embodiments, device 102 and/or device 140 may be configured to implement one or more MU communication mechanisms. For example, devices 102 and/or 140 may be configured to implement one or more MU mechanisms, which may be configured to enable MU communication of DL frames using a MIMO scheme, for example, between a device, e.g., device 102, and a plurality of devices, e.g., including device 140 and/or one or more other devices.

[0098] In some demonstrative embodiments, devices 102 and/or 140 may be configured to communicate over an NG60 network, an EDMG network, and/or any other network and/or any other frequency band. For example, devices 102 and/or 140 may be configured to communicate DL MIMO transmissions and/or UL MIMO transmissions, for example, for communicating over the NG60 and/or EDMG networks.

[0099] Some wireless communication Specifications, for example, the *IEEE 802.11ad-2012 Specification*, may be configured to support a SU system, in which a STA may transmit frames to a single STA at a time. Such Specifications may not be able, for example, to support a STA transmitting to multiple STAs simultaneously, for example, using a MU-MIMO scheme, e.g., a DL MU-MIMO, or any other MU scheme.

[00100] In some demonstrative embodiments, devices 102 and/or 140 may be configured to implement one or more mechanisms, which may, for example, enable to extend a single-channel BW scheme, e.g., a scheme in accordance with the *IEEE 802.11ad Specification* or any other scheme, for higher data rates and/or increased capabilities, e.g., as described below.

[00101] In one example, the single-channel BW scheme may include communication over a 2.16 GHz channel (also referred to as a “single-channel” or a “DMG channel”).

[00102] In some demonstrative embodiments, devices 102 and/or 140 may be configured to implement one or more channel bonding mechanisms, which may, for example, support communication over a channel BW (also referred to as a “wide

channel”, an “EDMG channel”, or a “bonded channel”) including two or more channels, e.g., two or more 2.16 GHz channels, e.g., as described below .

[00103] In some demonstrative embodiments, the channel bonding mechanisms may include, for example, a mechanism and/or an operation whereby two or more
5 channels, e.g., 2.16 GHz channels, can be combined, e.g., for a higher bandwidth of packet transmission, for example, to enable achieving higher data rates, e.g., when compared to transmissions over a single channel. Some demonstrative embodiments are described herein with respect to communication over a channel BW including two or more 2.16 GHz channels, however other embodiments may be implemented with
10 respect to communications over a channel bandwidth, e.g., a “wide” channel, including or formed by any other number of two or more channels, for example, an aggregated channel including an aggregation of two or more channels.

[00104] In some demonstrative embodiments, device 102 and/or device 140 may be configured to implement one or more channel bonding mechanisms, which may, for
15 example, support an increased channel bandwidth, for example, a channel BW of 4.32 GHz, a channel BW of 6.48 GHz, a channel BW of 8.64 GHz, and/or any other additional or alternative channel BW, e.g., as described below.

[00105] In some demonstrative embodiments, devices 102 and/or 140 may be configured to implement one or more multiple channel access mechanisms, e.g.,
20 channel bonding and/or channel aggregation mechanisms, which may allow, for example, to increase a link bitrate and/or a link capacity, e.g., as described below.

[00106] In some demonstrative embodiments, devices 102 and/or 140 may be configured to implement one or more mechanisms, which may, for example, utilize transmission and/or reception over a plurality of channels, e.g., a plurality of 2.16
25 GHz channels, for example, according to a multiple channel link access.

[00107] In some demonstrative embodiments, a first station (“initiator station”), e.g., device 102, may initiate link access transmission over a plurality of channels, e.g., a plurality of 2.16 GHz channels, which may include, for example, a primary channel, e.g., one primary channel, and one or more, e.g., one or several, secondary channels,
30 to communicate with a second station (“responder station”), e.g., device 140.

[00108] In some demonstrative embodiments, the initiator station, e.g., device 102, may be configured to determine on which channels to transmit, for example, by a

negotiation flow with the responder station, e.g., device 140, and/or according to any other scheme or mechanism.

[00109] In some demonstrative embodiments, the negotiation flow may include an exchange of frames, e.g., an RTS/CTS frame exchange of Request to Send (RTS) and
5 Clear to Send (CTS) frames, between the initiator station and the responder station, e.g., between devices 102 and 140.

[00110] In some demonstrative embodiments, an RTS frame sent to the responder station may include information (“channel width information”) to indicate which channels (“requested channels”) the transmitter of the RTS frame, e.g., the initiator
10 station, may want to use in an upcoming transmission opportunity (TxOP).

[00111] In some demonstrative embodiments, channels, which are allowed to be used by the initiator may include, for example, channels in which an energy detection sensing, e.g., just before the transmission of the RTS frame, is not busy, e.g., meaning that probably no other station is currently transmitting on those channels.

15 [00112] In some demonstrative embodiments, a responder station, e.g., device 140, which receives the RTS frame with the channel width information, may be, for example, required to perform energy detection, for example, prior to and/or subsequent to reception of the RTS frame from the initiator station.

[00113] In some demonstrative embodiments, the responder station, e.g., device 140,
20 may indicate in a CTS frame, e.g., in response to the RTS frame, one or more channels, (“the CTS channels”), e.g., a subset of the plurality of the requested channels, which were indicated in the RTS frame, for example, for which the energy detection performed by the responder station shows that the one or more requested channels is not busy.

25 [00114] In some demonstrative embodiments, the CTS frame from the responder station may be utilized, for example, to acknowledge the CTS channels to be used as a subset of the requested channels indicated in the channel bandwidth information in the RTS frame from the initiator station, for example, based on supported channels of the responder station and/or the energy sensing measures performed by the responder
30 station on each of the requested channels.

[00115] In some demonstrative embodiments, for example, after the RTS/CTS exchange, both initiator and responder stations may utilize the CTS channels, e.g., as

a channel bandwidth (BW) including a primary channel and one or more secondary channels, as indicated by the CTS, e.g., at the beginning of the TxOP.

[00116] In other embodiments, any other frames may be used in addition to or instead of the RTS/CTS frames, and/or the channels to be used for communication between the initiator station and the responder station may be determined, for example, based on any other additional or alternative operations and/or communications.

[00117] In some demonstrative embodiments, there may be a technical need to provide a mechanism, which may allow a station to modify channel width occupancy, for example, during the TxOP. For example, it may not be advantageous to assume that once a channel BW was agreed by the responder and initiator stations in the RTS/CTS exchange, it will remain constant throughout the TxOP, e.g., as described below.

[00118] In some demonstrative embodiments, there may be one or more scenarios, implementations, use cases, and/or reasons, for example, in which stations, e.g., the responder station and/or the initiator station, may want to adjust, modify, adapt, update, reconfigure, and/or change the channel BW, for example, during the TxOP, for example, such that the stations may be allowed to not necessarily use the CTS channels, which were indicated in the CTS.

[00119] In one example, a possible reason to adjust, modify, adapt, update, reconfigure, and/or change the channels to be utilized during the TxOP may be based on interference, which may occur, for example, on one or more of the secondary channels indicated in a CTS frame from the responder station. For example, in this case a station may want to reduce a channel bandwidth and not to transmit in one or more interfered channels of the secondary channels, e.g., as described below.

[00120] In another example, a possible reason to adjust, modify, adapt, update, reconfigure, and/or change the channels to be utilized during the TxOP may be to increase a TxOP throughput, e.g., as described below.

[00121] In another example, a possible reason to adjust, modify, adapt, update, reconfigure, and/or change the channels to be utilized during the TxOP may be to reduce the number of secondary channels, for example, in order to lower the consumed power for communicating over the channels, e.g., as described below.

[00122] In some demonstrative embodiments, a station may adjust, modify, adapt, update, reconfigure, and/or change the channels to be utilized during the TxOP, for example, based on one or more of the above reasons, and/or based on one or more additional or alternative reasons, criteria, parameters, use cases, and/or scenarios.

- 5 [00123] In some demonstrative embodiments, devices 102 and/or 140 may be configured to be allowed to modify a channel width, for example, even during a TxOP, e.g., as described below.

[00124] In some demonstrative embodiments, devices 102 and/or 140 may be configured modify a channel bandwidth (BW) including a primary channel and one or
10 more secondary channels during a TxOP, e.g., as described below.

[00125] In some demonstrative embodiments, controller 124 may be configured to control, cause and/or trigger device 102 to establish a TxOP to communicate with device 140 over a first channel BW including a primary channel and one or more first secondary channels, e.g., as described below.

- 15 [00126] In some demonstrative embodiments, controller 154 may be configured to control, cause and/or trigger device 140 to establish the TxOP to communicate with device 102 over the first channel BW including the primary channel and the one or more first secondary channels, e.g., as described below.

[00127] In some demonstrative embodiments, devices 102 and/or 140 may be
20 configured to communicate at least one frame over a second channel BW different from the first channel BW, for example, during the TxOP, e.g., as described below.

[00128] In some demonstrative embodiments, the second channel BW may include the primary channel and one or more second secondary channels, e.g., as described below.

- 25 [00129] In some demonstrative embodiments, each of the primary channel, the one or more first secondary channels, and/or the one or more second secondary channels may include a 2.16 GHz channel over a 45 GHz frequency band, e.g., as described below.

[00130] Some demonstrative embodiments are described herein with respect to a
30 channel BW including a plurality of 2.16 GHz channel over a 45 GHz frequency

band. However, in other embodiments the channel BW may include any other channel bandwidth and/or any other frequency band may be used.

[00131] In some demonstrative embodiments, device 102 may generate and transmit the frame over the second channel BW, and/or device 140 may receive and process the frame over the second channel BW, e.g., as described below.

[00132] In some demonstrative embodiments, controller 124 may be configured to control, cause and/or trigger device 102 to generate and transmit the frame to device 140 over the second channel BW different from the first channel BW, for example, during the TxOP, e.g., as described below.

[00133] In some demonstrative embodiments, controller 154 may be configured to control, cause and/or trigger device 140 to receive and process the frame from device 102 over the second channel BW different from the first channel BW, for example, during the TxOP, e.g., as described below.

[00134] In some demonstrative embodiments, the second channel BW may include a reduced channel BW having a bandwidth narrower than a bandwidth of the first channel BW, e.g., as described below.

[00135] In some demonstrative embodiments, the second channel BW may include a wider channel BW, which is wider than the first channel BW, e.g., as described below.

[00136] In some demonstrative embodiments, there may be one or more technical problems to be solved, for example, when reducing and/or increasing the channel bandwidth, for example, to address one or more constraints and/or obstacles, e.g., as described below.

[00137] In one example, in case a station wants to reduce the channel bandwidth, one or more of the following aspects should be maintained and/or addressed.

[00138] In one example, both stations, e.g., the initiator and responder stations, should utilize a same bandwidth during the TxOP. For example, keeping the same channel bandwidth, e.g., by both peers, may be important, in some use cases, implementations and/or scenarios, for example, so that a third station, which wishes to initiate a transmission over the channel bandwidth, will sense that the channel bandwidth is busy on both initiator and responder directions. For example, not

keeping this behavior, may result in one or more other stations attempting to transmit during the TxOP, and, hence, interfering a TxOP holder transmission.

[00139] In another example, the channel width information may not always be delivered in a transmitted frame. For example, there may be frames transmitted in a non-EDMG duplicated mode, which may be aligned with a legacy station in which the channel bandwidth information may not be delivered.

[00140] In some demonstrative embodiments, a problem of efficiently and/or effectively adjusting the channel bandwidth may be addressed and/or solved, for example, by a mechanism which may be configured to deliver the channel BW information and/or to convey rules when reducing a channel bandwidth is allowed, e.g., as described below.

[00141] In some demonstrative embodiments, the rules may be applied, for example, at least when channel bandwidth information configured to indicate a reduced channel BW having the bandwidth narrower than the bandwidth of the first channel BW, may not be delivered from a first STA to a second STA, for example, from device 102 to device 140, e.g., as described below.

[00142] In some demonstrative embodiments, in some use cases, implementations and/or scenarios, a frame may not always deliver the channel bandwidth information to a receiving peer station, e.g., as described below.

[00143] In some demonstrative embodiments, some frames, for example, EDMG Frames may carry the Channel Width information, for example, via a Compressed Bandwidth (BW) subfield in a legacy header (L-Header), and/or a BW subfield in A-Header, e.g., or using any other field and/or subfield, e.g., as described below.

[00144] In some demonstrative embodiments, some frames, for example, RTS, DMG CTS, DMG Denial to Send (DTS), and/or DMG CTS-to-Self, may be transmitted in a non-EDMG duplicate format, and may include a channel bandwidth indication, for example, in a Channel BW subfield in the L-Header, and/or in any other field, e.g., as described below.

[00145] In some demonstrative embodiments, some Physical Layer (PHY) Protocol Data Units (PPDUs), for example, other PPDUs transmitted in a non-EDMG duplicate format, may not carry the channel bandwidth information.

[00146] For example, an EDMG STA that receives a DMG Block Acknowledgement (BlockAck) may not be able to know a channel bandwidth over which the BlockAck is transmitted by a sender of the BlockAck, for example, if the EDMG STA is not able to determine if the BlockAck is, for example, transmitted as a single channel PPDU, or transmitted in several channels in the non-EDMG duplicate format by the sender of the BlockAck.

[00147] Reference is made to Fig. 2, which schematically illustrates communications over a channel BW, which may be implemented in accordance with some demonstrative embodiments.

10 [00148] In some demonstrative embodiments, as shown in Fig. 2, the channel BW may include a primary channel, denoted “Primary”, and a secondary channel, denoted “Secondary”.

[00149] In some demonstrative embodiments, as shown in Fig. 2, a first transmitted frame 202 may occupy two channels, e.g., the Primary and Secondary channels.

15 [00150] In one example, channel width information of frame 202 may be delivered in an L-Header 204 and/or an A-Header 206. Accordingly, a receiving station of frame 202 may be able to know the channel bandwidth occupied by a transmitter station of frame 202.

20 [00151] In some demonstrative embodiments, as shown in Fig. 2, one or more other frames transmitted during a TxOP, e.g., a BlockAck (BA) request (BA-Req) frame 208, may be transmitted, for example, in a non-EDMG duplicate mode, for example, by transmitting a duplicate of the BA-Req frame 208 over each of the Primary and the Secondary channels.

25 [00152] In some demonstrative embodiments, if a receiver of the BA-Req 208 is not able to know on which channel the BA-Req 208 was transmitted, the receiver station may not be able to determine, for example, in which channel bandwidth it should respond to the BA-Req 208.

30 [00153] Referring back to Fig. 1, in some demonstrative embodiments, there may be a need to address one or more technical problems, for example, with respect to a frame, which does not include channel bandwidth information.

[00154] In one example, a station, for example, an EDMG station may be required to respond to a frame with a same channel bandwidth. However, the EDMG station may not be able to respond to the frame with the same channel bandwidth, for example, if channel bandwidth information of the frame is not delivered, for example, in the non-EDMG duplicate format. For example, the EDMG station may not be able to respond to BA-Req 208 (Fig. 2) with the same channel bandwidth, for example, if channel bandwidth information of the BA-Req 208 (Fig. 2) is not delivered, for example, in the non-EDMG duplicate format.

[00155] In another example, a station, e.g., an EDMG STA, may want to reduce its channel bandwidth during a TxOP. However, the station may not be able to signal the reduction of the channel bandwidth to a peer station, for example, if channel bandwidth information is not delivered to the peer when a non-EDMG duplicate format PPDU is transmitted.

[00156] In some demonstrative embodiments, devices 102 and/or 140 may be configured to implement one or more rules, for example, for setting a channel bandwidth, e.g., as described below.

[00157] In some demonstrative embodiments, devices 102 and/or 140 implement the one or more rules, for example, for setting a channel bandwidth of frames in a non-EDMG duplicate format, e.g., as described below.

[00158] In some demonstrative embodiments, for example, an EDMG STA may be limited according to one or more rules, for example, which may not allow the station to reduce a channel bandwidth, for example, in case a PPDU is transmitted in the non-EDMG duplicate format, e.g., as described below.

[00159] In some demonstrative embodiments, a station, e.g., device 102 and/or 140, may be configured to be allowed to change, e.g., reduce, a channel width, for example, during a TxOP, for example, according to one or more rules, e.g., as described below.

[00160] In some demonstrative embodiments, the station, e.g., device 102 and/or 140, may be configured to be allowed to reduce a channel bandwidth, for example, during the TxOP, for example, even without delivering channel width information of the reduced channel BW, e.g., as described below.

[00161] In some demonstrative embodiments, devices 102 and 140 may communicate, for example, during a TxOP established over a first channel BW, a PPDU over a second channel BW, which includes a reduced channel narrower than the first channel BW, for example, over which devices 102 and 140 establish the TxOP, e.g., as described below.

[00162] In some demonstrative embodiments, a station (STA), which wishes to reduce a PPDU channel width during TxOP, shall reduce it, for example, only when the STA transmits an EDMG PPDU, e.g., as described below.

[00163] In some demonstrative embodiments, controller 124 may be configured to allow device 102 to transmit over the reduced channel BW during the TxOP a PPDU, which is to be prior to any other PPDU over the reduced channel BW, and which only includes an EDMG PPDU.

[00164] In some demonstrative embodiments, reducing the channel BW may not be allowed for some types of frames, for example, including at least, DMG frames sent in non-EDMG duplicate format, e.g., as described below.

[00165] In some demonstrative embodiments, controller 124 may be configured to prevent device 102 from transmitting over the reduced channel BW during the TxOP a PPDU, which is to be prior to any other PPDU over the reduced channel BW, and which includes a DMG frame to be transmitted in a non-EDMG duplicate format.

[00166] In some demonstrative embodiments, a channel BW of a PPDU transmitted by a TxOP owner, e.g., device 102, may be narrower than a channel width of a last PPDU, for example, transmitted by the TxOP owner, e.g., device 102, in a same TxOP, for example, only if the PPDU, e.g., that reduces the channel width, is an EDMG PPDU.

[00167] For example, the reduced channel BW of the PPDU transmitted by device 102 may be narrower than a bandwidth of the first channel BW, over which devices 102 and 140 establish the TxOP, for example, only if the PPDU includes an EDMG PPDU.

[00168] In some demonstrative embodiments, an occupied bandwidth of a PPDU transmitted by a TxOP owner, e.g., during a TxOP, may not be larger than an occupied bandwidth of a last PPDU, e.g., if any, transmitted by the TxOP owner in the same TxOP.

[00169] In some demonstrative embodiments, the occupied bandwidth of a PPDU transmitted by the TxOP owner e.g., during a TxOP, may be narrower than an occupied bandwidth of a last PPDU, if any, transmitted by the TxOP owner in the same TxOP. According to this example, the PPDU, e.g., that reduces the occupied
5 bandwidth, may be, e.g., may only be, an EDMG PPDU.

[00170] In some demonstrative embodiments, a PPDU transmitted by device 102 over the reduced channel BW, which is to be transmitted first over the reduced channel BW during the TxOP, may have a narrower channel BW than an established channel BW, for example, only if the PPDU includes an EDMG PPDU.

10 [00171] In some demonstrative embodiments, controller 124 may be configured to prevent device 102 from transmitting during a TxOP a PPDU over a narrower channel bandwidth, which is narrower than a channel BW of a last PPDU, e.g., transmitted by the TxOP owner, e.g., device 102, in the same TxOP, for example, if the PPDU includes a DMG frame to be transmitted in a non-EDMG duplicate format.

15 [00172] In some demonstrative embodiments, only Control frames of one or more predefined types may be allowed to be sent in non-EDMG duplicate format during a TxOP, e.g., as described below.

[00173] In some demonstrative embodiments, the one or more control frame types may include, for example, a Request to Send (RTS), a Clear to Send (CTS), a
20 Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a Grant, and/or a Grant-Ack, e.g., as described below.

[00174] In some demonstrative embodiments, controller 124 may be configured to allow device 102 to transmit during the TxOP in a non-EDMG duplicate format only
25 one or more control frames of an RTS, a DMG CTS, a DMG DTS, an Ack, a BlockAck, a BlockAckReq, a CF-End, a Grant, and/or a Grant-Ack.

[00175] In other embodiments, any other additional or alternative type of frame may be allowed to be sent in non-EDMG duplicate format during a TxOP.

[00176] In other embodiments, a station may be configured to be allowed to change,
30 e.g., reduce, a channel width, for example, during a TxOP, for example, according to only some of the above rules and/or according to one or more additional or alternative rules.

[00177] In some demonstrative embodiments, devices 102 and/or 140 may be configured to communicate channel BW information, for example, for signaling a channel bandwidth to be used to communicate one or more frames during a TxOP, e.g., as described below.

5 [00178] In some demonstrative embodiments, a problem of efficiently and/or effectively adjusting, e.g., reducing, the channel width may be addressed and/or solved, for example, by a mechanism which may be configured to deliver channel bandwidth information of a channel bandwidth to be used during a TxOP, e.g., as described below.

10 [00179] In some demonstrative embodiments, devices 102 and 140 may establish a TxOP over a first channel BW.

[00180] In some demonstrative embodiments, devices 102 and/or 140 may be configured to signal channel BW information in a frame, for example, to indicate a second channel BW of the frame, which is different from the first channel BW, e.g.,
15 as described below.

[00181] In some demonstrative embodiments, the frame may include channel BW information to indicate the second channel BW, e.g., as described below.

[00182] In some demonstrative embodiments, devices 102 and/or 140 may be configured to signal the channel BW information, for example, to indicate a reduced
20 channel BW of the second channel BW, which is narrower than the first channel BW over which devices 102 and 140 establish the TxOP, e.g., as described below.

[00183] In other embodiments, devices 102 and/or 140 may be configured to signal the channel BW information, for example, to indicate a wider channel BW of a second channel BW, which is wider than a first channel BW over which devices 102
25 and 140 establish the TxOP, e.g., as described below.

[00184] In some demonstrative embodiments, the frame may include a Legacy Header (L-header) including the channel BW information, e.g., as described below.

[00185] In one example, a mechanism may include extending a header, for example, an L-Header definition, for example, to include Channel BW information, for
30 example, in a non-EDMG duplicate format, for example, for one or more frames, e.g., for all frames.

[00186] In some demonstrative embodiments, the mechanism may be configured with respect to first and second cases, e.g., as described below. In other embodiments, the mechanism may be configured with respect to only one of the cases and/or with respect to one or more other additional or alternative cases. In other embodiments, the mechanism may not be implemented or may be implemented partially.

[00187] In some demonstrative embodiments, the frame may include a scrambler initialization field including the channel BW information, e.g., as described below.

[00188] In some demonstrative embodiments, the frame may include a Last Received Signal Strength Indication (RSSI) subfield including the channel BW information, e.g., as described below,

[00189] In some demonstrative embodiments, the frame may include a Control Physical Layer (CPHY) frame, e.g., as described below.

[00190] In some demonstrative embodiments, the frame may include a Single Carrier (SC) modulation frame, e.g., as described below.

[00191] In some demonstrative embodiments, a frame, for example, in case of a frame transmitted in a CPHY modulation, may include the channel bandwidth information, for example, to be delivered, for example, in a similar manner to an RTS/CTS exchange, e.g., as described below.

[00192] In some demonstrative embodiments, the frame may be configured to indicate the channel bandwidth information, for example, using one or more reserved bits, e.g., reserved bits 22 and 23.

[00193] In one example, the reserved bits 22 and 23 may both set, for example, to a predefined value, e.g., "1", and a Scrambler Initialization field of the frame may include a Channel BW field to indicate the channel bandwidth over which the frame is to be transmitted.

[00194] In some demonstrative embodiments, a frame, for example, in case of a frame transmitted in a SC modulation, may include the channel BW information, for example, to be delivered, for example, via an indicator, e.g., in a form of an additional Reserved bit, and/or any other indicator, e.g., as described below.

[00195] In some demonstrative embodiments, the additional reserved bit may indicate an n L-Header, e.g., for non-EDMG duplicate mode, and/or a representation

of the 3 Least Significant Bits (LSB) of a Last RSSI subfield, e.g., to carry the Channel BW information.

[00196] In one example, a reserved bit 47 of the frame may be set to “1”, for example, to indicate that three LSBs, e.g., bits B1-B3 of a last RSSI subfield may carry the channel BW information, e.g., as follows:

Bit field			Definition
Reserved bit 47	B0	B1-B3	
1	Reserved	Channel BW	When the PPDU contains an RTS, a DMG CTS or a DMG DTS frame, the Channel BW field indicates the bandwidth of the PPDU. Otherwise, the Channel BW field is reserved. The Channel BW field is defined in Table 5, where N is the value of the lowest channel number over which the PPDU is transmitted.
0	Last RSSI (legacy DMG)		

Table 1

[00197] For example, as shown in Table 1, the Last RSSI may be defined to indicate the channel bandwidth, for example, when transmitted using a single carrier in SC non-EDMG duplicate mode.

10 [00198] In some demonstrative embodiments, devices 102 and/or 140 may be configured to allow a station to increase a channel bandwidth, for example, during a TxOP, e.g., as described below.

[00199] In some demonstrative embodiments, devices 102 and 140 may establish a TxOP over a first channel BW including a primary channel and one or more first
15 secondary channels, e.g., as described below.

[00200] In some demonstrative embodiments, devices 102 and/or 140 may be configured to change the first channel bandwidth, e.g., to increase the channel bandwidth of the first channel BW, for example, during the same TxOP, e.g., as described below.

- 5 [00201] In some demonstrative embodiments, devices 102 and/or 140 may be configured to communicate a frame during the TxOP over a second channel BW having a different channel BW from the first channel BW, e.g., as described below.

[00202] In some demonstrative embodiments, the second channel BW may be wider than the first channel BW, e.g., as described below.

- 10 [00203] In some demonstrative embodiments, the second channel BW may include the primary channel and one or more second secondary channels, e.g., as described below.

- [00204] In some demonstrative embodiments, the one or more second secondary channels, e.g., of the second channel BW over which the frame is communicated, may
15 include all of the one or more first secondary channels of the first channel BW, over which the TxOP is established, and at least one channel not included in the one or more first secondary channels, e.g., as described below.

- [00205] In some demonstrative embodiments, a STA, e.g., devices 102 and/or 140, may be configured to be able to change the channel BW, e.g., to increase the channel
20 width, for example, during the TxOP, for example, by initiating an RTS/CTS exchange, for example, within the TxOP, for example, to support renegotiation of the channel BW, e.g., as described below.

- [00206] In some demonstrative embodiments, controller 124 may be configured to control, cause and/or trigger device 102 to transmit to device 140, e.g., during the
25 TxOP, a plurality of RTS frames over respective channels of a requested channel BW, and, in response to the RTS frames, to receive from device 140 a plurality of CTS frames over respective channels of a second channel BW, e.g., as described below.

- [00207] In some demonstrative embodiments, controller 154 may be configured to control, cause and/or trigger device 140 to process, e.g., during the TxOP, the
30 plurality of RTS frames from device 102 over respective channels of the requested channel BW, and, in response to the RTS frames, to transmit to device 102 the

plurality of CTS frames over respective channels of the second channel BW, e.g., as described below.

[00208] In some demonstrative embodiments, a STA may want to increase a channel BW, for example, to increase throughput, and/or for any other reason.

5 [00209] In some demonstrative embodiments, the STA may be allowed to increase the channel BW, e.g., during the TxOP, for example, while complying with a channel access mechanism, which may define that grabbing the secondary channel may be done, for example, only when both peer clear channel assessment (CCA) are not busy, e.g., as described below.

10 [00210] In some demonstrative embodiments, the STA may be allowed to increase the channel BW, e.g., during the TxOP, for example, while complying with a requirement that negotiation of the channel width is to be performed via an RTS/DMG-CTS exchange, e.g., as described below.

[00211] In some demonstrative embodiments, the STA may be allowed to increase
15 the channel bandwidth, e.g., during the TxOP, for example, even without requiring a mechanism for a station to increase its current Channel Width independently, e.g., even with no responder CCA on a secondary channel, e.g., as described below.

[00212] In some demonstrative embodiments, the STA may be allowed to increase the channel bandwidth, e.g., during the TxOP, for example, while complying with a
20 requirement that a new RTS/CTS exchange is to be capped by a RTS/CTS, which initiated the TxOP, e.g., as described below.

[00213] In some demonstrative embodiments, increasing the Channel Width during TxOP shall be done by initiating an RTS/DMG CTS exchange that may exploit a rest of the TxOP duration, e.g., as described below.

25 [00214] In some demonstrative embodiments, an additional RTS/DMG CTS exchange during TxOP shall be sent after a CCA is done, for example, during a Point Coordination Function (PCF) Inter-Frame Space (PIFS) time, on secondary channels, e.g., as described below.

[00215] In some demonstrative embodiments, an additional RTS/CTS shall be capped
30 with the Channel BW achieved by the RTS/CTS that established the TxOP, e.g., as described below.

[00216] In some demonstrative embodiments, initiating the RTS/CTS exchange shall be done after a PIFS interval in which the initiator may perform an energy detection, e.g., as described below.

5 [00217] In some demonstrative embodiments, an RTS frame may be sent only on secondary channels in which Energy Detection sensing show not busy, e.g., as described below.

[00218] In some demonstrative embodiments, a responder station may be required to be ready for initiation of an RTS/CTS exchange during TxOP, for example, in order to perform energy detection on secondary channels requested in the RTS frame, e.g.,
10 as described below.

[00219] In some demonstrative embodiments, the responder station may respond with CTS frames only on secondary channels in which Energy Detection sensing show not busy, e.g., as described below.

[00220] In some demonstrative embodiments, devices 102 and 140 may be
15 configured to establish a TxOP over a first channel BW including a primary channel and one or more first secondary channels based on an RTS/CTS exchange, e.g., as described below.

[00221] In some demonstrative embodiments, devices 102 and 140 may be configured to communicate a frame over a second channel BW including an increased
20 channel BW having a bandwidth wider than a bandwidth of the first channel BW, for example, based on another RTS/CTS exchange during the TxOP, e.g., as described below.

[00222] In some demonstrative embodiments, device 102 may initiate a first RTS/CTS exchange, for example, to establish the TxOP, e.g., as described below.

25 [00223] In some demonstrative embodiments, controller 124 may control, cause, and or trigger device 102 to transmit a first plurality of RTS frames to device 140 over a first plurality of channels including a primary channel and a plurality of first secondary channels, e.g., as described below.

[00224] In some demonstrative embodiments, controller 154 may control, cause, and
30 or trigger device 140 to receive the first plurality of RTS frames from device 102 over

the first plurality of channels including the primary channel and the plurality of first secondary channels, e.g., as described below.

[00225] In some demonstrative embodiments, controller 154 may control, cause, and or trigger device 140 to transmit to device 102 a first plurality of CTS frames over a second plurality of channels including the primary channel and one or more second secondary channels of the plurality of first secondary channels, e.g., as described below.

[00226] In some demonstrative embodiments, controller 124 may control, cause, and or trigger device 102 receive from device 140 the first plurality CTS frames over the second plurality of channels including the primary channel and one or more second secondary channels of the plurality of first secondary channels, e.g., as described below.

[00227] In some demonstrative embodiments, devices 102 and 140 may establish the TxOP, for example, after the first RTS/CTS exchange, e.g., as described below.

[00228] In some demonstrative embodiments, controller 124 may control, cause, and or trigger device 102 to establish a TxOP to communicate with device 140 over a first channel BW including the primary channel and the one or more second secondary channels, e.g., as described below.

[00229] In some demonstrative embodiments, controller 154 may control, cause, and or trigger device 140 to establish the TxOP to communicate with device 102 over the first channel BW including the primary channel and the one or more second secondary channels, e.g., as described below.

[00230] In some demonstrative embodiments, device 102 may initiate a second RTS/CTS exchange, for example, to increase the first channel BW, e.g., as described below.

[00231] In some demonstrative embodiments, controller 124 may control, cause, and or trigger device 102 to transmit to device 140 a second plurality of RTS frames over a third plurality of channels including one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels, for example, during the TxOP, e.g., as described below.

[00232] In some demonstrative embodiments, controller 154 may control, cause, and or trigger device 140 to receive from device 102 the second plurality of RTS frames over the third plurality of channels including the one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels, for example, during the TxOP, e.g., as described below.

[00233] In some demonstrative embodiments, controller 154 may control, cause, and or trigger device 140 to transmit to device 102 a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels, e.g., as described below.

[00234] In some demonstrative embodiments, controller 124 may control, cause, and or trigger device 102 to receive from device 140 the second plurality of CTS frames over the fourth plurality of channels included in the third plurality of channels, e.g., as described below.

[00235] In some demonstrative embodiments, devices 102 and/or 140 may be configured to communicate a frame over a second channel BW, for example, wider than the first channel BW, e.g., based on the second CTS/RTS exchange, e.g., as described below.

[00236] In some demonstrative embodiments, controller 124 may control, cause, and or trigger device 102 to communicate a frame with device 140 over a second channel BW including the fourth plurality of channels, e.g., as described below.

[00237] In some demonstrative embodiments, controller 154 may control, cause, and or trigger device 102 to communicate a frame with device 140 over the second channel BW including the fourth plurality of channels, e.g., as described below.

[00238] In some demonstrative embodiments, devices 102 and/or 140 may be configured to detect energy before and/or during transmission of frames, for example, during the second RTS/CTS exchange, e.g., as described below.

[00239] In some demonstrative embodiments, controller 124 may control, cause, and or trigger device 102 to detect energy over the third plurality of channels, e.g., prior to transmission of the second plurality of RTS frames, e.g., as described below.

[00240] In some demonstrative embodiments, controller 124 may control, cause, and/or trigger device 102 to transmit the second plurality of RTS frames over the third

plurality of channels, for example, based on detected energy over the third plurality of channels, e.g., as described below.

[00241] In some demonstrative embodiments, controller 124 may control, cause, and/or trigger device 102 to determine the third plurality of channels to include
5 channels determined to be clear during a predefined period, e.g., prior to transmission of the second plurality of RTS frames, e.g., as described below.

[00242] In some demonstrative embodiments, the predefined period may include a PIFS interval, e.g., as described below.

[00243] In some demonstrative embodiments, controller 154 may control, cause, and
10 or trigger device 140 to detect energy prior to transmission of the second plurality of CTS frames, e.g., as described below.

[00244] In some demonstrative embodiments, controller 154 may control, cause, and
or trigger device 140 to transmit the second plurality of CTS frames over the fourth
plurality of channels based on detected energy over the third plurality of channels,
15 e.g., as described below.

[00245] In some demonstrative embodiments, controller 154 may control, cause, and
or trigger device 140 to determine the fourth plurality of channels to include channels
included in the third plurality of channels determined to be clear, e.g., as described
below.

20 [00246] Reference is made to Fig. 3, which schematically illustrates communications and operations over a primary channel, denoted “Primary”, and first and second secondary channels, denoted “Secondary1 and Secondary2”, in accordance with some demonstrative embodiments.

[00247] In some demonstrative embodiments, as shown in Fig. 3, a first RTS/CTS
25 exchange 302 may be performed, e.g., by devices 102 and/or 140 (Fig. 1), to establish a TxOP over a channel BW 304 including two channels, e.g., including the primary channel and one secondary channel, e.g., channel Secondary 1.

[00248] In some demonstrative embodiments, as shown in Fig. 3, devices 102 and/or
140 (Fig. 1) may be configured to perform a second RTS/CTS exchange 306, for
30 example, during the TxOP, for example, to extend the channel BW to a channel

bandwidth 307 including three channels, e.g., including the primary channel and the secondary channels Secondary1 and Secondary2.

[00249] In some demonstrative embodiments, as shown in Fig. 3, a transmitter of the RTS frames may be configured to perform energy detection 305 over the secondary channels Secondary1 and Secondary2, for example, prior to transmission of the RTS in the second RTS/CTS exchange 306.

[00250] Some demonstrative embodiments are described herein with respect to extending a first channel BW including one secondary channel to a second channel BW including two secondary channels, e.g., as shown in Fig. 3. However, in other embodiments, the channel BW may be extended from a first channel BW including any other first number of secondary channels to a second channel BW including any other second number of secondary channels, which is greater than the first number of secondary channels. For example, devices 102 and 140 (Fig. 1) may perform RTS/CTS exchanges 302 and 306, for example, to increase a first channel BW including two secondary channels to a second channel BW including four secondary channels.

[00251] In some demonstrative embodiments, a mechanism to allow a station to increase a channel width during TxOP may be configured according to some or all of the rules defined above. In other embodiments, a mechanism to allow a station to increase a channel width during TxOP may be configured to comply with one or more additional or alternative rules and/or to include one or more additional or alternative operations.

[00252] Reference is made to Fig. 4, which schematically illustrates a method of modifying a channel bandwidth during a TxOP, in accordance with some demonstrative embodiments. For example, one or more of the operations of the method of Fig. 4 may be performed by one or more elements of a system, e.g., system 100 (Fig. 1), for example, one or more wireless devices, e.g., device 102 (Fig. 1), and/or device 140 (Fig. 1); a controller, e.g., controller 124 (Fig. 1), and/or controller 154 (Fig. 1); a radio, e.g., radio 114 (Fig. 1), and/or radio 144 (Fig. 1); a transmitter, e.g., transmitter 118 (Fig. 1), and/or transmitter 148 (Fig. 1); a receiver, e.g., receiver 116 (Fig. 1), and/or receiver 146 (Fig. 1); and/or a message processor, e.g., message processor 128 (Fig. 1), and/or message processor 158 (Fig. 1).

[00253] As indicated at block 402, the method may include establishing a TxOP to communicate with a second wireless station over a first channel BW including a primary channel and one or more first secondary channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to establish the TxOP to communicate with device 140 (Fig. 1) over the first channel BW including the primary channel and the one or more first secondary channels, e.g., as described above.

[00254] As indicated at block 404, the method may include during the TxOP, communicating at least one frame with the second wireless station over a second channel BW different from the first channel BW, the second channel BW including the primary channel and one or more second secondary channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to communicating at least one frame with device 140 (Fig. 1) over the second channel BW different from the first channel BW including the primary channel and the one or more second secondary channels, e.g., as described above.

[00255] As indicated at block 406, communicating the least one frame with the second wireless station over the second channel BW may include communicating the frame over a reduced channel BW, which is narrower than the first channel BW. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to communicate the frame with device 140 (Fig. 1) over the reduced channel BW, which is narrower than the bandwidth of the first channel BW, e.g., as described above.

[00256] As indicated at block 408, communicating the least one frame with the second wireless station over the second channel BW may include communicating the frame over a wider channel BW, which is wider than the first channel BW. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to communicate the frame with device 140 (Fig. 1) over the wider channel BW, which is wider than the bandwidth of the first channel BW, e.g., as described above.

[00257] Reference is made to Fig. 5, which schematically illustrates a method of modifying a channel bandwidth during a TxOP, in accordance with some demonstrative embodiments. For example, one or more of the operations of the method of Fig. 5 may be performed by one or more elements of a system, e.g., system

100 (Fig. 1), for example, one or more wireless devices, e.g., device 102 (Fig. 1), and/or device 140 (Fig. 1); a controller, e.g., controller 124 (Fig. 1), and/or controller 154 (Fig. 1); a radio, e.g., radio 114 (Fig. 1), and/or radio 144 (Fig. 1); a transmitter, e.g., transmitter 118 (Fig. 1), and/or transmitter 148 (Fig. 1); a receiver, e.g., receiver 116 (Fig. 1), and/or receiver 146 (Fig. 1); and/or a message processor, e.g., message processor 128 (Fig. 1), and/or message processor 158 (Fig. 1).

[00258] As indicated at block 502, the method may include transmitting a first plurality of RTS frames to a second wireless station over a first plurality of channels including a primary channel and a plurality of first secondary channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to transmit the first plurality of RTS frames to device 140 (Fig. 1) over the first plurality of channels including the primary channel and the plurality of first secondary channels, e.g., as described above.

[00259] As indicated at block 504, the method may include receiving from the second wireless station a first plurality of CTS frames over a second plurality of channels including the primary channel and one or more second secondary channels, which are included in the plurality of first secondary channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to receive from device 140 (Fig. 1) the first plurality of CTS frames over the second plurality of channels including the primary channel and the one or more second secondary channels, which are included in the plurality of first secondary channels, e.g., as described above.

[00260] As indicated at block 506, the method may include establishing a TxOP to communicate with the second wireless station over a first channel BW including the primary channel and the one or more second secondary channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to establish the TxOP to communicate with device 140 (Fig. 1) over the first channel BW including the primary channel and the one or more second secondary channels, e.g., as described above.

[00261] As indicated at block 508, the method may include, during the TxOP, transmitting to the second wireless station a second plurality of RTS frames over a third plurality of channels including one or more of the plurality of first secondary

channels, which are not included in the one or more second secondary channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to transmit to device 140 (Fig. 1), during the TxOP, the second plurality of RTS frames over the third plurality of channels including the one or more of the plurality of the first secondary channels, which are not included in the one or more second secondary channels, e.g., as described above.

[00262] As indicated at block 510, the method may include receiving from the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to receive from device 140 (Fig. 1) the second plurality of CTS frames over the fourth plurality of channels included in the third plurality of channels, e.g., as described above.

[00263] As indicated at block 512, the method may include communicating a frame with the second wireless station over a second channel BW including the fourth plurality of channels. For example, controller 124 (Fig. 1) may control, cause and/or trigger device 102 (Fig. 1) to communicating the frame with device 140 (Fig. 1) over the second channel BW including the fourth plurality of channels, e.g., as described above.

[00264] Reference is made to Fig. 6, which schematically illustrates a product of manufacture 600, in accordance with some demonstrative embodiments. Product 600 may include one or more tangible computer-readable non-transitory storage media 602, which may include computer-executable instructions, e.g., implemented by logic 604, operable to, when executed by at least one computer processor, enable the at least one computer processor to implement one or more operations at device 102 (Fig. 1), device 140 (Fig. 1), radio 114 (Fig. 1), radio 144 (Fig. 1), transmitter 118 (Fig. 1), transmitter 148 (Fig. 1), receiver 116 (Fig. 1), receiver 146 (Fig. 1), controller 124 (Fig. 1), controller 154 (Fig. 1), message processor 128 (Fig. 1), and/or message processor 158 (Fig. 1), to cause device 102 (Fig. 1), device 140 (Fig. 1), radio 114 (Fig. 1), radio 144 (Fig. 1), transmitter 118 (Fig. 1), transmitter 148 (Fig. 1), receiver 116 (Fig. 1), receiver 146 (Fig. 1), controller 124 (Fig. 1), controller 154 (Fig. 1), message processor 128 (Fig. 1), and/or message processor 158 (Fig. 1) to perform one or more operations, and/or to perform, trigger and/or implement one or more operations, communications and/or functionalities described above with reference to

Figs. 1, 2, 3, 4 and/or 5, and/or one or more operations described herein. The phrase “non-transitory machine-readable medium” is directed to include all computer-readable media, with the sole exception being a transitory propagating signal.

[00265] In some demonstrative embodiments, product 600 and/or storage media 602 may include one or more types of computer-readable storage media capable of storing data, including volatile memory, non-volatile memory, removable or non-removable memory, erasable or non-erasable memory, writeable or re-writable memory, and the like. For example, machine-readable storage media 602 may include, RAM, DRAM, Double-Data-Rate DRAM (DDR-DRAM), SDRAM, static RAM (SRAM), ROM, programmable ROM (PROM), erasable programmable ROM (EPROM), electrically erasable programmable ROM (EEPROM), Compact Disk ROM (CD-ROM), Compact Disk Recordable (CD-R), Compact Disk Rewritable (CD-RW), flash memory (e.g., NOR or NAND flash memory), content addressable memory (CAM), polymer memory, phase-change memory, ferroelectric memory, silicon-oxide-nitride-oxide-silicon (SONOS) memory, a disk, a floppy disk, a hard drive, an optical disk, a magnetic disk, a card, a magnetic card, an optical card, a tape, a cassette, and the like. The computer-readable storage media may include any suitable media involved with downloading or transferring a computer program from a remote computer to a requesting computer carried by data signals embodied in a carrier wave or other propagation medium through a communication link, e.g., a modem, radio or network connection.

[00266] In some demonstrative embodiments, logic 604 may include instructions, data, and/or code, which, if executed by a machine, may cause the machine to perform a method, process and/or operations as described herein. The machine may include, for example, any suitable processing platform, computing platform, computing device, processing device, computing system, processing system, computer, processor, or the like, and may be implemented using any suitable combination of hardware, software, firmware, and the like.

[00267] In some demonstrative embodiments, logic 604 may include, or may be implemented as, software, firmware, a software module, an application, a program, a subroutine, instructions, an instruction set, computing code, words, values, symbols, and the like. The instructions may include any suitable type of code, such as source code, compiled code, interpreted code, executable code, static code, dynamic code,

and the like. The instructions may be implemented according to a predefined computer language, manner or syntax, for instructing a processor to perform a certain function. The instructions may be implemented using any suitable high-level, low-level, object-oriented, visual, compiled and/or interpreted programming language, such as C, C++, Java, BASIC, Matlab, Pascal, Visual BASIC, assembly language, machine code, and the like.

EXAMPLES

[00268] The following examples pertain to further embodiments.

[00269] Example 1 includes an apparatus comprising logic and circuitry configured to cause a first wireless station to establish a Transmit Opportunity (TxOP) to communicate with a second wireless station over a first channel bandwidth (BW) comprising a primary channel and one or more first secondary channels; and during the TxOP, communicate at least one frame with the second wireless station over a second channel BW different from the first channel BW, the second channel BW comprising the primary channel and one or more second secondary channels.

[00270] Example 2 includes the subject matter of Example 1, and optionally, wherein the second channel BW comprises a reduced channel BW, which is narrower than the first channel BW.

[00271] Example 3 includes the subject matter of Example 2, and optionally, wherein the apparatus is configured to allow the first wireless station to transmit over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which only comprises an Enhanced Directional Multi-Gigabit (EDMG) PPDU.

[00272] Example 4 includes the subject matter of Example 2, and optionally, wherein the apparatus is configured to prevent the first wireless station from transmitting over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which comprises a Directional Multi-Gigabit (DMG) frame to be transmitted in a non-EDMG duplicate format.

[00273] Example 5 includes the subject matter of any one of Examples 1-4, and optionally, wherein the apparatus is configured to allow the first wireless station to transmit during the TxOP in a non Enhanced Directional Multi-Gigabit (EDMG)

(non-EDMG) duplicate format only one or more control frames selected from a group consisting of a Request to Send (RTS), a Clear to Send (CTS), a Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a

5 Grant, and a Grant-Ack.

[00274] Example 6 includes the subject matter of any one of Examples 1-5, and optionally, wherein the one or more second secondary channels comprise only some of the one or more first secondary channels.

[00275] Example 7 includes the subject matter of Example 1, and optionally,
10 wherein the second channel BW is wider than the first channel BW.

[00276] Example 8 includes the subject matter of Example 7, and optionally, wherein the one or more second secondary channels comprise all of the one or more first secondary channels, and at least one channel not included in the one or more first secondary channels.

[00277] Example 9 includes the subject matter of Example 7 or 8, and optionally, wherein the apparatus is configured to cause the first wireless station to, during the TxOP, transmit to the second wireless station a plurality of Request To Send (RTS) frames over respective channels of a requested channel BW, and, in response to the RTS frames, to receive from the second wireless station a plurality of Clear To Send
15 (CTS) frames over respective channels of the second channel BW.

[00278] Example 10 includes the subject matter of any one of Examples 1-9, and optionally, wherein the frame comprises channel BW information to indicate the second channel BW.

[00279] Example 11 includes the subject matter of Example 10, and optionally,
25 wherein the frame comprises a Legacy Header (L-header) comprising the channel BW information.

[00280] Example 12 includes the subject matter of Example 10 or 11, and optionally, wherein the frame comprises a scrambler initialization field comprising the channel BW information.

[00281] Example 13 includes the subject matter of Example 10 or 11, and optionally, wherein the frame comprises a Last Received Signal Strength Indication (RSSI) subfield comprising the channel BW information.

[00282] Example 14 includes the subject matter of any one of Examples 1-13, and optionally, wherein the frame comprises a Control Physical Layer (CPHY) frame.

[00283] Example 15 includes the subject matter of any one of Examples 1-14, and optionally, wherein the frame comprises a Single Carrier (SC) modulation frame.

[00284] Example 16 includes the subject matter of any one of Examples 1-15, and optionally, wherein the apparatus is configured to cause the first wireless station to establish the TxOP over the first channel BW based on a Request to Send (RTS) Clear to Send (CTS) (RTS/CTS) exchange with the second wireless station.

[00285] Example 17 includes the subject matter of any one of Examples 1-16, and optionally, wherein each channel of the one or more first secondary channels, the one or more second secondary channels, and the primary channel comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00286] Example 18 includes the subject matter of any one of Examples 1-17, and optionally, comprising a radio.

[00287] Example 19 includes the subject matter of any one of Examples 1-18, and optionally, comprising one or more antennas, a memory and a processor.

[00288] Example 20 includes a system of wireless communication comprising a first wireless station, the wireless station comprising one or more antennas; a radio; a memory; a processor; and a controller configured to cause the first wireless station to establish a Transmit Opportunity (TxOP) to communicate with a second wireless station over a first channel bandwidth (BW) comprising a primary channel and one or more first secondary channels; and during the TxOP, communicate at least one frame with the second wireless station over a second channel BW different from the first channel BW, the second channel BW comprising the primary channel and one or more second secondary channels.

[00289] Example 21 includes the subject matter of Example 20, and optionally, wherein the second channel BW comprises a reduced channel BW, which is narrower than the first channel BW.

[00290] Example 22 includes the subject matter of Example 21, and optionally, wherein the controller is configured to allow the first wireless station to transmit over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and
5 which only comprises an Enhanced Directional Multi-Gigabit (EDMG) PPDU.

[00291] Example 23 includes the subject matter of Example 21, and optionally, wherein the controller is configured to prevent the first wireless station from transmitting over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced
10 channel BW, and which comprises a Directional Multi-Gigabit (DMG) frame to be transmitted in a non-EDMG duplicate format.

[00292] Example 24 includes the subject matter of any one of Examples 20-23, and optionally, wherein the controller is configured to allow the first wireless station to transmit during the TxOP in a non Enhanced Directional Multi-Gigabit (EDMG)
15 (non-EDMG) duplicate format only one or more control frames selected from a group consisting of a Request to Send (RTS), a Clear to Send (CTS), a Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a Grant, and a Grant-Ack.

20 [00293] Example 25 includes the subject matter of any one of Examples 20-24, and optionally, wherein the one or more second secondary channels comprise only some of the one or more first secondary channels.

[00294] Example 26 includes the subject matter of Example 20, and optionally, wherein the second channel BW is wider than the first channel BW.

25 [00295] Example 27 includes the subject matter of Example 26, and optionally, wherein the one or more second secondary channels comprise all of the one or more first secondary channels, and at least one channel not included in the one or more first secondary channels.

[00296] Example 28 includes the subject matter of Example 26 or 27, and
30 optionally, wherein the controller is configured to cause the first wireless station to, during the TxOP, transmit to the second wireless station a plurality of Request To Send (RTS) frames over respective channels of a requested channel BW, and, in

response to the RTS frames, to receive from the second wireless station a plurality of Clear To Send (CTS) frames over respective channels of the second channel BW.

5 [00297] Example 29 includes the subject matter of any one of Examples 20-28, and optionally, wherein the frame comprises channel BW information to indicate the second channel BW.

[00298] Example 30 includes the subject matter of Example 29, and optionally, wherein the frame comprises a Legacy Header (L-header) comprising the channel BW information.

10 [00299] Example 31 includes the subject matter of Example 29 or 30, and optionally, wherein the frame comprises a scrambler initialization field comprising the channel BW information.

[00300] Example 32 includes the subject matter of Example 29 or 30, and optionally, wherein the frame comprises a Last Received Signal Strength Indication (RSSI) subfield comprising the channel BW information.

15 [00301] Example 33 includes the subject matter of any one of Examples 20-32, and optionally, wherein the frame comprises a Control Physical Layer (CPHY) frame.

[00302] Example 34 includes the subject matter of any one of Examples 20-33, and optionally, wherein the frame comprises a Single Carrier (SC) modulation frame.

20 [00303] Example 35 includes the subject matter of any one of Examples 20-34, and optionally, wherein the controller is configured to cause the first wireless station to establish the TxOP over the first channel BW based on a Request to Send (RTS) Clear to Send (CTS) (RTS/CTS) exchange with the second wireless station.

25 [00304] Example 36 includes the subject matter of any one of Examples 20-35, and optionally, wherein each channel of the one or more first secondary channels, the one or more second secondary channels, and the primary channel comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

30 [00305] Example 37 includes a method to be performed at a first wireless station, the method comprising establishing a Transmit Opportunity (TxOP) to communicate with a second wireless station over a first channel bandwidth (BW) comprising a primary channel and one or more first secondary channels; and during the TxOP, communicating at least one frame with the second wireless station over a second

channel BW different from the first channel BW, the second channel BW comprising the primary channel and one or more second secondary channels.

[00306] Example 38 includes the subject matter of Example 37, and optionally, wherein the second channel BW comprises a reduced channel BW, which is narrower than the first channel BW.

[00307] Example 39 includes the subject matter of Example 38, and optionally, comprising allowing the first wireless station to transmit over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which only comprises an Enhanced Directional Multi-Gigabit (EDMG) PPDU.

[00308] Example 40 includes the subject matter of Example 38, and optionally, comprising preventing the first wireless station from transmitting over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which comprises a Directional Multi-Gigabit (DMG) frame to be transmitted in a non-EDMG duplicate format.

[00309] Example 41 includes the subject matter of any one of Examples 37-40, and optionally, comprising allowing the first wireless station to transmit during the TxOP in a non Enhanced Directional Multi-Gigabit (EDMG) (non-EDMG) duplicate format only one or more control frames selected from a group consisting of a Request to Send (RTS), a Clear to Send (CTS), a Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a Grant, and a Grant-Ack.

[00310] Example 42 includes the subject matter of any one of Examples 37-41, and optionally, wherein the one or more second secondary channels comprise only some of the one or more first secondary channels.

[00311] Example 43 includes the subject matter of Example 37, and optionally, wherein the second channel BW is wider than the first channel BW.

[00312] Example 44 includes the subject matter of Example 43, and optionally, wherein the one or more second secondary channels comprise all of the one or more first secondary channels, and at least one channel not included in the one or more first secondary channels.

[00313] Example 45 includes the subject matter of Example 43 or 44, and optionally, comprising, during the TxOP, transmitting to the second wireless station a plurality of Request To Send (RTS) frames over respective channels of a requested channel BW, and, in response to the RTS frames, receiving from the second wireless station a plurality of Clear To Send (CTS) frames over respective channels of the second channel BW.

[00314] Example 46 includes the subject matter of any one of Examples 37-45, and optionally, wherein the frame comprises channel BW information to indicate the second channel BW.

10 [00315] Example 47 includes the subject matter of Example 46, and optionally, wherein the frame comprises a Legacy Header (L-header) comprising the channel BW information.

[00316] Example 48 includes the subject matter of Example 46 or 47, and optionally, wherein the frame comprises a scrambler initialization field comprising the channel BW information.

[00317] Example 49 includes the subject matter of Example 46 or 47, and optionally, wherein the frame comprises a Last Received Signal Strength Indication (RSSI) subfield comprising the channel BW information.

20 [00318] Example 50 includes the subject matter of any one of Examples 37-49, and optionally, wherein the frame comprises a Control Physical Layer (CPHY) frame.

[00319] Example 51 includes the subject matter of any one of Examples 37-50, and optionally, wherein the frame comprises a Single Carrier (SC) modulation frame.

[00320] Example 52 includes the subject matter of any one of Examples 37-51, and optionally, comprising establishing the TxOP over the first channel BW based on a Request to Send (RTS) Clear to Send (CTS) (RTS/CTS) exchange with the second wireless station.

[00321] Example 53 includes the subject matter of any one of Examples 37-52, and optionally, wherein each channel of the one or more first secondary channels, the one or more second secondary channels, and the primary channel comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00322] Example 54 includes a product comprising one or more tangible computer-readable non-transitory storage media comprising computer-executable instructions operable to, when executed by at least one processor, enable the at least one processor to cause a first wireless station to establish a Transmit Opportunity (TxOP) to communicate with a second wireless station over a first channel bandwidth (BW) comprising a primary channel and one or more first secondary channels; and during the TxOP, communicate at least one frame with the second wireless station over a second channel BW different from the first channel BW, the second channel BW comprising the primary channel and one or more second secondary channels.

10 [00323] Example 55 includes the subject matter of Example 54, and optionally, wherein the second channel BW comprises a reduced channel BW, which is narrower than the first channel BW.

[00324] Example 56 includes the subject matter of Example 55, and optionally, wherein the instructions, when executed, allow the first wireless station to transmit over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which only comprises an Enhanced Directional Multi-Gigabit (EDMG) PPDU.

15 [00325] Example 57 includes the subject matter of Example 55, and optionally, wherein the instructions, when executed, prevent the first wireless station from transmitting over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which comprises a Directional Multi-Gigabit (DMG) frame to be transmitted in a non-EDMG duplicate format.

20 [00326] Example 58 includes the subject matter of any one of Examples 54-57, and optionally, wherein the instructions, when executed, allow the first wireless station to transmit during the TxOP in a non Enhanced Directional Multi-Gigabit (EDMG) (non-EDMG) duplicate format only one or more control frames selected from a group consisting of a Request to Send (RTS), a Clear to Send (CTS), a Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a Grant, and a Grant-Ack.

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[00327] Example 59 includes the subject matter of any one of Examples 54-58, and optionally, wherein the one or more second secondary channels comprise only some of the one or more first secondary channels.

[00328] Example 60 includes the subject matter of Example 54, and optionally,
5 wherein the second channel BW is wider than the first channel BW.

[00329] Example 61 includes the subject matter of Example 60, and optionally, wherein the one or more second secondary channels comprise all of the one or more first secondary channels, and at least one channel not included in the one or more first secondary channels.

10 [00330] Example 62 includes the subject matter of Example 60 or 61, and optionally, wherein the instructions, when executed, cause the first wireless station to, during the TxOP, transmit to the second wireless station a plurality of Request To Send (RTS) frames over respective channels of a requested channel BW, and, in response to the RTS frames, to receive from the second wireless station a plurality of
15 Clear To Send (CTS) frames over respective channels of the second channel BW.

[00331] Example 63 includes the subject matter of any one of Examples 54-62, and optionally, wherein the frame comprises channel BW information to indicate the second channel BW.

[00332] Example 64 includes the subject matter of Example 63, and optionally,
20 wherein the frame comprises a Legacy Header (L-header) comprising the channel BW information.

[00333] Example 65 includes the subject matter of Example 63 or 64, and optionally, wherein the frame comprises a scrambler initialization field comprising the channel BW information.

25 [00334] Example 66 includes the subject matter of Example 63 or 64, and optionally, wherein the frame comprises a Last Received Signal Strength Indication (RSSI) subfield comprising the channel BW information.

[00335] Example 67 includes the subject matter of any one of Examples 54-66, and optionally, wherein the frame comprises a Control Physical Layer (CPHY) frame.

30 [00336] Example 68 includes the subject matter of any one of Examples 54-67, and optionally, wherein the frame comprises a Single Carrier (SC) modulation frame.

[00337] Example 69 includes the subject matter of any one of Examples 54-68, and optionally, wherein the instructions, when executed, cause the first wireless station to establish the TxOP over the first channel BW based on a Request to Send (RTS) Clear to Send (CTS) (RTS/CTS) exchange with the second wireless station.

- 5 [00338] Example 70 includes the subject matter of any one of Examples 54-69, and optionally, wherein each channel of the one or more first secondary channels, the one or more second secondary channels, and the primary channel comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

- [00339] Example 71 includes an apparatus of wireless communication by a first
10 wireless station, the apparatus comprising means for establishing a Transmit Opportunity (TxOP) to communicate with a second wireless station over a first channel bandwidth (BW) comprising a primary channel and one or more first secondary channels; and means for, during the TxOP, communicating at least one
15 frame with the second wireless station over a second channel BW different from the first channel BW, the second channel BW comprising the primary channel and one or more second secondary channels.

[00340] Example 72 includes the subject matter of Example 71, and optionally, wherein the second channel BW comprises a reduced channel BW, which is narrower than the first channel BW.

- 20 [00341] Example 73 includes the subject matter of Example 72, and optionally, comprising means for allowing the first wireless station to transmit over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which only comprises an Enhanced Directional Multi-Gigabit (EDMG) PPDU.

- 25 [00342] Example 74 includes the subject matter of Example 72, and optionally, comprising means for preventing the first wireless station from transmitting over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which comprises a Directional Multi-Gigabit (DMG) frame to be transmitted in a non-
30 EDMG duplicate format.

[00343] Example 75 includes the subject matter of any one of Examples 71-74, and optionally, comprising means for allowing the first wireless station to transmit during

the TxOP in a non Enhanced Directional Multi-Gigabit (EDMG) (non-EDMG) duplicate format only one or more control frames selected from a group consisting of a Request to Send (RTS), a Clear to Send (CTS), a Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a
5 BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a Grant, and a Grant-Ack.

[00344] Example 76 includes the subject matter of any one of Examples 71-75, and optionally, wherein the one or more second secondary channels comprise only some of the one or more first secondary channels.

10 [00345] Example 77 includes the subject matter of Example 71, and optionally, wherein the second channel BW is wider than the first channel BW.

[00346] Example 78 includes the subject matter of Example 77, and optionally, wherein the one or more second secondary channels comprise all of the one or more first secondary channels, and at least one channel not included in the one or more first
15 secondary channels.

[00347] Example 79 includes the subject matter of Example 77 or 78, and optionally, comprising means for, during the TxOP, transmitting to the second wireless station a plurality of Request To Send (RTS) frames over respective channels of a requested channel BW, and, in response to the RTS frames, receiving from the
20 second wireless station a plurality of Clear To Send (CTS) frames over respective channels of the second channel BW.

[00348] Example 80 includes the subject matter of any one of Examples 71-79, and optionally, wherein the frame comprises channel BW information to indicate the second channel BW.

25 [00349] Example 81 includes the subject matter of Example 80, and optionally, wherein the frame comprises a Legacy Header (L-header) comprising the channel BW information.

[00350] Example 82 includes the subject matter of Example 80 or 81, and optionally, wherein the frame comprises a scrambler initialization field comprising
30 the channel BW information.

[00351] Example 83 includes the subject matter of Example 80 or 81, and optionally, wherein the frame comprises a Last Received Signal Strength Indication (RSSI) subfield comprising the channel BW information.

5 [00352] Example 84 includes the subject matter of any one of Examples 71-83, and optionally, wherein the frame comprises a Control Physical Layer (CPHY) frame.

[00353] Example 85 includes the subject matter of any one of Examples 71-84, and optionally, wherein the frame comprises a Single Carrier (SC) modulation frame.

10 [00354] Example 86 includes the subject matter of any one of Examples 71-85, and optionally, comprising means for establishing the TxOP over the first channel BW based on a Request to Send (RTS) Clear to Send (CTS) (RTS/CTS) exchange with the second wireless station.

[00355] Example 87 includes the subject matter of any one of Examples 71-86, and optionally, wherein each channel of the one or more first secondary channels, the one or more second secondary channels, and the primary channel comprises a 2.16
15 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00356] Example 88 includes an apparatus comprising logic and circuitry configured to cause a first wireless station to transmit a first plurality of Request to Send (RTS) frames to a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; receive from
20 the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels, which are included in the plurality of first secondary channels; establish a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel bandwidth (BW) comprising the primary channel and the
25 one or more second secondary channels; during the TxOP, transmit to the second wireless station a second plurality of RTS frames over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels; receive from the second wireless station a second plurality of CTS frames over a fourth plurality of channels
30 included in the third plurality of channels; and communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

[00357] Example 89 includes the subject matter of Example 88, and optionally, wherein the apparatus is configured to cause the first wireless station to detect energy over the third plurality of channels prior to transmission of the second plurality of RTS frames, and to transmit the second plurality of RTS frames over the third plurality of channels based on detected energy over the third plurality of channels.

[00358] Example 90 includes the subject matter of Example 89, and optionally, wherein the apparatus is configured to cause the first wireless station to determine the third plurality of channels to include channels determined to be clear during a predefined period prior to transmission of the second plurality of RTS frames.

10 [00359] Example 91 includes the subject matter of Example 90, and optionally, wherein the predefined period comprises a Point Coordination Function (PCF) Inter-Frame Space (PIFS) interval.

[00360] Example 92 includes the subject matter of any one of Examples 88-91, and optionally, wherein the second channel BW is wider than the first channel BW.

15 [00361] Example 93 includes the subject matter of any one of Examples 88-92, and optionally, wherein each channel of the first plurality of channels, the second plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00362] Example 94 includes the subject matter of any one of Examples 88-93, and optionally, comprising a radio.

[00363] Example 95 includes the subject matter of any one of Examples 88-94, and optionally, comprising one or more antennas, a memory and a processor.

[00364] Example 96 includes a system of wireless communication comprising a first wireless station, the wireless station comprising one or more antennas; a radio; a memory; a processor; and a controller configured to cause the first wireless station to transmit a first plurality of Request to Send (RTS) frames to a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; receive from the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels, which are included in the plurality of first secondary channels; establish a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel bandwidth (BW)

comprising the primary channel and the one or more second secondary channels; during the TxOP, transmit to the second wireless station a second plurality of RTS frames over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels; receive from the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

[00365] Example 97 includes the subject matter of Example 96, and optionally, wherein the controller is configured to cause the first wireless station to detect energy over the third plurality of channels prior to transmission of the second plurality of RTS frames, and to transmit the second plurality of RTS frames over the third plurality of channels based on detected energy over the third plurality of channels.

[00366] Example 98 includes the subject matter of Example 97, and optionally, wherein the controller is configured to cause the first wireless station to determine the third plurality of channels to include channels determined to be clear during a predefined period prior to transmission of the second plurality of RTS frames.

[00367] Example 99 includes the subject matter of Example 98, and optionally, wherein the predefined period comprises a Point Coordination Function (PCF) Inter-Frame Space (PIFS) interval.

[00368] Example 100 includes the subject matter of any one of Examples 96-99, and optionally, wherein the second channel BW is wider than the first channel BW.

[00369] Example 101 includes the subject matter of any one of Examples 96-100, and optionally, wherein each channel of the first plurality of channels, the second plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00370] Example 102 includes a method to be performed at a first wireless station, the method comprising transmitting a first plurality of Request to Send (RTS) frames to a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; receiving from the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels,

which are included in the plurality of first secondary channels; establishing a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel bandwidth (BW) comprising the primary channel and the one or more second secondary channels; during the TxOP, transmitting to the second wireless station a
5 second plurality of RTS frames over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels; receiving from the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and communicating a frame with the second wireless station
10 over a second channel BW comprising the fourth plurality of channels.

[00371] Example 103 includes the subject matter of Example 102, and optionally, comprising detecting energy over the third plurality of channels prior to transmission of the second plurality of RTS frames, and transmitting the second plurality of RTS frames over the third plurality of channels based on detected energy over the third
15 plurality of channels.

[00372] Example 104 includes the subject matter of Example 103, and optionally, comprising determining the third plurality of channels to include channels determined to be clear during a predefined period prior to transmission of the second plurality of RTS frames.

[00373] Example 105 includes the subject matter of Example 104, and optionally, wherein the predefined period comprises a Point Coordination Function (PCF) Inter-Frame Space (PIFS) interval.

[00374] Example 106 includes the subject matter of any one of Examples 102-105, and optionally, wherein the second channel BW is wider than the first channel BW.

[00375] Example 107 includes the subject matter of any one of Examples 102-106, and optionally, wherein each channel of the first plurality of channels, the second plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00376] Example 108 includes a product comprising one or more tangible
30 computer-readable non-transitory storage media comprising computer-executable instructions operable to, when executed by at least one processor, enable the at least one processor to cause a first wireless station to transmit a first plurality of Request to

Send (RTS) frames to a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; receive from the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second
5 secondary channels, which are included in the plurality of first secondary channels; establish a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel bandwidth (BW) comprising the primary channel and the one or more second secondary channels; during the TxOP, transmit to the second wireless station a second plurality of RTS frames over a third plurality of channels
10 comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels; receive from the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of
15 channels.

[00377] Example 109 includes the subject matter of Example 108, and optionally, wherein the instructions, when executed, cause the first wireless station to detect energy over the third plurality of channels prior to transmission of the second plurality of RTS frames, and to transmit the second plurality of RTS frames over the third
20 plurality of channels based on detected energy over the third plurality of channels.

[00378] Example 110 includes the subject matter of Example 109, and optionally, wherein the instructions, when executed, cause the first wireless station to determine the third plurality of channels to include channels determined to be clear during a predefined period prior to transmission of the second plurality of RTS frames.

25 [00379] Example 111 includes the subject matter of Example 110, and optionally, wherein the predefined period comprises a Point Coordination Function (PCF) Inter-Frame Space (PIFS) interval.

[00380] Example 112 includes the subject matter of any one of Examples 108-111, and optionally, wherein the second channel BW is wider than the first channel BW.

30 [00381] Example 113 includes the subject matter of any one of Examples 108-112, and optionally, wherein each channel of the first plurality of channels, the second

plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00382] Example 114 includes an apparatus of wireless communication by a first wireless station, the apparatus comprising means for transmitting a first plurality of
5 Request to Send (RTS) frames to a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; means for receiving from the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels, which are included in the plurality of first
10 secondary channels; means for establishing a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel bandwidth (BW) comprising the primary channel and the one or more second secondary channels; means for, during the TxOP, transmitting to the second wireless station a second plurality of RTS frames over a third plurality of channels comprising one or more of
15 the plurality of first secondary channels, which are not included in the one or more second secondary channels; means for receiving from the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and means for communicating a frame with the second wireless station over a second channel BW comprising the fourth plurality of
20 channels.

[00383] Example 115 includes the subject matter of Example 114, and optionally, comprising means for detecting energy over the third plurality of channels prior to transmission of the second plurality of RTS frames, and transmitting the second plurality of RTS frames over the third plurality of channels based on detected energy
25 over the third plurality of channels.

[00384] Example 116 includes the subject matter of Example 115, and optionally, comprising means for determining the third plurality of channels to include channels determined to be clear during a predefined period prior to transmission of the second plurality of RTS frames.

30 [00385] Example 117 includes the subject matter of Example 116, and optionally, wherein the predefined period comprises a Point Coordination Function (PCF) Inter-Frame Space (PIFS) interval.

[00386] Example 118 includes the subject matter of any one of Examples 114-117, and optionally, wherein the second channel BW is wider than the first channel BW.

[00387] Example 119 includes the subject matter of any one of Examples 114-118, and optionally, wherein each channel of the first plurality of channels, the second plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00388] Example 120 includes an apparatus comprising logic and circuitry configured to cause a first wireless station to process a first plurality of Request to Send (RTS) frames from a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; transmit to the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels of the plurality of first secondary channels; establish a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel BW comprising the primary channel and the one or more second secondary channels; during the TxOP, process a second plurality of RTS frames from the second wireless station over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels; transmit to the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

[00389] Example 121 includes the subject matter of Example 120, and optionally, wherein the apparatus is configured to cause the first wireless station to detect energy over the third plurality of channels prior to transmission of the second plurality of CTS frames, and to transmit the second plurality of CTS frames over the fourth plurality of channels based on detected energy over the third plurality of channels.

[00390] Example 122 includes the subject matter of Example 121, and optionally, wherein the apparatus is configured to cause the first wireless station to determine the fourth plurality of channels to include channels included in the third plurality of channels determined to be clear.

[00391] Example 123 includes the subject matter of any one of Examples 120-122, and optionally, wherein the second channel BW is wider than the first channel BW.

[00392] Example 124 includes the subject matter of any one of Examples 120-123, and optionally, wherein each channel of the first plurality of channels, the second
5 plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00393] Example 125 includes the subject matter of any one of Examples 120-124, and optionally, comprising a radio.

[00394] Example 126 includes the subject matter of any one of Examples 120-125,
10 and optionally, comprising one or more antennas, a memory and a processor.

[00395] Example 127 includes a system of wireless communication comprising a first wireless station, the wireless station comprising one or more antennas; a radio; a memory; a processor; and a controller configured to cause the first wireless station to process a first plurality of Request to Send (RTS) frames from a second wireless
15 station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; transmit to the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels of the plurality of first secondary channels; establish a Transmit Opportunity (TxOP) to communicate with
20 the second wireless station over a first channel BW comprising the primary channel and the one or more second secondary channels; during the TxOP, process a second plurality of RTS frames from the second wireless station over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels; transmit to the second
25 wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

[00396] Example 128 includes the subject matter of Example 127, and optionally,
30 wherein the controller is configured to cause the first wireless station to detect energy over the third plurality of channels prior to transmission of the second plurality of

CTS frames, and to transmit the second plurality of CTS frames over the fourth plurality of channels based on detected energy over the third plurality of channels.

[00397] Example 129 includes the subject matter of Example 128, and optionally, wherein the controller is configured to cause the first wireless station to determine the fourth plurality of channels to include channels included in the third plurality of channels determined to be clear.

[00398] Example 130 includes the subject matter of any one of Examples 127-129, and optionally, wherein the second channel BW is wider than the first channel BW.

[00399] Example 131 includes the subject matter of any one of Examples 127-130, and optionally, wherein each channel of the first plurality of channels, the second plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00400] Example 132 includes a method to be performed at a first wireless station, the method comprising processing a first plurality of Request to Send (RTS) frames from a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; transmitting to the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels of the plurality of first secondary channels; establishing a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel BW comprising the primary channel and the one or more second secondary channels; during the TxOP, processing a second plurality of RTS frames from the second wireless station over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels; transmitting to the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and communicating a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

[00401] Example 133 includes the subject matter of Example 132, and optionally, comprising detecting energy over the third plurality of channels prior to transmission of the second plurality of CTS frames, and transmitting the second plurality of CTS

frames over the fourth plurality of channels based on detected energy over the third plurality of channels.

[00402] Example 134 includes the subject matter of Example 133, and optionally, comprising determining the fourth plurality of channels to include channels included
5 in the third plurality of channels determined to be clear.

[00403] Example 135 includes the subject matter of any one of Examples 132-134, and optionally, wherein the second channel BW is wider than the first channel BW.

[00404] Example 136 includes the subject matter of any one of Examples 132-135, and optionally, wherein each channel of the first plurality of channels, the second
10 plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00405] Example 137 includes a product comprising one or more tangible computer-readable non-transitory storage media comprising computer-executable instructions operable to, when executed by at least one processor, enable the at least
15 one processor to cause a first wireless station to process a first plurality of Request to Send (RTS) frames from a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; transmit to the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second
20 secondary channels of the plurality of first secondary channels; establish a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel BW comprising the primary channel and the one or more second secondary channels; during the TxOP, process a second plurality of RTS frames from the second wireless station over a third plurality of channels comprising one or more of the
25 plurality of first secondary channels, which are not included in the one or more second secondary channels; transmit to the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

30 [00406] Example 138 includes the subject matter of Example 137, and optionally, wherein the instructions, when executed, cause the first wireless station to detect energy over the third plurality of channels prior to transmission of the second plurality

of CTS frames, and to transmit the second plurality of CTS frames over the fourth plurality of channels based on detected energy over the third plurality of channels.

[00407] Example 139 includes the subject matter of Example 138, and optionally, wherein the instructions, when executed, cause the first wireless station to determine
5 the fourth plurality of channels to include channels included in the third plurality of channels determined to be clear.

[00408] Example 140 includes the subject matter of any one of Examples 137-139, and optionally, wherein the second channel BW is wider than the first channel BW.

[00409] Example 141 includes the subject matter of any one of Examples 137-140,
10 and optionally, wherein each channel of the first plurality of channels, the second plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00410] Example 142 includes an apparatus of wireless communication by a first wireless station, the apparatus comprising means for processing a first plurality of
15 Request to Send (RTS) frames from a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels; means for transmitting to the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels of the plurality of first secondary channels;
20 means for establishing a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel BW comprising the primary channel and the one or more second secondary channels; means for, during the TxOP, processing a second plurality of RTS frames from the second wireless station over a third plurality of channels comprising one or more of the plurality of first secondary channels, which
25 are not included in the one or more second secondary channels; means for transmitting to the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and means for communicating a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

30 [00411] Example 143 includes the subject matter of Example 142, and optionally, comprising means for detecting energy over the third plurality of channels prior to transmission of the second plurality of CTS frames, and transmitting the second

plurality of CTS frames over the fourth plurality of channels based on detected energy over the third plurality of channels.

[00412] Example 144 includes the subject matter of Example 143, and optionally, comprising means for determining the fourth plurality of channels to include channels
5 included in the third plurality of channels determined to be clear.

[00413] Example 145 includes the subject matter of any one of Examples 142-144, and optionally, wherein the second channel BW is wider than the first channel BW.

[00414] Example 146 includes the subject matter of any one of Examples 142-145, and optionally, wherein each channel of the first plurality of channels, the second
10 plurality of channels, the third plurality of channels, and the fourth plurality of channels comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

[00415] Functions, operations, components and/or features described herein with reference to one or more embodiments, may be combined with, or may be utilized in combination with, one or more other functions, operations, components and/or
15 features described herein with reference to one or more other embodiments, or vice versa.

[00416] While certain features have been illustrated and described herein, many modifications, substitutions, changes, and equivalents may occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to
20 cover all such modifications and changes as fall within the true spirit of the disclosure.

CLAIMS

What is claimed is:

1. An apparatus comprising logic and circuitry configured to cause a first wireless station to:
 - 5 establish a Transmit Opportunity (TxOP) to communicate with a second wireless station over a first channel bandwidth (BW) comprising a primary channel and one or more first secondary channels; and
 - during the TxOP, communicate at least one frame with the second wireless station over a second channel BW different from the first channel BW, the second
 - 10 channel BW comprising the primary channel and one or more second secondary channels.
2. The apparatus of claim 1, wherein the second channel BW comprises a reduced channel BW, which is narrower than the first channel BW.
3. The apparatus of claim 2 configured to allow the first wireless station to
 - 15 transmit over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which only comprises an Enhanced Directional Multi-Gigabit (EDMG) PPDU.
4. The apparatus of claim 2 configured to prevent the first wireless station from
 - 20 transmitting over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which comprises a Directional Multi-Gigabit (DMG) frame to be transmitted in a non-EDMG duplicate format.
5. The apparatus of claim 1 configured to allow the first wireless station to
 - 25 transmit during the TxOP in a non Enhanced Directional Multi-Gigabit (EDMG) (non-EDMG) duplicate format only one or more control frames selected from a group consisting of a Request to Send (RTS), a Clear to Send (CTS), a Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a
 - 30 Grant, and a Grant-Ack.

6. The apparatus of claim 1, wherein the one or more second secondary channels comprise only some of the one or more first secondary channels.

7. The apparatus of claim 1, wherein the second channel BW is wider than the first channel BW.

5 8. The apparatus of claim 7, wherein the one or more second secondary channels comprise all of the one or more first secondary channels, and at least one channel not included in the one or more first secondary channels.

9. The apparatus of claim 7 configured to cause the first wireless station to, during the TxOP, transmit to the second wireless station a plurality of Request To Send (RTS) frames over respective channels of a requested channel BW, and, in
10 response to the RTS frames, to receive from the second wireless station a plurality of Clear To Send (CTS) frames over respective channels of the second channel BW.

10. The apparatus of any one of claims 1-9 configured to cause the first wireless station to establish the TxOP over the first channel BW based on a Request to Send
15 (RTS) Clear to Send (CTS) (RTS/CTS) exchange with the second wireless station.

11. The apparatus of any one of claims 1-9, wherein each channel of the one or more first secondary channels, the one or more second secondary channels, and the primary channel comprises a 2.16 Gigahertz (GHz) channel over a 45 GHz frequency band.

20 12. The apparatus of any one of claims 1-9 comprising one or more antennas, a memory and a processor.

13. A method to be performed at a first wireless station, the method comprising:
establishing a Transmit Opportunity (TxOP) to communicate with a second
wireless station over a first channel bandwidth (BW) comprising a primary channel
25 and one or more first secondary channels; and

during the TxOP, communicating at least one frame with the second wireless station over a second channel BW different from the first channel BW, the second channel BW comprising the primary channel and one or more second secondary channels.

14. The method of claim 13, wherein the second channel BW comprises a reduced channel BW, which is narrower than the first channel BW.

15. The method of claim 14 comprising allowing the first wireless station to transmit over the reduced channel BW during the TxOP a Physical Layer (PHY) Protocol Data Unit (PPDU), which is to be prior to any other PPDU over the reduced channel BW, and which only comprises an Enhanced Directional Multi-Gigabit (EDMG) PPDU.

16. The method of claim 13 comprising allowing the first wireless station to transmit during the TxOP in a non Enhanced Directional Multi-Gigabit (EDMG) (non-EDMG) duplicate format only one or more control frames selected from a group consisting of a Request to Send (RTS), a Clear to Send (CTS), a Directional Multi-Gigabit (DMG) Denial to Send (DTS), an Acknowledgment (Ack), a Block Ack (BlockAck), a BlockAck request (BlockAckReq), a Contention-Free End (CF-end), a Grant, and a Grant-Ack.

17. A product comprising one or more tangible computer-readable non-transitory storage media comprising computer-executable instructions operable to, when executed by at least one processor, enable the at least one processor to cause a wireless station to perform the method of any one of claims 13-16.

18. A system of wireless communication comprising an apparatus, the apparatus comprising logic and circuitry configured to cause a first wireless station to:

transmit a first plurality of Request to Send (RTS) frames to a second wireless station over a first plurality of channels comprising a primary channel and a plurality of first secondary channels;

receive from the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels, which are included in the plurality of first secondary channels;

establish a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel bandwidth (BW) comprising the primary channel and the one or more second secondary channels;

during the TxOP, transmit to the second wireless station a second plurality of RTS frames over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels;

- 5 receive from the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and
 communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

19. The system of claim 18, wherein the apparatus is configured to cause the first
10 wireless station to detect energy over the third plurality of channels prior to transmission of said second plurality of RTS frames, and to transmit the second plurality of RTS frames over the third plurality of channels based on detected energy over said third plurality of channels.

20. The system of claim 19, wherein the apparatus is configured to cause the first
15 wireless station to determine the third plurality of channels to include channels determined to be clear during a predefined period prior to transmission of said second plurality of RTS frames.

21. The system of claim 20, wherein the predefined period comprises a Point Coordination Function (PCF) Inter-Frame Space (PIFS) interval.

20 22. The system of claims 18-21, wherein the second channel BW is wider than the first channel BW.

23. The system of any one of claims 18-21, wherein the apparatus comprises one or more antennas, a memory and a processor.

24. A product comprising one or more tangible computer-readable non-transitory
25 storage media comprising computer-executable instructions operable to, when executed by at least one processor, enable the at least one processor to cause a first wireless station to:

 process a first plurality of Request to Send (RTS) frames from a second wireless station over a first plurality of channels comprising a primary channel and a
30 plurality of first secondary channels;

transmit to the second wireless station a first plurality of Clear To Send (CTS) frames over a second plurality of channels comprising the primary channel and one or more second secondary channels of the plurality of first secondary channels;

5 establish a Transmit Opportunity (TxOP) to communicate with the second wireless station over a first channel BW comprising the primary channel and the one or more second secondary channels;

10 during the TxOP, process a second plurality of RTS frames from the second wireless station over a third plurality of channels comprising one or more of the plurality of first secondary channels, which are not included in the one or more second secondary channels;

transmit to the second wireless station a second plurality of CTS frames over a fourth plurality of channels included in the third plurality of channels; and

communicate a frame with the second wireless station over a second channel BW comprising the fourth plurality of channels.

15 25. The product of claim 24, wherein the instructions, when executed, cause the first wireless station to detect energy over the third plurality of channels prior to transmission of said second plurality of CTS frames, and to transmit the second plurality of CTS frames over the fourth plurality of channels based on detected energy over said third plurality of channels.

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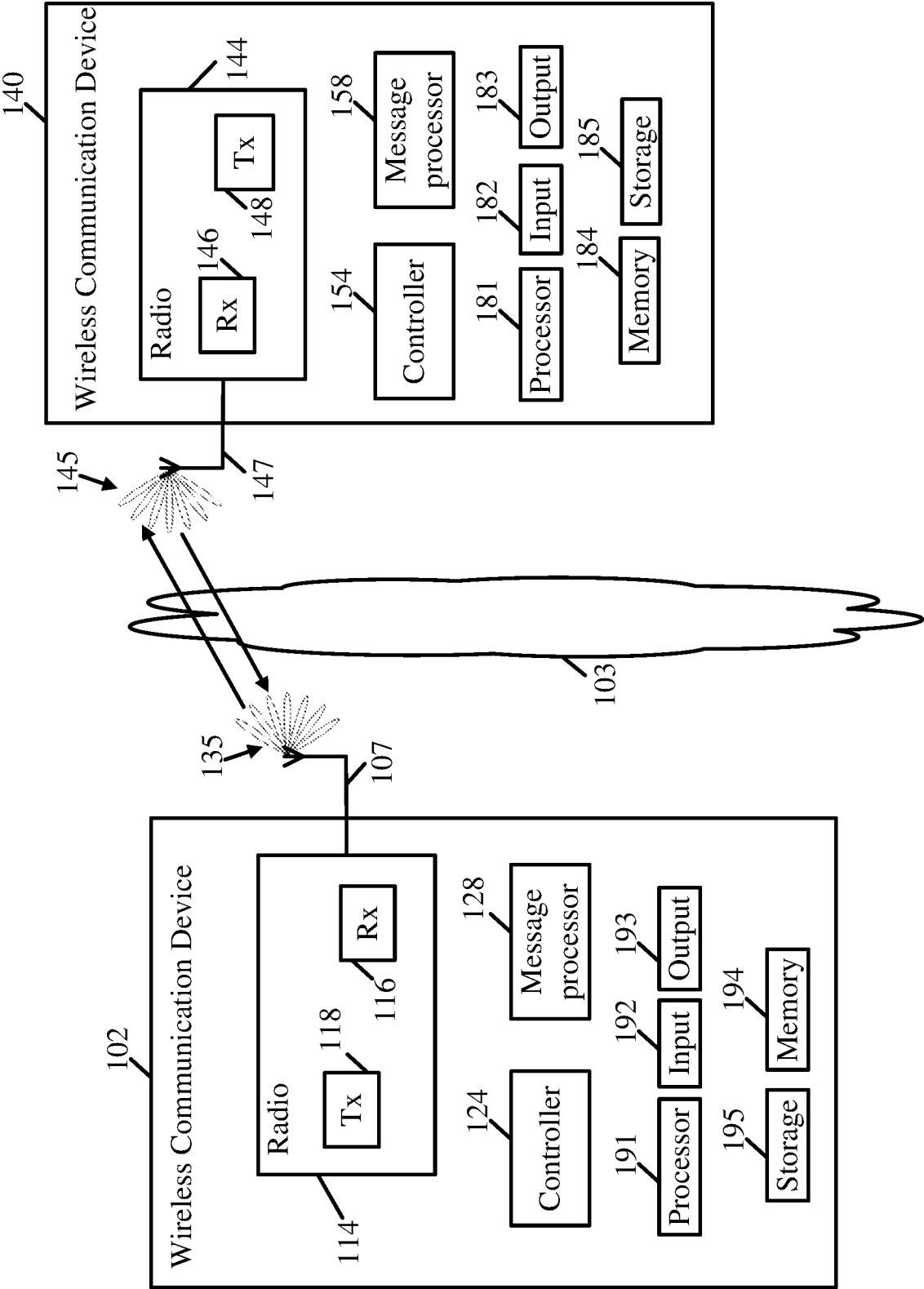


Fig. 1

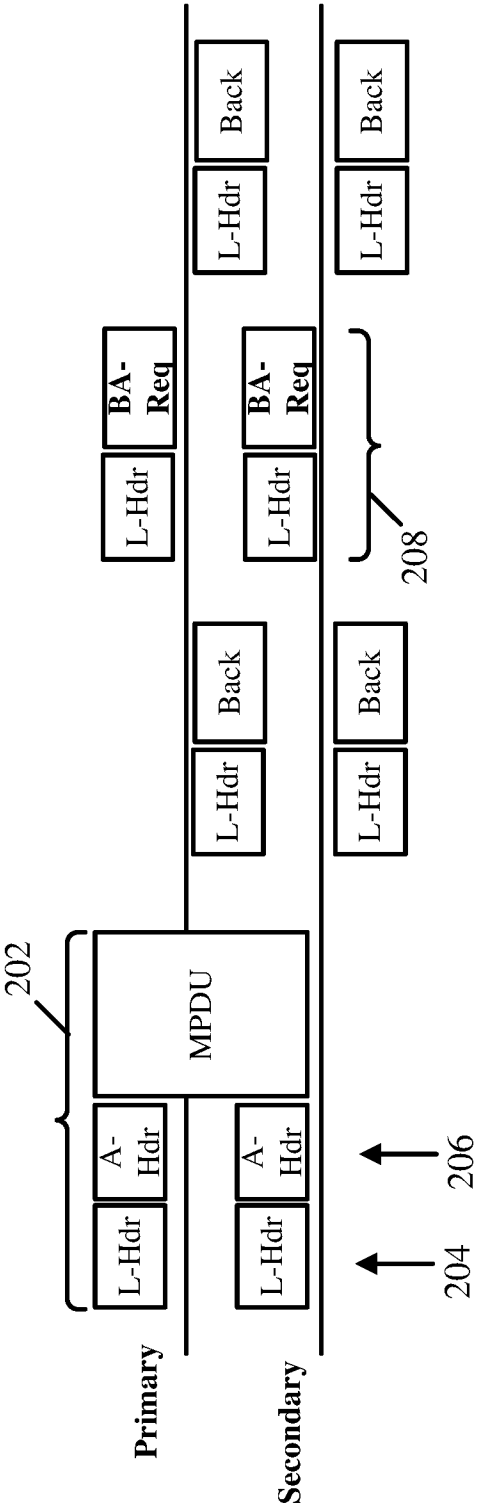


Fig. 2

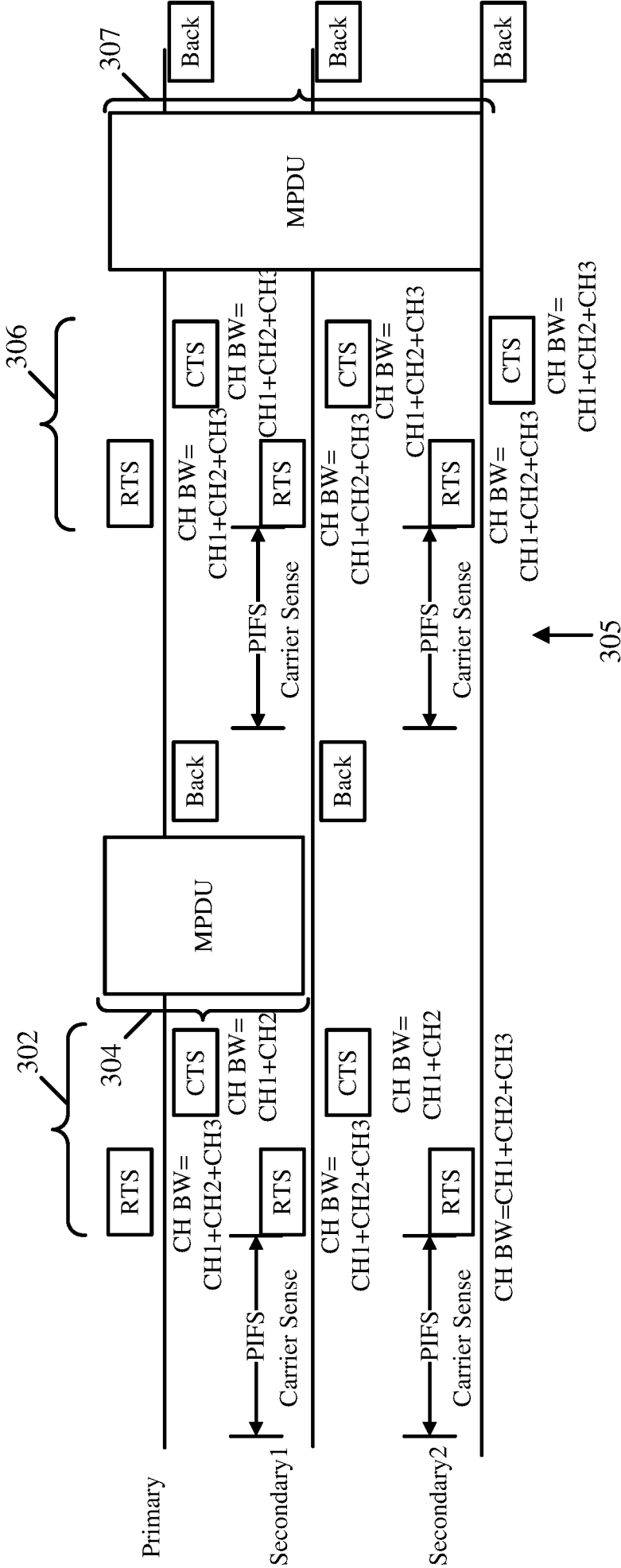


Fig. 3

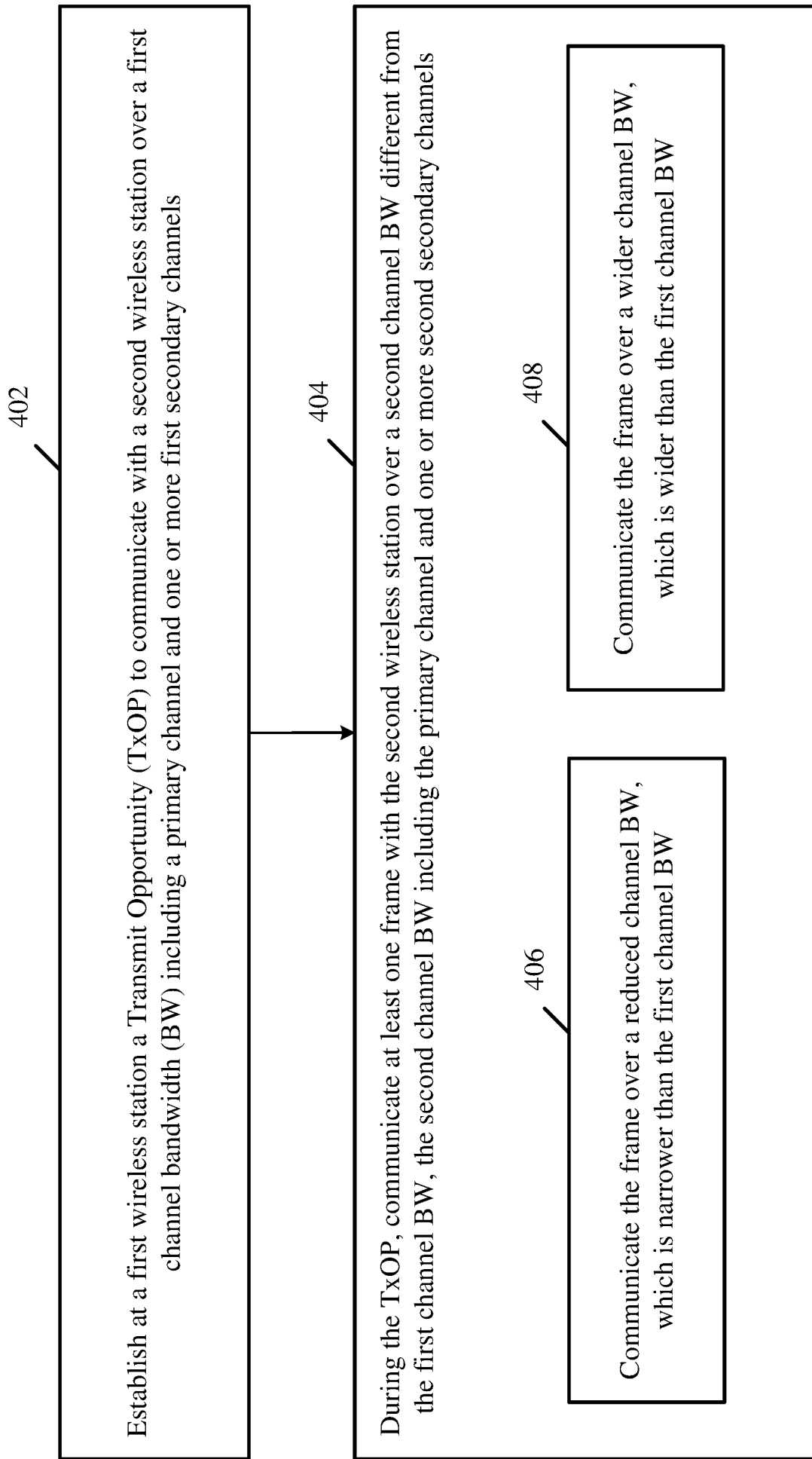


Fig. 4

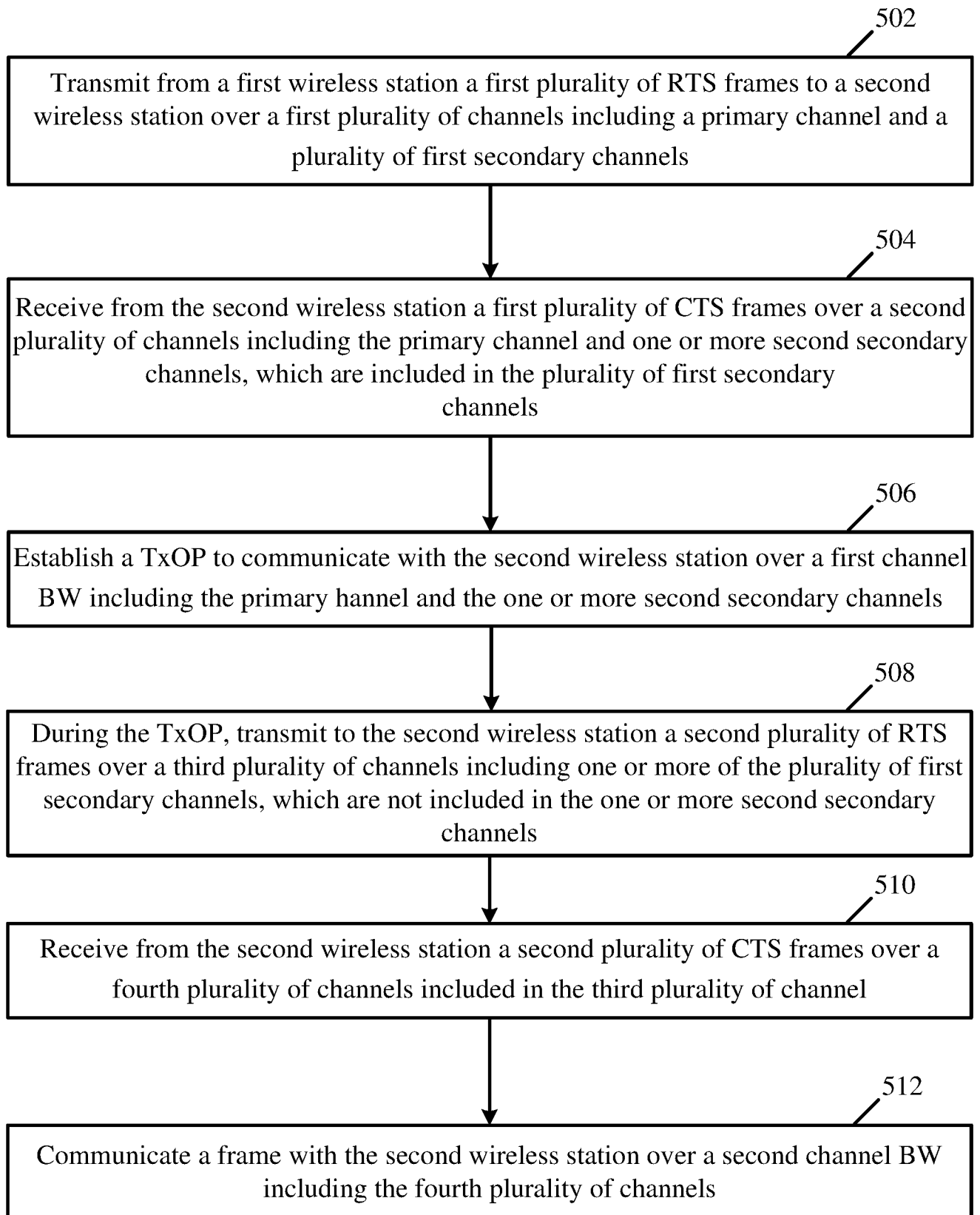


Fig. 5

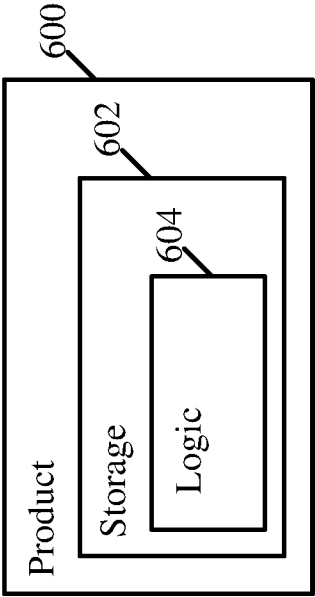


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/024950**A. CLASSIFICATION OF SUBJECT MATTER****H04W 74/00(2009.01)i, H04W 74/08(2009.01)i, H04W 28/06(2009.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W 74/00; H04B 7/26; H04W 74/02; H04B 10/90; H04L 29/06; H04W 72/04; H04B 7/04; H04W 74/08; H04W 28/06

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: Transmit Opportunity (TxOP), channel bandwidth, primary channel, secondary channel, enhanced directional multi-gigabit (EDMG) PPDU, non-EDMG duplicate format, RTS frame, CTS frame

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2012-002705 A2 (LG ELECTRONICS INC.) 05 January 2012 See paragraphs [0003], [0076]-[0086]; claims 1-3, 7; and figure 5.	1-2, 10-14, 17
A		3-9, 15-16, 18-25
Y	US 2015-0349857 A1 (CARLOS CORDEIRO et al.) 03 December 2015 See paragraphs [0012]-[0020]; and figure 1.	1-2, 10-14, 17
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A	WO 2016-146767 A1 (CANON EUROPE LIMITED et al.) 22 September 2016 See pages 20-21; claims 1-3; and figure 8.	1-25
A	US 2014-0079016 A1 (YUYING DAI et al.) 20 March 2014 See paragraphs [0005], [0104]-[0108]; and figure 4.	1-25



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

13 October 2017 (13.10.2017)

Date of mailing of the international search report

13 October 2017 (13.10.2017)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

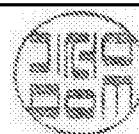


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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2017/024950

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