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[Continued on next page]

- (54) **Title:** SIXTY GIGAHERTZ BAND SUPPORT IN CELLULAR AND WIRELESS LOCAL AREA NETWORK AGGREGATION

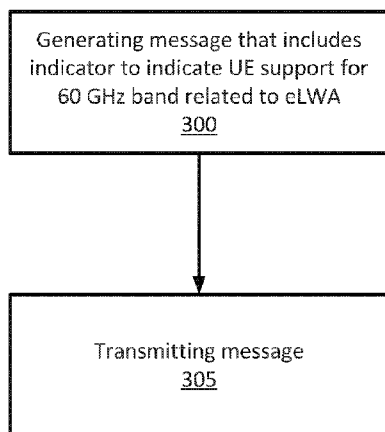


Figure 3

(57) **Abstract:** Embodiments of the present disclosure relate to support of a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) - wireless local area network (WLAN) Aggregation (eLWA). Some embodiments may relate to mechanisms by which a user equipment (UE) can signal support of the 60 GHz band. Other embodiments may relate to mechanisms by which an evolved NodeB (eNB) can signal information to the UE related to the 60 GHz band. Other embodiments may be described and/or claimed.



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SIXTY GIGAHERTZ BAND SUPPORT IN CELLULAR AND WIRELESS LOCAL AREA NETWORK AGGREGATION

Cross Reference to Related Applications

The present application claims priority to U.S. Provisional Patent Application Ser.
5 No. 62/314,246, entitled 60GHZ-LWA SUPPORT: UE CAPABILITY,
MEASUREMENT, BAND INDICATOR, filed March 28, 2016, which is herein
incorporated by reference in its entirety.

Field

Embodiments of the present disclosure generally relate to the field of wireless band
10 support, and more particularly to 60 Gigahertz (GHz) band support in cellular and wireless
local area network (WLAN) aggregation.

Background

Long Term Evolution (LTE) and WiFi Link Aggregation (LWA) or enhanced
LWA (eLWA) present an alternative for LTE and WLAN interworking. Generally, an
15 evolved NodeB (eNB) may schedule packets to be served to a user equipment (UE) or
other mobile device on one or both of an LTE link and a WLAN link. eLWA may provide
increased control and utilization of radio resources on both the LTE link and the WLAN
link, which in turn can increase throughput and management of radio resources.

Of interest with respect to eLWA is support of a 60 GHz band and channels and
20 increased data rates for various WLAN networks.

Brief Description of the Drawings

Embodiments will be readily understood by the following detailed description
in conjunction with the accompanying drawings. To facilitate this description, like
reference numerals designate like structural elements. Embodiments are illustrated by way
25 of example and not by way of limitation in the figures of the accompanying drawings.

Figure 1 illustrates an example electronic device, in accordance with various
embodiments.

Figure 2 illustrates an example eLWA network, in accordance with various
embodiments.

30 Figure 3 illustrates an example process, in accordance with various embodiments.

Figure 4 illustrates an alternative example process, in accordance with various
embodiments.

Figure 5 illustrates an alternative example process, in accordance with various embodiments.

Figure 6 illustrates an example computer system that may be used to practice various embodiments.

5 Figure 7 illustrates an example computer-readable media in accordance with some embodiments.

Figure 8 illustrates an example computing device in accordance with various embodiments herein.

Detailed Description

10 In the following detailed description, reference is made to the accompanying drawings, which form a part hereof wherein like numerals designate like parts throughout, and in which is shown by way of illustration embodiments that may be practiced. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present disclosure.

15 Various operations may be described as multiple discrete actions or operations in turn, in a manner that is most helpful in understanding the claimed subject matter. However, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations may not be performed in the order of presentation. Operations described may be performed in a
20 different order than the described embodiment. Various additional operations may be performed or described operations may be omitted in additional embodiments.

For the purposes of the present disclosure, the phrases “A or B,” “A and/or B,” and “A/B” mean (A), (B), or (A and B).

25 The description may use the phrases “in an embodiment,” or “in embodiments,” which may each refer to one or more of the same or different embodiments. Furthermore, the terms “comprising,” “including,” “having,” and the like, as used with respect to embodiments of the present disclosure, are synonymous.

30 As used herein, the term “circuitry” may refer to, be part of, or include an Application Specific Integrated Circuit (ASIC), 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 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.

As noted above, of interest with respect to eLWA is support of a 60 GHz band and channels and increased data rates for various WLAN networks. For example, such channels may be used in measurements related to the 60 GHz band. Embodiments herein may relate to various techniques that may provide support for the 60 GHz band. For example, embodiments may relate to techniques by which a UE may indicate that it supports the 60 GHz band. Other embodiments may relate to a measurement framework that may be used by the UE for measurement and reporting of parameters related to the 60 GHz band. Other embodiments may relate to support for a WLAN mobility set. Each of these embodiments is described in further detail below.

Embodiments described herein may be implemented into a system using any suitably configured hardware and/or software. Figure 1 illustrates, for one embodiment, example components of an electronic device 100. In embodiments, the electronic device 100 may be, implement, be incorporated into, or otherwise be a part of a user equipment (UE), an evolved NodeB (eNB), a WLAN access point (AP), or some other electronic device. In some embodiments, the electronic device 100 may include application circuitry 102, baseband circuitry 104, radio frequency (RF) circuitry 106, front-end module (FEM) circuitry 108 and one or more antennas 110, coupled together at least as shown.

The application circuitry 102 may include one or more application processors. For example, the application circuitry 102 may include circuitry such as, but not limited to, one or more single-core or multi-core processors. The processor(s) may include any combination of general-purpose processors and dedicated processors (e.g., graphics processors, application processors, etc.). The processors may be coupled with and/or may include memory/storage and may be configured to execute instructions stored in the memory/storage to enable various applications and/or operating systems to run on the system.

The baseband circuitry 104 may include circuitry such as, but not limited to, one or more single-core or multi-core processors. The baseband circuitry 104 may include one or more baseband processors and/or control logic to process baseband signals received from a receive signal path of the RF circuitry 106 and to generate baseband signals for a transmit signal path of the RF circuitry 106. Baseband circuitry 104 may interface with the application circuitry 102 for generation and processing of the baseband signals and for controlling operations of the RF circuitry 106. For example, in some embodiments, the

baseband circuitry 104 may include a second generation (2G) baseband processor 104a, third generation (3G) baseband processor 104b, fourth generation (4G) baseband processor 104c, and/or other baseband processor(s) 104d for other existing generations, generations in development or to be developed in the future (e.g., fifth generation (5G), 6G, etc.). The baseband circuitry 104 (e.g., one or more of baseband processors 104a-d) may handle various radio control functions that enable communication with one or more radio networks via the RF circuitry 106. The radio control functions may include, but are not limited to, signal modulation/demodulation, encoding/decoding, radio frequency shifting, etc. In some embodiments, modulation/demodulation circuitry of the baseband circuitry 104 may include Fast-Fourier Transform (FFT), precoding, and/or constellation mapping/demapping functionality. In some embodiments, encoding/decoding circuitry of the baseband circuitry 104 may include convolution, tail-biting convolution, turbo, Viterbi, and/or Low Density Parity Check (LDPC) encoder/decoder functionality. Embodiments of modulation/demodulation and encoder/decoder functionality are not limited to these examples and may include other suitable functionality in other embodiments.

In some embodiments, the baseband circuitry 104 may include elements of a protocol stack such as, for example, elements of an evolved universal terrestrial radio access network (EUTRAN) protocol including, for example, physical (PHY), media access control (MAC), radio link control (RLC), packet data convergence protocol (PDCP), and/or radio resource control (RRC) elements. A central processing unit (CPU) 104e of the baseband circuitry 104 may be configured to run elements of the protocol stack for signaling of the PHY, MAC, RLC, PDCP and/or RRC layers. In some embodiments, the baseband circuitry may include one or more audio digital signal processor(s) (DSP) 104f. The audio DSP(s) 104f may include elements for compression/decompression and echo cancellation and may include other suitable processing elements in other embodiments.

The baseband circuitry 104 may further include memory/storage 104g. The memory/storage 104g may be used to load and store data and/or instructions for operations performed by the processors of the baseband circuitry 104. Memory/storage for one embodiment may include any combination of suitable volatile memory and/or non-volatile memory. The memory/storage 104g may include any combination of various levels of memory/storage including, but not limited to, read-only memory (ROM) having embedded software instructions (e.g., firmware), random access memory (e.g., dynamic

random access memory (DRAM)), cache, buffers, etc. The memory/storage 104g may be shared among the various processors or dedicated to particular processors.

Components of the baseband circuitry may be suitably combined in a single chip, a single chipset, or disposed on a same circuit board in some embodiments. In some
5 embodiments, some or all of the constituent components of the baseband circuitry 104 and the application circuitry 102 may be implemented together such as, for example, on a system on a chip (SOC).

In some embodiments, the baseband circuitry 104 may provide for communication compatible with one or more radio technologies. For example, in some
10 embodiments, the baseband circuitry 104 may support communication with an evolved universal terrestrial radio access network (EUTRAN) and/or other wireless metropolitan area networks (WMAN), a wireless local area network (WLAN), a wireless personal area network (WPAN). Embodiments in which the baseband circuitry 104 is configured to support radio communications of more than one wireless protocol may be referred to as
15 multi-mode baseband circuitry.

RF circuitry 106 may enable communication with wireless networks using modulated electromagnetic radiation through a non-solid medium. In various embodiments, the RF circuitry 106 may include switches, filters, amplifiers, etc. to facilitate the communication with the wireless network. RF circuitry 106 may include a
20 receive signal path which may include circuitry to down-convert RF signals received from the FEM circuitry 108 and provide baseband signals to the baseband circuitry 104. RF circuitry 106 may also include a transmit signal path which may include circuitry to up-convert baseband signals provided by the baseband circuitry 104 and provide RF output signals to the FEM circuitry 108 for transmission.

In some embodiments, the RF circuitry 106 may include a receive signal path and a transmit signal path. The receive signal path of the RF circuitry 106 may include mixer circuitry 106a, amplifier circuitry 106b and filter circuitry 106c. The transmit signal path of the RF circuitry 106 may include filter circuitry 106c and mixer circuitry 106a. RF circuitry 106 may also include synthesizer circuitry 106d for synthesizing a frequency for
25 use by the mixer circuitry 106a of the receive signal path and the transmit signal path. In some embodiments, the mixer circuitry 106a of the receive signal path may be configured to down-convert RF signals received from the FEM circuitry 108 based on the synthesized frequency provided by synthesizer circuitry 106d. The amplifier circuitry 106b may be configured to amplify the down-converted signals and the filter circuitry 106c may be a

low-pass filter (LPF) or band-pass filter (BPF) configured to remove unwanted signals from the down-converted signals to generate output baseband signals. Output baseband signals may be provided to the baseband circuitry 104 for further processing. In some embodiments, the output baseband signals may be zero-frequency baseband signals, although this is not a requirement. In some embodiments, mixer circuitry 106a of the receive signal path may comprise passive mixers, although the scope of the embodiments is not limited in this respect.

In some embodiments, the mixer circuitry 106a of the transmit signal path may be configured to up-convert input baseband signals based on the synthesized frequency provided by the synthesizer circuitry 106d to generate RF output signals for the FEM circuitry 108. The baseband signals may be provided by the baseband circuitry 104 and may be filtered by filter circuitry 106c. The filter circuitry 106c may include a low-pass filter (LPF), although the scope of the embodiments is not limited in this respect.

In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a of the transmit signal path may include two or more mixers and may be arranged for quadrature downconversion and/or upconversion respectively. In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a of the transmit signal path may include two or more mixers and may be arranged for image rejection (e.g., Hartley image rejection). In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a of the transmit signal path may be arranged for direct downconversion and/or direct upconversion, respectively. In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a of the transmit signal path may be configured for super-heterodyne operation.

In some embodiments, the output baseband signals and the input baseband signals may be analog baseband signals, although the scope of the embodiments is not limited in this respect. In some alternate embodiments, the output baseband signals and the input baseband signals may be digital baseband signals. In these alternate embodiments, the RF circuitry 106 may include analog-to-digital converter (ADC) and digital-to-analog converter (DAC) circuitry and the baseband circuitry 104 may include a digital baseband interface to communicate with the RF circuitry 106.

In some dual-mode embodiments, a separate radio IC circuitry may be provided for processing signals for each spectrum, although the scope of the embodiments is not limited in this respect.

In some embodiments, the synthesizer circuitry 106d may be a fractional-N synthesizer or a fractional $N/N+1$ synthesizer, although the scope of the embodiments is not limited in this respect as other types of frequency synthesizers may be suitable. For example, synthesizer circuitry 106d may be a delta-sigma synthesizer, a frequency multiplier, or a synthesizer comprising a phase-locked loop with a frequency divider.

The synthesizer circuitry 106d may be configured to synthesize an output frequency for use by the mixer circuitry 106a of the RF circuitry 106 based on a frequency input and a divider control input. In some embodiments, the synthesizer circuitry 106d may be a fractional $N/N+1$ synthesizer.

In some embodiments, frequency input may be provided by a voltage controlled oscillator (VCO), although that is not a requirement. Divider control input may be provided by either the baseband circuitry 104 or the application circuitry 102 depending on the desired output frequency. In some embodiments, a divider control input (e.g., N) may be determined from a look-up table based on a channel indicated by the application circuitry 102.

Synthesizer circuitry 106d of the RF circuitry 106 may include a divider, a delay-locked loop (DLL), a multiplexer and a phase accumulator. In some embodiments, the divider may be a dual modulus divider (DMD) and the phase accumulator may be a digital phase accumulator (DPA). In some embodiments, the DMD may be configured to divide the input signal by either N or $N+1$ (e.g., based on a carry out) to provide a fractional division ratio. In some example embodiments, the DLL may include a set of cascaded, tunable, delay elements, a phase detector, a charge pump and a D-type flip-flop. In these embodiments, the delay elements may be configured to break a VCO period up into N_d equal packets of phase, where N_d is the number of delay elements in the delay line. In this way, the DLL provides negative feedback to help ensure that the total delay through the delay line is one VCO cycle.

In some embodiments, synthesizer circuitry 106d may be configured to generate a carrier frequency as the output frequency, while in other embodiments, the output frequency may be a multiple of the carrier frequency (e.g., twice the carrier frequency, four times the carrier frequency) and used in conjunction with quadrature generator and divider circuitry to generate multiple signals at the carrier frequency with multiple different phases with respect to each other. In some embodiments, the output frequency may be a LO frequency (f_{LO}). In some embodiments, the RF circuitry 106 may include an IQ/polar converter.

FEM circuitry 108 may include a receive signal path which may include circuitry configured to operate on RF signals received from one or more antennas 110, amplify the received signals and provide the amplified versions of the received signals to the RF circuitry 106 for further processing. FEM circuitry 108 may also include a transmit signal path which may include circuitry configured to amplify signals for transmission provided by the RF circuitry 106 for transmission by one or more of the one or more antennas 110.

In some embodiments, the FEM circuitry 108 may include a TX/RX switch to switch between transmit mode and receive mode operation. The FEM circuitry may include a receive signal path and a transmit signal path. The receive signal path of the FEM circuitry may include a low-noise amplifier (LNA) to amplify received RF signals and provide the amplified received RF signals as an output (e.g., to the RF circuitry 106). The transmit signal path of the FEM circuitry 108 may include a power amplifier (PA) to amplify input RF signals (e.g., provided by RF circuitry 106), and one or more filters to generate RF signals for subsequent transmission (e.g., by one or more of the one or more antennas 110).

In some embodiments, the electronic device 100 may include additional elements such as, for example, memory/storage, display, camera, sensor, and/or input/output (I/O) interface.

Figure 2 illustrates an example eLWA network 200. Specifically, the eLWA network 200 may include an eNB 215 and a WLAN AP 225. The eLWA network 200 may further include a UE 220. In embodiments, the eNB 215, the WLAN AP 225, and/or the UE 220 may be the electronic device 100, described above.

As shown in Figure 2, the eNB 215 may include a cellular service area 205. Specifically, the eNB 215 may be able to send and/or receive cellular signals to or from one or more UEs within the cellular service area 205. The cellular signals may be, for example, long term evolution (LTE) signals in accordance with third generation partnership project (3GPP) specifications, or some other cellular signals.

Similarly, the WLAN AP 225 may include a WLAN service area 210. The WLAN AP 225 may be able to send and/or receive WLAN signals to or from one or more UEs within the WLAN service area 210. The WLAN signals may be, for example, Wi-Fi signals in accordance with the Institute of Electrical and Electronics Engineers (IEEE) 802.11 specifications.

As shown in Figure 2, a UE such as UE 220 may be within both the cellular service area 205 and the WLAN service area 210. In these embodiments, the UE 220 may

be able to send and/or receive signals from both the eNB 215 and the WLAN AP 225. As noted above, the eNB 215 and the WLAN AP 225 may be communicatively coupled through a link such as link 230. In embodiments, the link 230 may be wired, wireless, or some combination thereof. The eNB 215 may schedule one or more packets to be served to the UE 220 via the WLAN AP 225.

UE Capabilities

UE capability signaling may be enhanced so that a UE such as UE 220 may indicate to a network node such as eNB 215 that the UE supports the 60 GHz band. Specifically, as depicted in the process shown in Figure 3, baseband circuitry such as baseband circuitry 104 may be to generate a message that includes an information element (IE) with an indicator to indicate that the UE supports the 60 GHz band at 300. RF circuitry such as RF circuitry 106 may be to transmit the message to the network node such as the eNB 215 at 305.

Below are some embodiments by which the UE may be able to indicate its capability to support the 60 GHz band. It will be understood that the below embodiments are merely intended as non-limiting examples, and other embodiments may include slight non-substantive variations such as the specific names of various IEs or indicators. Additionally, some embodiments may include combinations of the below embodiments.

Embodiment 1

In a first embodiment, the UE capability signaling may be performed through an alteration to a WLAN Band Indicator IE. Specifically, an indicator such as a band60 indicator may be introduced to an existing WLAN Band Indicator IE such as the WLAN-BandIndicator-r13 IE. Example language of such an addition to the 3GPP technical specification (TS) 36.331 may be as follows. Additions to the TS are indicated by ***bold, italics, and underline***. This formatting style will be followed throughout the remainder of this document to indicate possible additions to the TS 36.331.

```
-- ASN1START
IRAT-ParametersWLAN-r13 ::=          SEQUENCE {
    supportedBandListWLAN-r13          SEQUENCE (SIZE (1 . .
maxWLAN-Bands-r13)) OF WLAN-BandIndicator-r13)  OPTIONAL
}
```

```
WLAN-BandIndicator-r13 ::= ENUMERATED {band2dot4, band5, band60, spare5,
spare4, spare3, spare2, spare1}
```

```
-- ASN1STOP
```

A field description for the MeasObjectWLAN field of the bandIndicatorListWLAN may be revised as follows:

MeasObjectWLAN field descriptions
bandIndicatorListWLAN Includes the list of WLAN bands where the value band2dot4 indicates the 2.4 GHz band; the value band5 indicates the 5 GHz band; <u>the value band60 indicates the 60 GHz band.</u>

- 5 In some embodiments, the WLAN-BandIndicator-r13 IE may be an element of a UE evolved universal terrestrial radio access (EUTRA) Capability IE such as a UE-EUTRA-Capability IE. Specifically, the WLAN-BandIndicator-r13 IE may be an element of a supportedBandListWLAN IE in the UE-EUTRA-Capability IE as follows:

IRAT-ParametersWLAN-r13 ::=	SEQUENCE {
supportedBandListWLAN-r13	SEQUENCE (SIZE (1..maxWLAN-
Bands-r13)) OF WLAN-BandIndicator-r13	OPTIONAL
}	

10 Embodiment 2

In a second embodiment, the UE capability signaling may be performed through the addition of a new capability bit to support 60 GHz. Specifically, the new capability bit may be introduced to a UE EUTRA Capability IE such as a UE-EUTRA-Capability IE.

The capability bit may be a WLAN 60 GHz bit such as wlan-60GHz-r14. This

- 15 embodiment may be desirable if the WLAN-BandIndicator-r13 IE discussed above is not extendable. An example alteration to the TS 36.331 may be as follows:

<u>UE-EUTRA-Capability-vxxx-IEs ::= SEQUENCE {</u>		
<u>wlan-60GHz-r14</u>	<u>ENUMERATED (supported)</u>	<u>OPTIONAL</u>
<u>nonCriticalExtensions</u>	<u>SEQUENCE{</u>	<u>OPTIONAL</u>
<u>}</u>		

Embodiment 3

In a third embodiment, the UE capability signaling may be performed through the use of a new inter-radio access technology (IRAT) Parameters IE such as an IRAT-ParametersWLAN-r14 IE. In this embodiment, the indicator may be or include a supported band list indicator such as a supportedBandList60GHz-r14 indicator. An example alteration to the TS 36.331 may be as follows:

<u>IRAT-ParametersWLAN-r14 ::= SEQUENCE {</u>		
<u>supportedBandList60GHz-r14</u>	<u>ENUMERATED {supported}</u>	<u>OPTIONAL</u>
<u>nonCriticalExtension</u>	<u>SEQUENCE{</u>	
<u>}</u>		

Embodiment 4

In some embodiments, it may be desirable to allow a UE to indicate that it has the capability to roam between legacy WLAN bands and the 60 GHz band. As used in this instance, roaming may refer to the capability for the UE to switch from using a legacy WLAN band to the 60 GHz band, or vice-versa. In some embodiments, such a capability may be signaled through a UE EUTRA Capability IE such as a UE-EUTRA-Capability-vxxx-IEs IE. In some embodiments, the IE may include an indicator that indicates whether the UE supports the roaming. The indicator may be, for example, a WLAN 60 GHz roaming indicator such as a wlan-60GHz-roaming-r14 indicator. An example alteration to the TS 36.331 may be as follows:

<u>UE-EUTRA-Capability-vxxx-IEs ::= SEQUENCE {</u>		
<u>wlan-60GHz-r14</u>	<u>ENUMERATED {supported}</u>	
<u>wlan-60GHz-roaming-r14</u>	<u>ENUMERATED {supported}</u>	
<u>nonCriticalExtension</u>	<u>SEQUENCE{</u>	<u>OPTIONAL</u>
<u>}</u>		

Measurement Framework

In some embodiments, it may be desirable for a network node such as eNB 215 to provide an indicator in one or more measurement configurations and/or reporting IEs. The UE may then perform measurement and reporting of parameters related to the 60 GHz band based on the indicator. Specifically, as shown in the process depicted in Figure 4, in some embodiments baseband circuitry such as baseband circuitry 104 may be to identify that a UE is to use the 60 GHz band at 400 and generate a message that includes an indicator that the UE is to use the 60 GHz band at 405. RF circuitry such as RF circuitry 106 may be to transmit the message to the UE at 410. The UE may then perform one or more measurements of the 60 GHz band based on the indicator.

Below are some embodiments by which the network may provide the indicator to a UE. It will be understood that the below embodiments are merely intended as non-limiting examples, and other embodiments may include slight non-substantive variations such as the specific names of various IEs or indicators. Additionally, some embodiments may include combinations of the below embodiments.

Embodiment 1

In some embodiments, the indicator may be an indicator of a WLAN Band Indicator IE such as a WLAN-BandIndicator-r13 IE. In this embodiment, the indicator may be a band60 indicator. An example alteration to TS 36.331 may be as follows:

WLAN-BandIndicator-r13 ::= ENUMERATED {band2dot4, band5, band60, spare5, spare4, spare3, spare2, spare1}

Embodiment 2

In some embodiments, the indicator may be an indicator of a WLAN Band Indicator IE such as a WLAN-BandIndicator-r14 IE. In this embodiment, the indicator may be one or more of the indicators contained with the IE, and in some embodiments may include a band60 indicator. An example alteration to TS 36.331 to support such an IE may be as follows:

```

--ASN1START

MeasObjectWLAN-r14 ::= SEQUENCE {
    bandIndicatorListWLAN-r14 SEQUENCE (SIZE (1..maxWLAN-Bands-
r13)) OF WLAN-BandIndicator-r14,
    carrierInfoListWLAN-r14 SEQUENCE (SIZE (1..maxWLAN-
CarrierInfo-r13)) OF WLAN-CarrierInfo-r14
    { OPTIONAL, --Need ON
    wlan-ToAddModList-r14 WLAN-ID-List-r14 OPTIONAL, --Need
ON
    wlan-ToRemoveList-r14 WLAN-ID-List-r14 OPTIONAL, --Need
ON
    }
}

WLAN-BandIndicator-r14 ::= ENUMERATED {band60, spare1}

--ASN1STOP

```

A field description for the MeasObjectWLAN field of the bandIndicatorListWLAN may be revised as follows:

MeasObjectWLAN field descriptions
bandIndicatorListWLAN Includes the list of WLAN bands where the value band2dot4 indicates the 2.4 GHz band; the value band5 indicates the 5 GHz band; <u>the value band60 indicates the 60 GHz band.</u>

- 5 In some embodiments, the message transmitted from the eNB to the UE may further include an IRAT Parameters IE related to the WLAN Band Indicator IE. The IRAT Parameters IE may be, for example, an IRAT-ParametersWLAN-r14 IE that may be used to support the WLAN Band Indicator IE. An example alteration to TS 36.331 to support such an IE may be as follows:

```

...
IRAT-ParametersWLAN-r14 ::= SEQUENCE (
    supportedBandListWLAN-r14 SEQUENCE (SIZE (1..maxWLAN-Bands-
r13)) OF WLAN-BandIndicator-r14 OPTIONAL
;
...

```

In some embodiments, the UE may provide an indication of the measurement results related to the 60 GHz band. The indication of the measurement may include a WLAN Band indicator such as a bandWLAN-r14 indicator. An example alteration to TS

5 36.331 to support such an indicator may be as follows:

MeasResultListWLAN-r13 ::= SEQUENCE (SIZE (1..maxCellReport)) OF
MeasResultWLAN-r13

MeasResultWLAN-r13 ::= (SEQUENCE {

wlan-Identifiers-r13	WLAN-Identifiers-r12,
carrierInfoWLAN-r13	WLAN-CarrierInfo-r13
OPTIONAL,	
bandWLAN-r13	WLAN-BandIndicator-r13
OPTIONAL,	
rssIWLAN-r13	WLAN-RSSI-Range-r13,
availableAdmissionCapacityWLAN-r13	INTEGER (0..31250)
OPTIONAL,	
backhaulDL-BandwidthWLAN-r13	WLAN-backhaulRate-r12
OPTIONAL,	
backhaulUL-BandwidthWLAN-r13	WLAN-backhaulRate-r12
OPTIONAL,	
channelUtilizationWLAN-r13	INTEGER (0..255)
OPTIONAL,	
stationCountWLAN-r13	INTEGER (0..65535)
OPTIONAL,	
connectedWLAN-r13	ENUMERATED {true}
OPTIONAL,	
...	
<u>bandWLAN-r14</u>	<u>WLAN-BandIndicator-r14</u>
<u>OPTIONAL,</u>	

}

Channel Numbers, Operating Class, and Country Code for 60 GHz

In some embodiments, it may be desirable for a network node such as eNB 215 to
5 provide to a UE such as UE 220 an indicator related to transmission parameters of the 60
GHz band. Such transmission parameters may include one or more of a channel number,
an operating class, and a country code related to the 60 GHz band. Specifically, returning

to Figure 4, in some embodiments baseband circuitry such as baseband circuitry 104 may be to identify that a UE is to use the 60 GHz band at 400 and generate a message that includes an indicator that the UE is to use the 60 GHz band at 405. RF circuitry such as RF circuitry 106 may be to transmit the message to the UE at 410. The message may
5 include an indicator related to the transmission parameters.

Below are some embodiments by which the NW may provide the indicator to a UE. It will be understood that the below embodiments are merely intended as non-limiting examples, and other embodiments may include slight non-substantive variations such as the specific names of various IEs or indicators. Additionally, some embodiments may
10 include combinations of the below embodiments.

Embodiment 1

In some embodiments, the indicator related to the transmission parameters may be an indicator of a WLAN carrier IE such as a WLAN-CarrierInfo-r13 IE. In this
15 embodiment, the indicator related to the transmission parameters may be a 60 GHz indicator such as a 60GHzIndicator of the IE. An example alteration to TS 36.331 to support such an indicator may be as follows:

```

-- ASN1START

WLAN-CarrierInfo-r13 ::= SEQUENCE (
    operatingClass-r13          INTEGER (0..255)          OPTIONAL,  -- Need
ON
    countryCode-r13            ENUMERATED {United States, Europe, japan,
global, korea, ...}          OPTIONAL,  -- Need ON
    channelNumbers-r13         WLAN-ChannelList-r13       OPTIONAL,  -- Need
ON
    ...
    60GHzIndicator            ENUMERATED {true},      OPTIONAL, --
NEED OR
}

WLAN-ChannelList-r13 ::= SEQUENCE (SIZE (1..maxWLAN-Channels-r13)) OF
WLAN-Channel-r13

WLAN-Channel-r13 ::=      INTEGER (0..255)

--ASN1STOP

```

Embodiment 2

In some embodiments, the indicator related to the transmission parameters may be an indicator of a 60 GHz Channel Numbers IE such as a 60GHzChannelNumbers-r14 IE or an indicator of a 60 GHz Channel IE such as a 60GHz-Channel-r14 IE. In some

5 embodiments, as denoted by the “r14” at the end of the IE name, the 60 GHz Channel Numbers IE or the 60 GHz Channel IE may be release 14 (r14) IEs. An example alteration to TS 36.331 to support such an indicator may be as follows:

-- ASN1START

```

WLAN-CarrierInfo-r13 ::= SEQUENCE (
    operatingClass-r13          INTEGER (0..255)          OPTIONAL,  -- Need
ON
    countryCode-r13            ENUMERATED {United States, Europe, japan,
global, korea, ...}          OPTIONAL,  -- Need ON
    channelNumbers-r13         WLAN-ChannelList-r13       OPTIONAL,  -- Need
ON
    ...
    60GHzChannelNumbers-r14    6-GHz-ChannelList-r14,,  OPTIONAL,
--NEED ON
}

```

```

WLAN-ChannelList-r13 ::= SEQUENCE (SIZE (1..maxWLAN-Channels-r13)) OF
WLAN-Channel-r13

```

```

WLAN-Channel-r13 ::= INTEGER (0..255)

```

60GHzChannelNumbers-r14 ::= SEQUENCE (SIZE (1..4)) OF 60GHz-Channel-r14

60GHz-Channel-r14 ::= INTEGER (1..4)

--ASN1STOP

Embodiment 3

In some embodiments, the transmission parameters may be a channel number and/or operating class related to the 60 GHz band in an IE related to 60 GHz carrier information such as a 60GHz-CarrierInfo-r14 IE. Such an IE may be useful if a WLAN Carrier Information IE such as WLAN-CarrierInfo is to support communication using the 60 GHz band. In some embodiments, the WLAN network may also choose to support the 60 GHz band using a legacy reserved operating class.

An example alteration to TS 36.331 to support such the above described 60 GHz carrier information IE may be as follows:

```
-- ASNISTART

60 GHz-CarrierInfo-r14 ::= SEQUENCE {
    operatingClass-r14          INTEGER (0..255)          OPTIONAL, -- Need
ON
    countryCode-r14          ENUMERATED {unitedStates, europe, japan,
korea, australia, ...}          OPTIONAL, -- Need ON
    channelNumbers-r13      60GHz-ChannelList-r14      OPTIONAL, --Need
ON
    ...
}

60GHz-ChannelList-r14 ::= SEQUENCE (SIZE (1..maxWLAN-Channels-r13)) OF
60GHz-Channel-r14

60GHz-Channel-r14 ::= INTEGER (1..4)

-- ASNISTOP
```

10

The 60GHz-Identifiers field descriptions may be further revised as depicted below:

<u>60GHz-Identifiers field descriptions</u>
<u>channelNumbers</u> <u>Indicates the WLAN channels as defined in 60 GHz.</u>
<u>countryCode</u> <u>Indicates the country code of WLAN as defined in 60 GHz.</u>

operatingClass**Indicates the Operating Class of WLAN as defined in 60 GHz.****Embodiment 4**

In some embodiments, the indicator related to the transmission parameters may be a WLAN band indicator related to the 60 GHz band such as wlanBandIndicator-r14. In

5 embodiments, the WLAN band indicator related to the 60 GHz band may be related to or based on a WLAN band indicator related to the legacy WLAN band such as WLAN-BandIndicator-r13. An example alteration to TS 36.331 is depicted below:

```
-- ASN1START

WLAN-CarrierInfo-r13 ::= SEQUENCE (
    operatingClass-r13          INTEGER (0..255)          OPTIONAL, -- Need
ON
    countryCode-r13            ENUMERATED {United States, Europe, japan,
global, ... }          OPTIONAL, -- Need ON
    channelNumbers-r13         WLAN-ChannelList-r13      OPTIONAL, -- Need
ON
    ...
    wlanBandIndicator-r14      WLAN-BandIndicator-r13,  OPTIONAL, --
Need ON
}

WLAN-ChannelList-r13 ::= SEQUENCE (SIZE (1..maxWLAN-Channels-r13)) OF
WLAN-Channel-r13

WLAN-Channel-r13 ::= INTEGER (0..255)

--ASN1STOP
```

Embodiment 5

10 In some embodiments, it may be desirable to force the signal of the channel together with the operating class in a WLAN Carrier Information IE such as WLAN-

CarrierInfo-r13. This may be desirable because, for example, some channel numbers may be overlapped with the same operating class, therefore, to get a unique channel number of a specific band, the operating class may be used. In some embodiments, this may be accomplished by making an operating class indicator such as operatingClass-r13

5 conditional on a channel number indicator such as chanNum as described below.

Specifically, one example alteration to TS 36.331 to support the conditional indicator may be as follows:

```
-- ASN1START

WLAN-CarrierInfo-r13 ::= SEQUENCE (
    operatingClass-r13          INTEGER (0..255)          OPTIONAL,  -- Cond
    chanNum
    countryCode-r13            ENUMERATED {United States, Europe, japan,
global, . . .}              OPTIONAL, -- Need ON
    channelNumbers-r13         WLAN-ChannelList-r13      OPTIONAL, -- Need
ON
}

WLAN-ChannelList-r13 ::= SEQUENCE (SIZE (1..maxWLAN-Channels-r13)) OF
WLAN-Channel-r13

WLAN-Channel-r13 ::= INTEGER (0..255)

--ASN1STOP
```

Embodiment 6

10 In some embodiments, the indicator related to the transmission parameters may be a WLAN band indicator related to the 60 GHz band such as globalOperatingClass-r14. In embodiments, the globalOperatingClass-r14 indicator may uniquely identify any band in any frequency. An example alteration to TS 36.331 is depicted below:

```

--ASN1START

WLAN-CarrierInfo-r13 ::= SEQUENCE (
    operatingClass-r13          INTEGER (0..255)          OPTIONAL,
-- Need ON
    countryCode-r13            ENUMERATED {United States, Europe, japan,
global, ... }                OPTIONAL, -- Need ON
    channelNumbers-r13         WLAN-ChannelList-r13       OPTIONAL, -
- Need ON
    ...
    globalOperatingClass-r14   INTEGER (0..N),   OPTIONAL, -- Need ON
}

WLAN-ChannelList-r13 ::= SEQUENCE (SIZE (1..maxWLAN-Channels-r13)) OF
WLAN-Channel-r13

WLAN-Channel-r13 ::= INTEGER (0..255)

--ASN1STOP

```

WLAN Mobility Set

A WLAN mobility set may be a list of WLAN APs such as WLAN AP 225 between which mobility of a UE such as UE 220 is supported. For example, a UE that is
5 configured with a mobility set may be able to select any WLAN AP within the mobility set and transmit or receive information to/from that WLAN AP without notifying the network. In embodiments, all WLAN APs within a given mobility set may be connected to the same WLAN termination node (WT).

In networks that support 60 GHz, two different scenarios may exist. A first
10 scenario might be one in which a WLAN network supports roaming between the legacy WLAN band and the 60 GHz band, in which case the mobility set may include a mixture of networks or APs that support the legacy WLAN band, the 60 GHz band, or both. A second scenario might be one in which the WLAN network does not support roaming

between the legacy WLAN band and the 60 GHz band, in which case the mobility set may include only networks or APs that support the legacy WLAN band or the 60 GHz band, but not both.

In embodiments in which the WLAN network does not support roaming between the legacy WLAN band and the 60 GHz band, the mobility set may include only APs that support the 60 GHz band. In these embodiments, it may be desirable for the network to indicate to the UE that the mobility set is only for APs that support the 60 GHz band. Such an indication may be used by the UE for example to reduce UE scanning time during mobility (i.e., the period in which the UE is attempting to connect to a new WLAN AP).

Below are some embodiments by which the NW may provide an indicator of the mobility set to a UE. For example, a network node such as eNB 215 may be able to provide to a UE such as UE 220 an indicator related to the mobility set. More specifically, as depicted in Figure 5, in some embodiments baseband circuitry such as baseband circuitry 104 may be to identify a mobility set of one or more APs that support the 60 GHz band at 500. RF circuitry such as RF circuitry 106 may then be to transmit, to the UE, a message that includes an indicator of the mobility set at 505.

It will be understood that the below embodiments are merely intended as non-limiting examples, and other embodiments may include slight non-substantive variations such as the specific names of various IEs or indicators. Additionally, some embodiments may include combinations of the below embodiments.

Embodiment 1

In some embodiments, the indicator of the mobility set may be an indicator of an LWA Configuration information element such as an LWA-Config-r13 IE. In these embodiments, the indicator may be, for example, a 60 GHz indicator such as a 60GhzIndicator or a 60 GHz Mobility Configuration indicator such as a 60GHz-MobilityConfig-r14 indicator. One example alteration to TS 36.331 to support the 60 GHz indicator may be as follows:

```

LWA-Config-r13 ::= SEQUENCE {
    lwa-MobilityConfig-r13    WLAN-MobilityConfig-r13  OPTIONAL, --Need
ON
    lwa-WT-Counter-r13       INTEGER (0..65535)         OPTIONAL, --Need
ON
    ...
    60GHzIndicator          ENUMERATED {true},      OPTIONAL, --Need
ON
}

```

An alternative example alteration to TS 36.331 to support the 60 GHz Mobility Configuration indicator may be as follows:

```

LWA-Config-r13 ::= SEQUENCE {
    lwa-MobilityConfig-r13    WLAN-MobilityConfig-r13  OPTIONAL, --Need
ON
    lwa-WT-Counter-r13       INTEGER (0..65535)         OPTIONAL, --Need
ON
    ...
    60GHz-MobilityConfig-r14 WLAN-MobilityConfig-r13 OPTIONAL, --Need
ON
}

```

5 Embodiment 2

In some embodiments, the indicator of the mobility set may be a bit in a mobility configuration IE such as WLAN-MobilityConfig-r13. Specifically, the indicator may be related to setting an indication of a “type” in a legacy mobility set. In this embodiment, the “type” may refer to whether the mobility set is related to a legacy WLAN band or the 60

10 GHz band. In this embodiment, the indicator may be a 60 GHz indicator such as 60GHzIndicator. One example alteration to TS 36.331 to support the 60 GHz indicator may be as follows:

```

--ASN1START
WLAN-MobilityConfig-r13 ::= SEQUENCE {
    wlan-ToReleaseList-r13    Wlan-Id-List-r13    OPTIONAL, --Need ON
    wlan-ToAddList-r13       Wlan-Id-List-r13    OPTIONAL, --Need ON
    associationTimer-r13      ENUMERATED {s10, s30, s60, s120, s240}
OPTIONAL, --Need ON
    successReportRequested    ENUMERATED {true},    OPTIONAL, --Need
ON
    ...
    60GHzIndicator           ENUMERATED {true},    OPTIONAL, --Need
OR
}
--ASN1STOP

```

The WLAN-MobilityConfig field descriptions may be revised as shown below:

<i>WLAN-MobilityConfig field descriptions</i>
<p><i>associationTimer</i></p> <p>Indicates the maximum time for connection to WLAN before connection failure reporting is initiated.</p>
<p><i>successReportRequested</i></p> <p>Indicates whether the UE should report successful connection to WLAN. Applicable to LWA and LWP.</p>
<p><i>wlan-ToAddList</i></p> <p>Indicates the WLAN identifiers to be added to the WLAN mobility set.</p>
<p><i>wlan-ToReleaseList</i></p> <p>Indicates the WLAN identifiers to be removed from the WLAN mobility set.</p>
<p><u>60GHzIndicator</u></p> <p><u>Indicates this is a mobility set for 60 GHz, if set to true.</u></p>

Embodiment 3

- 5 In some embodiments, the indicator of the mobility set may be an indicator in a WLAN Mobility Configuration IE such as WLAN-MobilityConfig-r13. In this

embodiment, the indicator may be one or both of a 60 GHz add or release list such as 60GHz-ToAddList-r14 and 60GHz-ToReleaseList-r14. One example alteration to TS 36.331 to support the 60 GHz indicator may be as follows:

```

--ASN1START

WLAN-MobilityConfig-r13 ::= SEQUENCE {
    wlan-ToReleaseList-r13  Wlan-Id-List-r13    OPTIONAL, --Need ON
    wlan-ToAddList-r13     Wlan-Id-List-r13    OPTIONAL, --Need ON
    associationTimer-r13   ENUMERATED {s10, s30, s60, s120, s24}
OPTIONAL, --Need ON
    successReportRequested ENUMERATED {true},   OPTIONAL, --Need
OR
    . . .
    60GHz-ToReleaseList-r14 Wlan-Id-List-r13    OPTIONAL, --Need ON
    60GHz-ToAddList-r14   Wlan-Id-List-r13    OPTIONAL, --Need ON
}

--ASN1STOP

```

5 Embodiments of the present disclosure may be implemented into a system using any suitable hardware and/or software to configure as desired. Figure 6 schematically illustrates an example computer system 600 that may be used to practice various embodiments described herein. Figure 6 illustrates, for one embodiment, an example computer system 600 having processor circuitry 604, system memory 608, 10 nonvolatile memory (NVM)/storage 612, and communication circuitry 616. The system 600 may further include interface circuitry 620 coupled to processor circuitry 604, system memory 608, NVM/storage 612, and communication circuitry 616 as shown.

15 In some embodiments, the system 600 may be capable of functioning as electronic device 100, a UE such as UE 220, a WLAN AP such as WLAN AP 225, an eNB such as eNB 215, or another device implementing the embodiments described herein.

 Interface circuitry 620 for one embodiment may include any suitable interface controllers and connectors to interconnect one or more of the processor circuitry 604, system memory 608, NVM/storage 612, and communication circuitry 616. The

interface controllers may include, but are not limited to, memory controllers, storage controllers (for example, redundant array of independent disk (RAID) controllers, baseboard management controllers (BMCs), input/output controllers, etc. The connectors may include, for example, busses (for example, peripheral component interconnect express (PCIe) busses), ports, slots, jumpers, interconnect modules, etc.).

The processor circuitry 604 may include any type or combination of configurable or non-configurable circuit that is designed to perform basic arithmetic, logical, control, or input/output operations specified by instructions of the computer program. The processor circuitry 604 may include one or more single-core or multi-core processors that operate as a clock-driven, register-based programmable electronic device that accepts digital data as input and processes it according to instructions stored in the system memory 608 and/or NVM/storage 612 in order to provide an output to enable operations described in various parts of the present description. The processor circuitry 604 may be coupled with the system memory 608 and/or NVM/storage 612 and configured to execute instructions stored therein to enable various applications or operating systems running on the system 600.

The processor circuitry 604 may include any combination of general-purpose processors and dedicated processors. In some embodiments, the processor circuitry 604 may include a central processing unit, an application processor, communication processor, microprocessor, ASIC, reduced instruction set computer (RISC), digital signal processor, DSP, co-processor, combinational logic circuit, controller (e.g., memory, bridge, bus, etc.), etc.

For one embodiment, at least some of the processor circuitry 604 may be packaged together with logic for one or more controller(s) of interface circuitry. For one embodiment, at least one of the processors of the processor circuitry 604 may be packaged together with logic for one or more controllers of the interface circuitry 620 to form a System in Package, SiP. For one embodiment, at least one of the processors of the processor circuitry 620 may be integrated on the same die with logic for one or more controllers of the interface circuitry 620 to form a System on Chip.

System memory 608 may be used to load and store data and/or instructions, for example, for the system 600. System memory 608 for one embodiment may include any suitable volatile memory, such as suitable DRAM or SRAM, for example. In some embodiments, the system memory 608 may include double data rate type four synchronous dynamic random-access memory (DDR4 SDRAM).

The NVM/storage 612 may be used to store data and/or instructions, for example. NVM/storage 612 may include any suitable non-volatile memory, such as flash memory, for example, and/or may include any suitable non-volatile storage device(s), such as one or more hard disk drive(s), HDD(s), one or more compact disc, CD, drive(s),

5 RAID(s), and/or one or more digital versatile disc, DVD, drive(s), for example.

The NVM/storage 612 may include a storage/memory resource physically part of a device on which the system 600 may be installed or it may be accessible by, but not necessarily a part of, the device. For example, the NVM/storage 600 may be accessed over a network via the communication circuitry 616.

10 Communication circuitry 616 may provide an interface for system 600 to communicate over one or more network(s) and/or with any other suitable device. The system 600 may communicate with the one or more components of a network in accordance with any of one or more network standards and/or protocols. In some embodiments, the communication circuitry 616 may provide signal processing according to the appropriate communication network protocols. For example, the communication
15 circuitry 616 may include an Ethernet controller that implements Ethernet protocols of, for example, 10 Gigabit Ethernet, 1000BASE-T, 100BASE-TX, or 10BASE-T standards.

Figure 7 illustrates an example computer-readable media 704 that may be suitable for use to store instructions that cause an apparatus, in response to execution of the
20 instructions by the apparatus, to practice selected aspects of the present disclosure. In some embodiments, the computer-readable media 704 may be non-transitory. As shown, computer-readable storage medium 704 may include programming instructions 708.

Programming instructions 708 may be configured to enable a device, for example, electronic device 100, a UE such as UE 220, a WLAN AP such as WLAN AP 225, an
25 eNB such as eNB 215, or another device, in response to execution of the programming instructions 708, to implement (aspects of) any of the methods or elements described throughout this disclosure related to VM monitoring and management. In some embodiments, programming instructions 708 may be disposed on computer-readable media 704 that is transitory in nature, such as signals.

30 Any combination of one or more computer-usable or computer-readable media may be utilized. The computer-usable or computer-readable media may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium. More specific examples (a non-exhaustive list) of the computer-readable media would include the following: an

electrical connection having one or more wires, a portable computer diskette, a hard disk, RAM, ROM, an erasable programmable read-only memory (for example, EPROM, EEPROM, or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a transmission media such as those supporting the Internet or an intranet, or a magnetic storage device. Note that the computer-usable or computer-readable media could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via, for instance, optical scanning of the paper or other medium, then compiled, interpreted, or otherwise processed in a suitable manner, if necessary, and then stored in a computer memory. In the context of this document, a computer-usable or computer-readable media may be any medium that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The computer-usable media may include a propagated data signal with the computer-usable program code embodied therewith, either in baseband or as part of a carrier wave. The computer-usable program code may be transmitted using any appropriate medium, including but not limited to wireless, wireline, optical fiber cable, radio frequency, etc.

Computer program code for carrying out operations of the present disclosure may be written in any combination of one or more programming languages, including an object oriented programming language such as Java, Smalltalk, C++ or the like and conventional procedural programming languages, such as the “C” programming language or similar programming languages. The program code may execute entirely on the user’s computer, partly on the user’s computer, as a stand-alone software package, partly on the user’s computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user’s computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider).

The present disclosure is described with reference to flowchart illustrations or block diagrams of methods, apparatus (systems) and computer program products according to embodiments of the disclosure. It will be understood that each block of the flowchart illustrations or block diagrams, and combinations of blocks in the flowchart illustrations or block diagrams, can be implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to

produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart or block diagram block or blocks.

5 These computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instruction means that implement the function/act specified in the flowchart or block diagram block or blocks.

10 The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions that execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified
15 in the flowchart or block diagram block or blocks.

 Figure 8 illustrates an example computing device 800 that may employ the apparatuses and/or techniques described herein. Specifically, the computing device may be the UE 220, the WLAN AP 225 and/or the eNB 215. As shown, computing device 800 may include a number of components, such as one or more
20 processor(s) 804 (one shown) and at least one communication chip 806.

 In various embodiments, the one or more processor(s) 804 each may include one or more processor cores. In various embodiments, the at least one communication chip 806 may be physically and electrically coupled to the one or more processor(s) 804. In further implementations, the communication chip 806 may be part of the one or more
25 processor(s) 804. In various embodiments, computing device 800 may include printed circuit board (PCB) 802. For these embodiments, the one or more processor(s) 804 and communication chip 806 may be disposed thereon. In alternate embodiments, the various components may be coupled without the employment of PCB 802.

 Depending on its applications, computing device 800 may include
30 other components that may or may not be physically and electrically coupled to the PCB 802. These other components include, but are not limited to, memory controller 826, volatile memory (e.g., dynamic random access memory (DRAM) 820), non-volatile memory such as read only memory (ROM) 824, flash memory 822, storage device 854 (e.g., a hard-disk drive (HDD)), an I/O controller 841, a digital signal processor (not

shown), a crypto processor (not shown), a graphics processor 830, one or more antenna 828, a display (not shown), a touch screen display 832, a touch screen controller 846, a battery 836, an audio codec (not shown), a video codec (not shown), a global positioning system (GPS) device 840, a compass 842, an accelerometer (not shown), a gyroscope (not shown), a speaker 850, a camera 852, and a mass storage device (such as hard disk drive, a solid state drive, compact disk (CD), digital versatile disk (DVD)) (not shown), and so forth.

In some embodiments, the one or more processor(s) 804, flash memory 822, and/or storage device 854 may include associated firmware (not shown) storing programming instructions configured to enable computing device 800, in response to execution of the programming instructions by one or more processor(s) 804, to practice all or selected aspects of the methods described herein. In various embodiments, these aspects may additionally or alternatively be implemented using hardware separate from the one or more processor(s) 804, flash memory 822, or storage device 854.

The communication chips 806 may enable wired and/or wireless communications for the transfer of data to and from the computing device 800. The term “wireless” and its derivatives may be used to describe circuits, devices, systems, methods, techniques, communications channels, etc., that may communicate data through the use of modulated electromagnetic radiation through a non-solid medium. The term does not imply that the associated devices do not contain any wires, although in some embodiments they might not. The communication chip 806 may implement any of a number of wireless standards or protocols, including but not limited to IEEE 802.11, Long Term Evolution (LTE), LTE Advanced (LTE-A), General Packet Radio Service (GPRS), Evolution Data Optimized (Ev-DO), Evolved High Speed Packet Access (HSPA+), Evolved High Speed Downlink Packet Access (HSDPA+), Evolved High Speed Uplink Packet Access (HSUPA+), Global System for Mobile Communications (GSM), Enhanced Data rates for GSM Evolution (EDGE), Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Digital Enhanced Cordless Telecommunications (DECT), Worldwide Interoperability for Microwave Access (WiMAX), Bluetooth, derivatives thereof, as well as any other wireless protocols that are designated as 3G, 4G, 5G, and beyond. The computing device 800 may include a plurality of communication chips 806. For instance, a first communication chip 806 may be

dedicated to shorter range wireless communications such as Wi-Fi and Bluetooth, and a second communication chip 806 may be dedicated to longer range wireless communications such as GPS, EDGE, GPRS, CDMA, WiMAX, LTE, Ev-DO, and others.

In various implementations, the computing device 800 may be a laptop,
5 a netbook, a notebook, an ultrabook, a smartphone, a computing tablet, a personal digital assistant (PDA), an ultra-mobile PC, a mobile phone, a desktop computer, a server, a printer, a scanner, a monitor, a set-top box, an entertainment control unit (e.g., a gaming console or automotive entertainment unit), a digital camera, an appliance, a portable music player, or a digital video recorder. In further implementations, the computing
10 device 800 may be any other electronic device that processes data.

Some non-limiting examples are provided below.

Example 1 may include a user equipment (UE) comprising: baseband circuitry to generate a message that includes an information element (IE) with an indicator to indicate that the UE supports a 60 gigahertz (GHz) band related to enhanced long term evolution
15 (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and radio frequency (RF) circuitry coupled with the baseband circuitry, the RF circuitry to transmit the message to a network node.

Example 2 may include the UE of example 1, wherein the IE is a WLAN Band Indicator IE.

20 Example 3 may include the UE of example 2, wherein the indicator is a band60 indicator.

Example 4 may include the UE of example 2, wherein the IE is an element of a UE evolved universal terrestrial radio access (EUTRA) Capability IE.

Example 5 may include the UE of example 1, wherein the IE is a UE evolved
25 universal terrestrial radio access (EUTRA) Capability IE.

Example 6 may include the UE of example 5, wherein the IE further includes a roaming indicator to indicate the UE supports roaming between a first WLAN network that does not support the 60 GHz band and a second WLAN network that does support the 60 GHz band.

30 Example 7 may include the UE of example 6, wherein the roaming indicator is a WLAN 60 GHz roaming indicator.

Example 8 may include the UE of example 1, wherein the indicator is a supported band list indicator of an inter-radio access technology (IRAT) Parameters IE.

Example 9 may include an evolved NodeB (eNB) comprising: baseband circuitry

to: identify that a user equipment (UE) is to use a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and generate a message that includes an indicator that the UE is to use the 60 GHz band; and radio frequency (RF) circuitry coupled with the baseband circuitry, the RF circuitry to transmit the message to the UE.

Example 10 may include the eNB of example 9, wherein the indicator is an indicator of a measurement configuration and reporting information element (IE).

Example 11 may include the eNB of example 10, wherein the IE is a WLAN Band Indicator information element (IE), and the baseband circuitry is further to identify, based on a measurement report received from the UE, an indication of a measurement related to the 60 GHz band.

Example 12 may include the eNB of example 11, wherein the indicator is a band60 indicator.

Example 13 may include the eNB of example 11, wherein the message includes an inter-radio access technology (IRAT) Parameters IE related to the WLAN Band Indicator IE.

Example 14 may include the eNB of example 11, wherein the indication of the measurement includes a WLAN Band indicator.

Example 15 may include the eNB of example 9, wherein the message includes an indicator related to transmission parameters that include a channel number, an operating class, and a country code related to the 60 GHz band.

Example 16 may include the eNB of example 15, wherein the indicator related to the transmission parameters is an indicator of a WLAN carrier information element (IE), a 60 GHz Channel Numbers IE, a 60 GHz Channel IE, or a 60 GHz carrier information IE.

Example 17 may include the eNB of example 16, wherein the 60 GHz Channel Numbers IE or the 60 GHz Channel IE are release 14 (r14) IEs.

Example 18 may include an evolved NodeB (eNB) comprising: baseband circuitry to identify a mobility set of wireless local area network (WLAN) access points (APs) that support a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – WLAN Aggregation (eLWA); and radio frequency (RF) circuitry coupled with the baseband circuitry, the RF circuitry to transmit, to a user equipment (UE), a message that includes an indicator of the mobility set.

Example 19 may include the eNB of example 18, wherein the indicator of the mobility set is an indicator of an LWA Configuration information element (IE) or a

WLAN Mobility Configuration IE.

Example 20 may include the eNB of example 19, wherein the indicator of the mobility set is an indicator related to a release list or an add list.

5 Example 21 may include one or more non-transitory computer-readable media comprising instructions to cause one or more processors of a user equipment (UE), upon execution of the instructions by the one or more processors of the UE, to: generate a message that includes an information element (IE) with an indicator to indicate that the UE supports a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and transmit the message to a
10 network node.

Example 22 may include the one or more non-transitory computer-readable media of example 21, wherein the IE is a WLAN Band Indicator IE.

Example 23 may include the one or more non-transitory computer-readable media of example 22, wherein the indicator is a band60 indicator.

15 Example 24 may include the one or more non-transitory computer-readable media of example 22, wherein the IE is an element of a UE evolved universal terrestrial radio access (EUTRA) Capability IE.

Example 25 may include the one or more non-transitory computer-readable media of example 21, wherein the IE is a UE evolved universal terrestrial radio access (EUTRA)
20 Capability IE.

Example 26 may include the one or more non-transitory computer-readable media of example 25, wherein the IE further includes a roaming indicator to indicate the UE supports roaming between a first WLAN network that does not support the 60 GHz band and a second WLAN network that does support the 60 GHz band.

25 Example 27 may include the one or more non-transitory computer-readable media of example 26, wherein the roaming indicator is a WLAN 60 GHz roaming indicator.

Example 28 may include the one or more non-transitory computer-readable media of example 21, wherein the indicator is a supported band list indicator of an inter-radio access technology (IRAT) Parameters IE.

30 Example 29 may include a method comprising: generating, by a user equipment (UE), a message that includes an information element (IE) with an indicator to indicate that the UE supports a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and transmitting, by the UE, the message to a network node.

Example 30 may include the method of example 29, wherein the IE is a WLAN Band Indicator IE.

Example 31 may include the method of example 30, wherein the indicator is a band60 indicator.

5 Example 32 may include the method of example 30, wherein the IE is an element of a UE evolved universal terrestrial radio access (EUTRA) Capability IE.

Example 33 may include the method of example 29, wherein the IE is a UE evolved universal terrestrial radio access (EUTRA) Capability IE.

10 Example 34 may include the method of example 33, wherein the IE further includes a roaming indicator to indicate the UE supports roaming between a first WLAN network that does not support the 60 GHz band and a second WLAN network that does support the 60 GHz band.

Example 35 may include the method of example 34, wherein the roaming indicator is a WLAN 60 GHz roaming indicator.

15 Example 36 may include the method of example 29, wherein the indicator is a supported band list indicator of an inter-radio access technology (IRAT) Parameters IE.

Example 37 may include a user equipment (UE) comprising: means to generate a message that includes an information element (IE) with an indicator to indicate that the UE supports a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) –
20 wireless local area network (WLAN) Aggregation (eLWA); and means to transmit the message to a network node.

Example 38 may include the UE of example 37, wherein the IE is a WLAN Band Indicator IE.

25 Example 39 may include the UE of example 38, wherein the indicator is a band60 indicator.

Example 40 may include the UE of example 38, wherein the IE is an element of a UE evolved universal terrestrial radio access (EUTRA) Capability IE.

Example 41 may include the UE of example 37, wherein the IE is a UE evolved universal terrestrial radio access (EUTRA) Capability IE.

30 Example 42 may include the UE of example 41, wherein the IE further includes a roaming indicator to indicate the UE supports roaming between a first WLAN network that does not support the 60 GHz band and a second WLAN network that does support the 60 GHz band.

Example 43 may include the UE of example 42, wherein the roaming indicator is a

WLAN 60 GHz roaming indicator.

Example 44 may include the UE of example 37, wherein the indicator is a supported band list indicator of an inter-radio access technology (IRAT) Parameters IE.

5 Example 45 may include one or more non-transitory computer-readable media comprising instructions to cause one or more processors of an evolved NodeB (eNB), upon execution of the instructions by the one or more processors, to: identify that a user equipment (UE) is to use a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); generate a message that includes an indicator that the UE is to use the 60 GHz band; and transmit the
10 message to the UE.

Example 46 may include the one or more non-transitory computer-readable media of example 45, wherein the indicator is an indicator of a measurement configuration and reporting information element (IE).

15 Example 47 may include the one or more non-transitory computer-readable media of example 46, wherein the IE is a WLAN Band Indicator information element (IE), and the instructions are further to identify, based on a measurement report received from the UE, an indication of a measurement related to the 60 GHz band.

Example 48 may include the one or more non-transitory computer-readable media of example 47, wherein the indicator is a band60 indicator.

20 Example 49 may include the one or more non-transitory computer-readable media of example 47, wherein the message includes an inter-radio access technology (IRAT) Parameters IE related to the WLAN Band Indicator IE.

25 Example 50 may include the one or more non-transitory computer-readable media of example 47, wherein the indication of the measurement includes a WLAN Band indicator.

Example 51 may include the one or more non-transitory computer-readable media of example 45, wherein the message includes an indicator related to transmission parameters that include a channel number, an operating class, and a country code related to the 60 GHz band.

30 Example 52 may include the one or more non-transitory computer-readable media of example 51, wherein the indicator related to the transmission parameters is an indicator of a WLAN carrier information element (IE), a 60 GHz Channel Numbers IE, a 60 GHz Channel IE, or a 60 GHz carrier information IE.

Example 53 may include the one or more non-transitory computer-readable media

of example 52, wherein the 60 GHz Channel Numbers IE or the 60 GHz Channel IE are release 14 (r14) IEs.

Example 54 may include a method comprising: identifying, by an evolved NodeB (eNB), that a user equipment (UE) is to use a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA);
5 generating, by the eNB, a message that includes an indicator that the UE is to use the 60 GHz band; and transmitting, by the eNB, the message to the UE.

Example 55 may include the method of example 54, wherein the indicator is an indicator of a measurement configuration and reporting information element (IE).

10 Example 56 may include the method of example 55, wherein the IE is a WLAN Band Indicator information element (IE), and further comprising identifying, by the eNB, based on a measurement report received from the UE, an indication of a measurement related to the 60 GHz band.

Example 57 may include the method of example 56, wherein the indicator is a
15 band60 indicator.

Example 58 may include the method of example 56, wherein the message includes an inter-radio access technology (IRAT) Parameters IE related to the WLAN Band Indicator IE.

Example 59 may include the method of example 56, wherein the indication of the
20 measurement includes a WLAN Band indicator.

Example 60 may include the method of example 54, wherein the message includes an indicator related to transmission parameters that include a channel number, an operating class, and a country code related to the 60 GHz band.

Example 61 may include the method of example 60, wherein the indicator related
25 to the transmission parameters is an indicator of a WLAN carrier information element (IE), a 60 GHz Channel Numbers IE, a 60 GHz Channel IE, or a 60 GHz carrier information IE.

Example 62 may include the method of example 61, wherein the 60 GHz Channel Numbers IE or the 60 GHz Channel IE are release 14 (r14) IEs.

30 Example 63 may include an evolved NodeB (eNB) comprising: means to identify that a user equipment (UE) is to use a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); means to generate a message that includes an indicator that the UE is to use the 60 GHz band; and means to transmit the message to the UE.

Example 64 may include the eNB of example 63, wherein the indicator is an indicator of a measurement configuration and reporting information element (IE).

Example 65 may include the eNB of example 64, wherein the IE is a WLAN Band Indicator information element (IE), and further comprising means to identify, based on a measurement report received from the UE, an indication of a measurement related to the 60 GHz band.

Example 66 may include the eNB of example 65, wherein the indicator is a band60 indicator.

Example 67 may include the eNB of example 65, wherein the message includes an inter-radio access technology (IRAT) Parameters IE related to the WLAN Band Indicator IE.

Example 68 may include the eNB of example 65, wherein the indication of the measurement includes a WLAN Band indicator.

Example 69 may include the eNB of example 63, wherein the message includes an indicator related to transmission parameters that include a channel number, an operating class, and a country code related to the 60 GHz band.

Example 70 may include the eNB of example 69, wherein the indicator related to the transmission parameters is an indicator of a WLAN carrier information element (IE), a 60 GHz Channel Numbers IE, a 60 GHz Channel IE, or a 60 GHz carrier information IE.

Example 71 may include the eNB of example 70, wherein the 60 GHz Channel Numbers IE or the 60 GHz Channel IE are release 14 (r14) IEs.

Example 72 may include one or more non-transitory computer-readable media comprising instructions to cause one or more processors of an evolved NodeB (eNB), upon execution of the instructions by the one or more processors, to: identify a mobility set of wireless local area network (WLAN) access points (APs) that support a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – WLAN Aggregation (eLWA); and transmit, to a user equipment (UE), a message that includes an indicator of the mobility set.

Example 73 may include the one or more non-transitory computer-readable media of example 72, wherein the indicator of the mobility set is an indicator of an LWA Configuration information element (IE) or a WLAN Mobility Configuration IE.

Example 74 may include the one or more non-transitory computer-readable media of example 73, wherein the indicator of the mobility set is an indicator related to a release list or an add list.

Example 75 may include a method comprising: identifying, by an evolved NodeB (eNB), a mobility set of wireless local area network (WLAN) access points (APs) that support a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – WLAN Aggregation (eLWA); and transmitting, by the eNB to a user equipment (UE), a message that includes an indicator of the mobility set.

Example 76 may include the method of example 75, wherein the indicator of the mobility set is an indicator of an LWA Configuration information element (IE) or a WLAN Mobility Configuration IE.

Example 77 may include the method of example 76, wherein the indicator of the mobility set is an indicator related to a release list or an add list.

Example 78 may include an evolved NodeB (eNB) comprising: means to identify a mobility set of wireless local area network (WLAN) access points (APs) that support a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – WLAN Aggregation (eLWA); and means to transmit, to a user equipment (UE), a message that includes an indicator of the mobility set.

Example 79 may include the eNB of example 78, wherein the indicator of the mobility set is an indicator of an LWA Configuration information element (IE) or a WLAN Mobility Configuration IE.

Example 80 may include the eNB of example 79, wherein the indicator of the mobility set is an indicator related to a release list or an add list.

Example 81 may include an apparatus to be implemented in a user equipment (UE), the apparatus comprising: first circuitry to generate a message that includes an information element (IE) with an indicator to indicate that the UE supports a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and second circuitry coupled with the first circuitry, the second circuitry to modulate and/or encode the message for transmission to a network node.

Example 82 may include the apparatus of example 81, wherein the IE is a WLAN Band Indicator IE.

Example 83 may include the apparatus of example 82, wherein the indicator is a band60 indicator.

Example 84 may include the apparatus of example 82, wherein the IE is an element of a UE evolved universal terrestrial radio access (EUTRA) Capability IE.

Example 85 may include the apparatus of example 81, wherein the IE is a UE

evolved universal terrestrial radio access (EUTRA) Capability IE.

Example 86 may include the apparatus of example 85, wherein the IE further includes a roaming indicator to indicate the UE supports roaming between a first WLAN network that does not support the 60 GHz band and a second WLAN network that does
5 support the 60 GHz band.

Example 87 may include the apparatus of example 86, wherein the roaming indicator is a WLAN 60 GHz roaming indicator.

Example 88 may include the apparatus of example 81, wherein the indicator is a supported band list indicator of an inter-radio access technology (IRAT) Parameters IE.

10 Example 89 may include an apparatus to be implemented in an evolved NodeB (eNB), the apparatus comprising: first circuitry to: identify that a user equipment (UE) is to use a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and generate a message that includes an indicator that the UE is to use the 60 GHz band; and second circuitry coupled
15 with the first circuitry, the second circuitry to modulate and/or encode the message for transmission of the message to the UE.

Example 90 may include the apparatus of example 89, wherein the indicator is an indicator of a measurement configuration and reporting information element (IE).

Example 91 may include the apparatus of example 90, wherein the IE is a WLAN
20 Band Indicator information element (IE), and the first circuitry is further to identify, based on a measurement report received from the UE, an indication of a measurement related to the 60 GHz band.

Example 92 may include the apparatus of example 91, wherein the indicator is a band60 indicator.

25 Example 93 may include the apparatus of example 91, wherein the message includes an inter-radio access technology (IRAT) Parameters IE related to the WLAN Band Indicator IE.

Example 94 may include the apparatus of example 91, wherein the indication of the measurement includes a WLAN Band indicator.

30 Example 95 may include the apparatus of example 89, wherein the message includes an indicator related to transmission parameters that include a channel number, an operating class, and a country code related to the 60 GHz band.

Example 96 may include the apparatus of example 95, wherein the indicator related to the transmission parameters is an indicator of a WLAN carrier information

element (IE), a 60 GHz Channel Numbers IE, a 60 GHz Channel IE, or a 60 GHz carrier information IE.

Example 97 may include the apparatus of example 96, wherein the 60 GHz Channel Numbers IE or the 60 GHz Channel IE are release 14 (r14) IEs.

5 Example 98 may include an apparatus to be implemented in an evolved NodeB (eNB), the apparatus comprising: first circuitry to identify a mobility set of wireless local area network (WLAN) access points (APs) that support a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – WLAN Aggregation (eLWA); and second circuitry coupled with the first circuitry, the second circuitry to encode and/or modulate,
10 for transmission to a user equipment (UE), a message that includes an indicator of the mobility set.

Example 99 may include the apparatus of example 98, wherein the indicator of the mobility set is an indicator of an LWA Configuration information element (IE) or a WLAN Mobility Configuration IE.

15 Example 100 may include the apparatus of example 99, wherein the indicator of the mobility set is an indicator related to a release list or an add list.

The description herein of illustrated implementations, including what is described in the Abstract, is not intended to be exhaustive or to limit the present disclosure to the precise forms disclosed. While specific implementations and examples are described
20 herein for illustrative purposes, a variety of alternate or equivalent embodiments or implementations calculated to achieve the same purposes may be made in light of the above detailed description, without departing from the scope of the present disclosure, as those skilled in the relevant art will recognize.

CLAIMS

What is claimed is:

1. A user equipment (UE) comprising:
baseband circuitry to generate a message that includes an information element (IE)
5 with an indicator to indicate that the UE supports a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and
radio frequency (RF) circuitry coupled with the baseband circuitry, the RF
circuitry to transmit the message to a network node.
- 10 2. The UE of claim 1, wherein the IE is a WLAN Band Indicator IE.
3. The UE of claim 2, wherein the indicator is a band60 indicator.
4. The UE of claim 2, wherein the IE is an element of a UE evolved universal
terrestrial radio access (EUTRA) Capability IE.
5. The UE of claim 1, wherein the IE is a UE evolved universal terrestrial radio
15 access (EUTRA) Capability IE.
6. The UE of claim 5, wherein the IE further includes a roaming indicator to
indicate the UE supports roaming between a first WLAN network that does not support
the 60 GHz band and a second WLAN network that does support the 60 GHz band.
7. The UE of claim 6, wherein the roaming indicator is a WLAN 60 GHz roaming
20 indicator.
8. The UE of claim 1, wherein the indicator is a supported band list indicator of an
inter-radio access technology (IRAT) Parameters IE.
9. An evolved NodeB (eNB) comprising:
baseband circuitry to:
25 identify that a user equipment (UE) is to use a 60 gigahertz (GHz) band related to enhanced long term evolution (LTE) – wireless local area network (WLAN) Aggregation (eLWA); and
generate a message that includes an indicator that the UE is to use the 60 GHz
band; and
30 radio frequency (RF) circuitry coupled with the baseband circuitry, the RF
circuitry to transmit the message to the UE.
10. The eNB of claim 9, wherein the indicator is an indicator of a measurement
configuration and reporting information element (IE).

11. The eNB of claim 10, wherein the IE is a WLAN Band Indicator information element (IE), and the baseband circuitry is further to identify, based on a measurement report received from the UE, an indication of a measurement related to the 60 GHz band.

12. The eNB of claim 11, wherein the indicator is a band60 indicator.

5 13. The eNB of claim 11, wherein the message includes an inter-radio access technology (IRAT) Parameters IE related to the WLAN Band Indicator IE.

14. The eNB of claim 11, wherein the indication of the measurement includes a WLAN Band indicator.

10 15. The eNB of claim 9, wherein the message includes an indicator related to transmission parameters that include a channel number, an operating class, and a country code related to the 60 GHz band.

16. The eNB of claim 15, wherein the indicator related to the transmission parameters is an indicator of a WLAN carrier information element (IE), a 60 GHz Channel Numbers IE, a 60 GHz Channel IE, or a 60 GHz carrier information IE.

15 17. The eNB of claim 16, wherein the 60 GHz Channel Numbers IE or the 60 GHz Channel IE are release 14 (r14) IEs.

18. An evolved NodeB (eNB) comprising:

baseband circuitry to identify a mobility set of wireless local area network (WLAN) access points (APs) that support a 60 gigahertz (GHz) band related to enhanced
20 long term evolution (LTE) – WLAN Aggregation (eLWA); and

radio frequency (RF) circuitry coupled with the baseband circuitry, the RF circuitry to transmit, to a user equipment (UE), a message that includes an indicator of the mobility set.

25 19. The eNB of claim 18, wherein the indicator of the mobility set is an indicator of an LWA Configuration information element (IE) or a WLAN Mobility Configuration IE.

20. The eNB of claim 19, wherein the indicator of the mobility set is an indicator related to a release list or an add list.

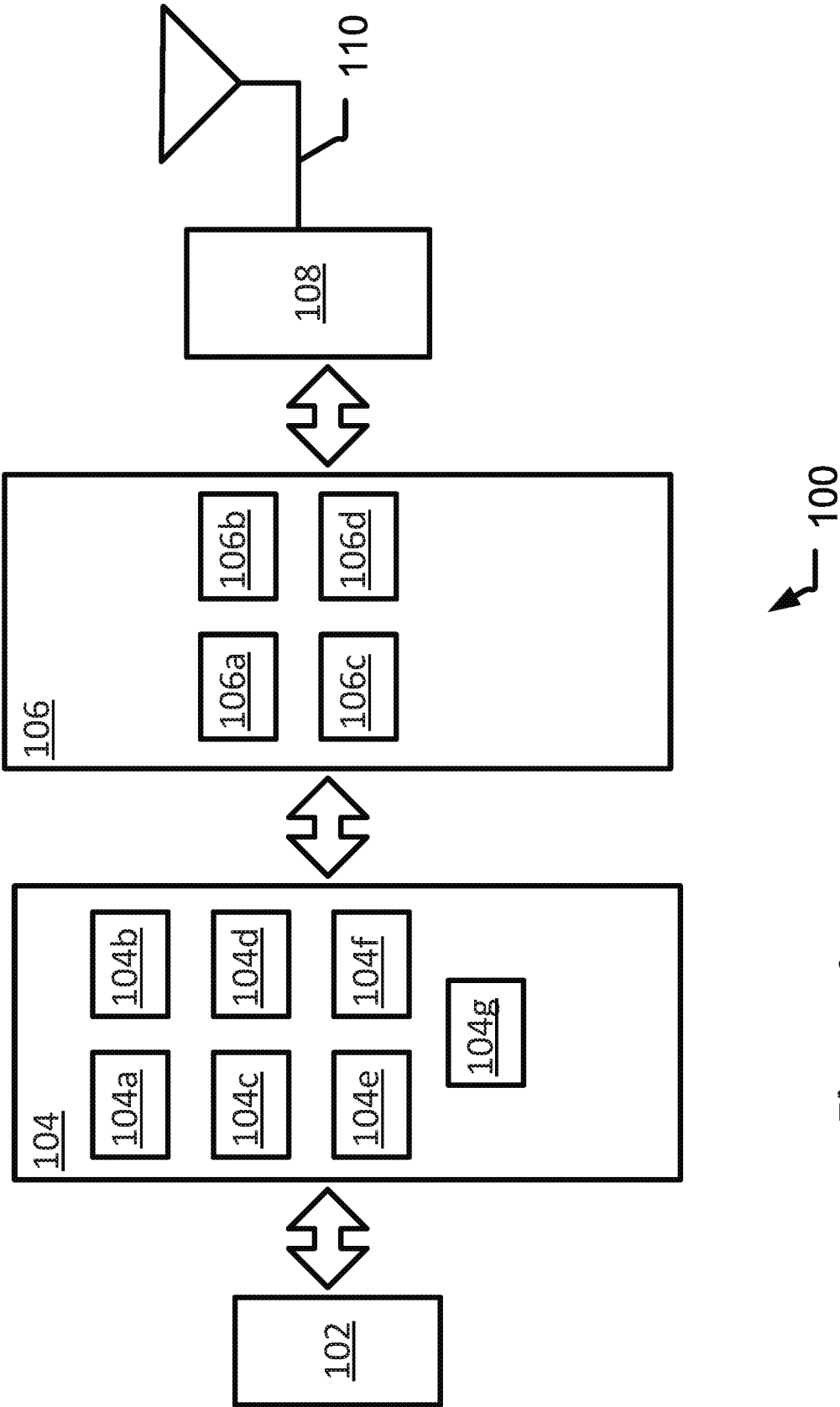


Figure 1

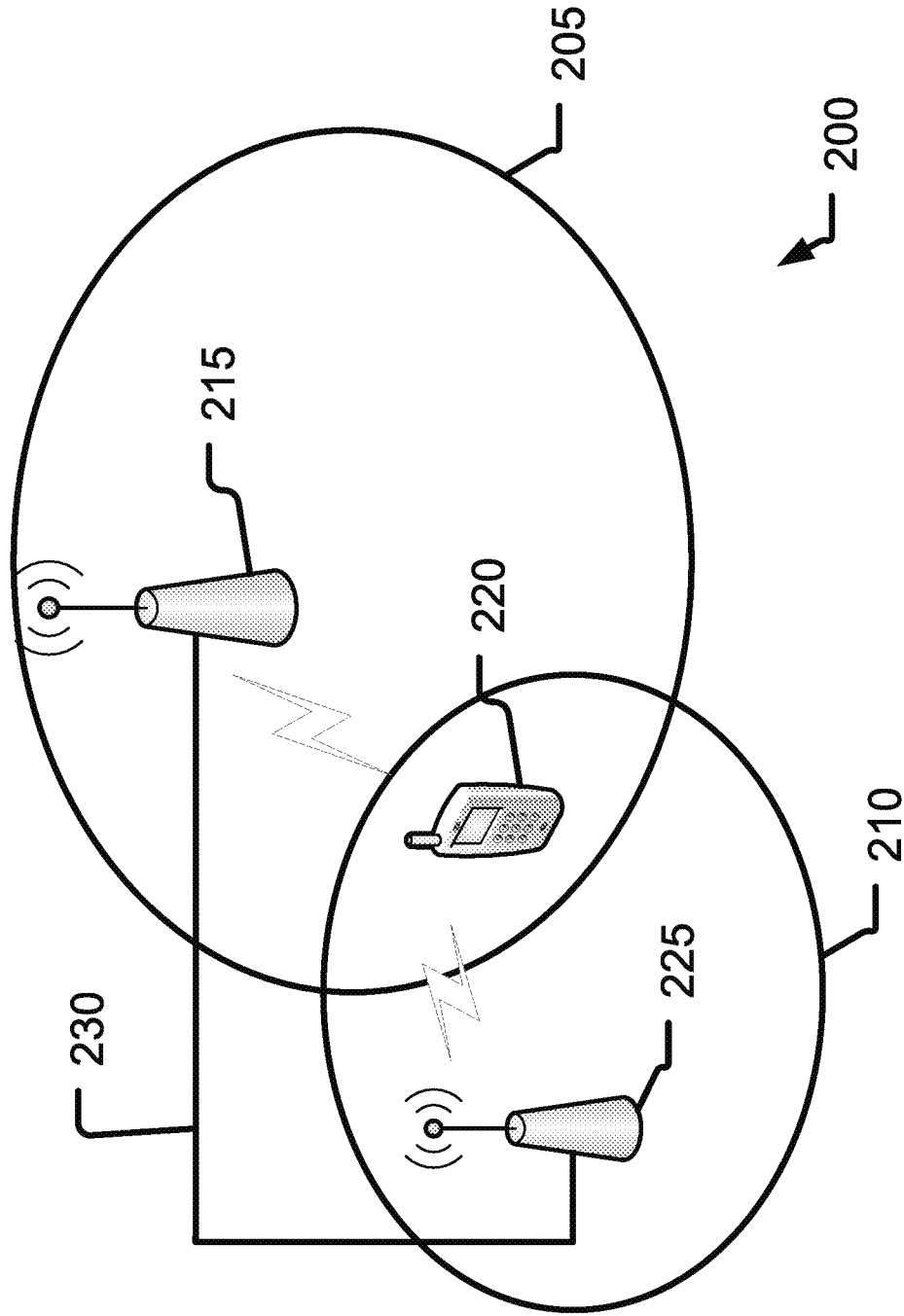
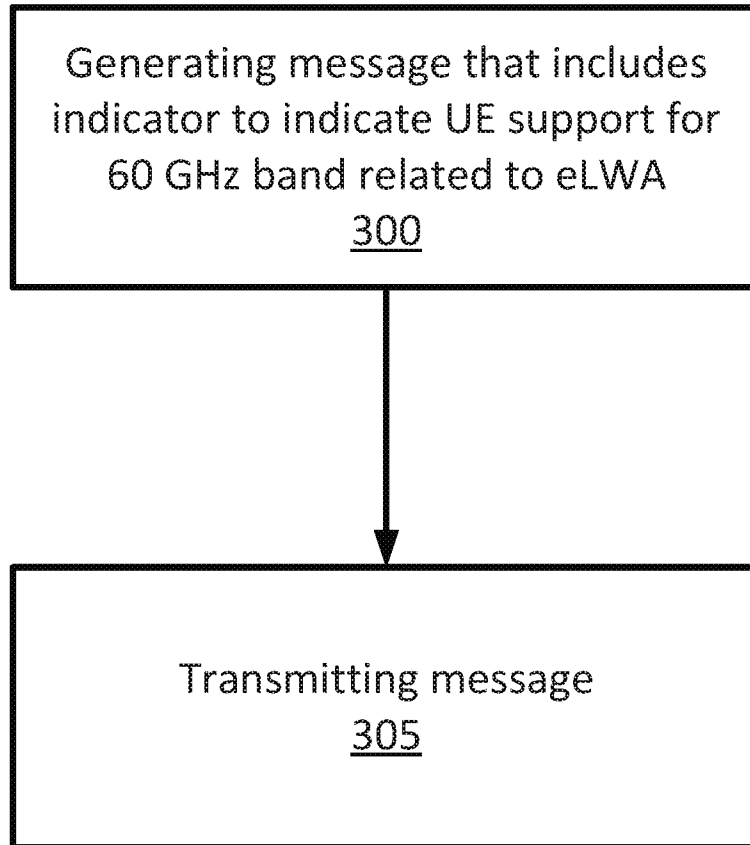
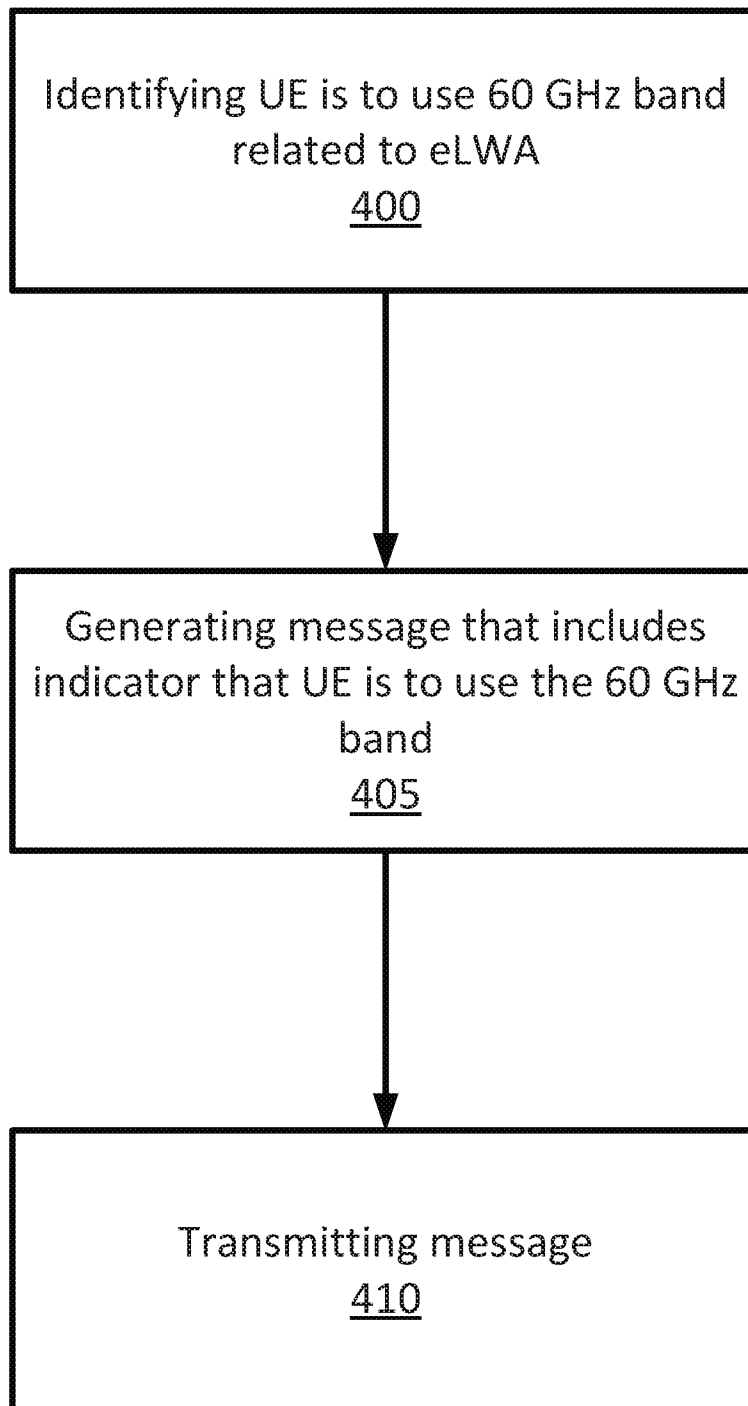
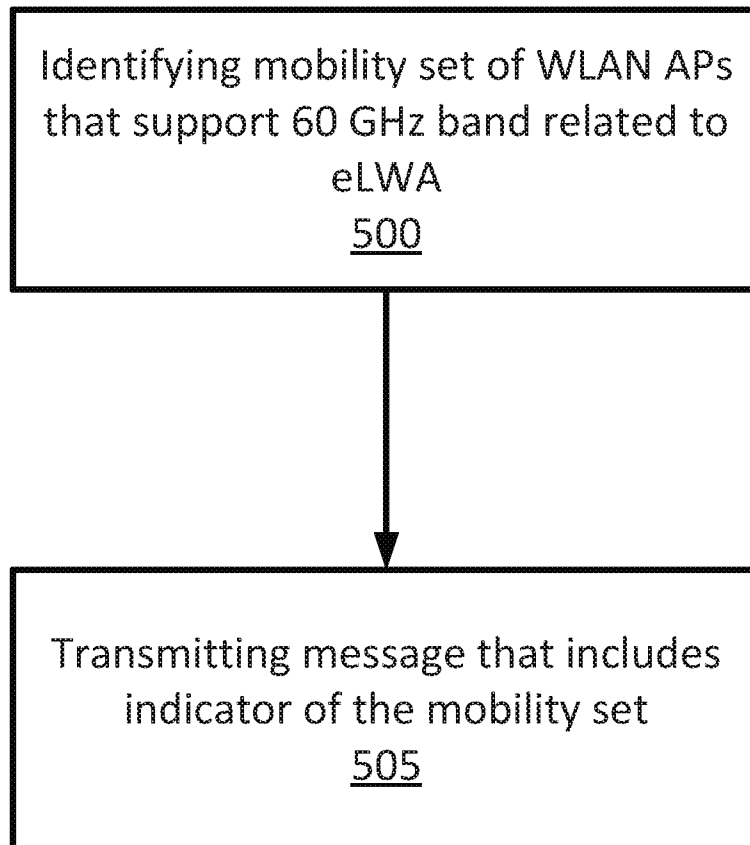


Figure 2

**Figure 3**

4/8

**Figure 4**

**Figure 5**

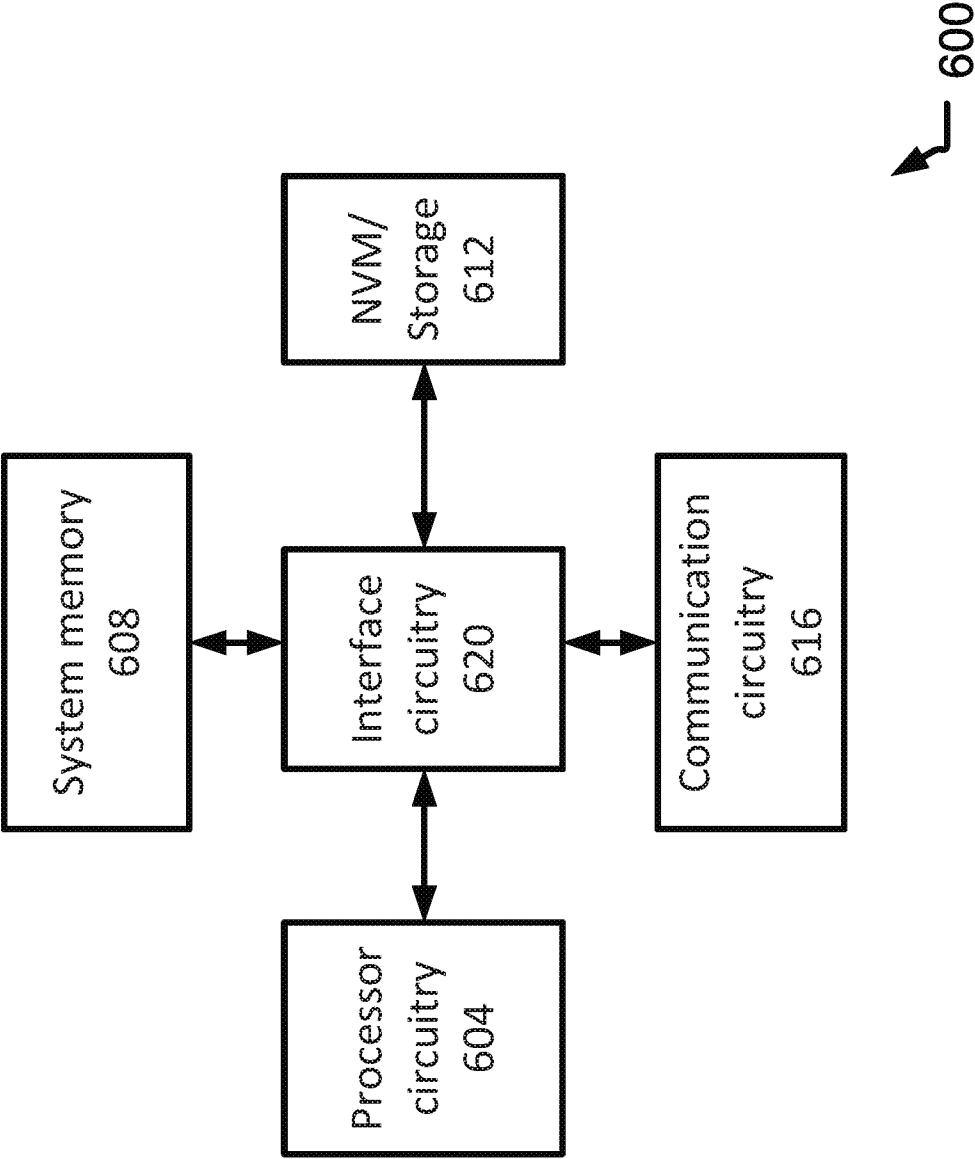


Figure 6

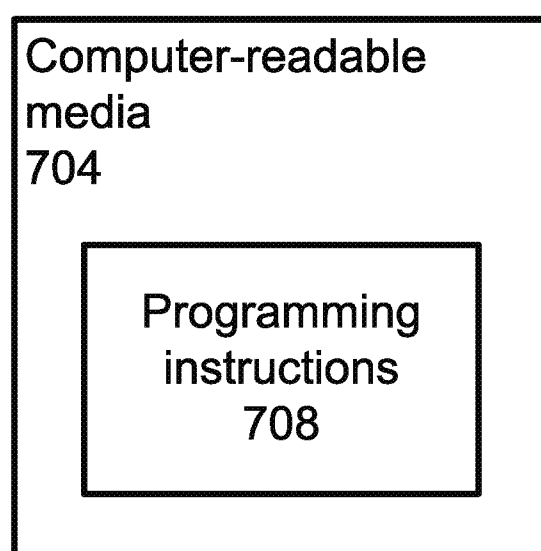


Figure 7

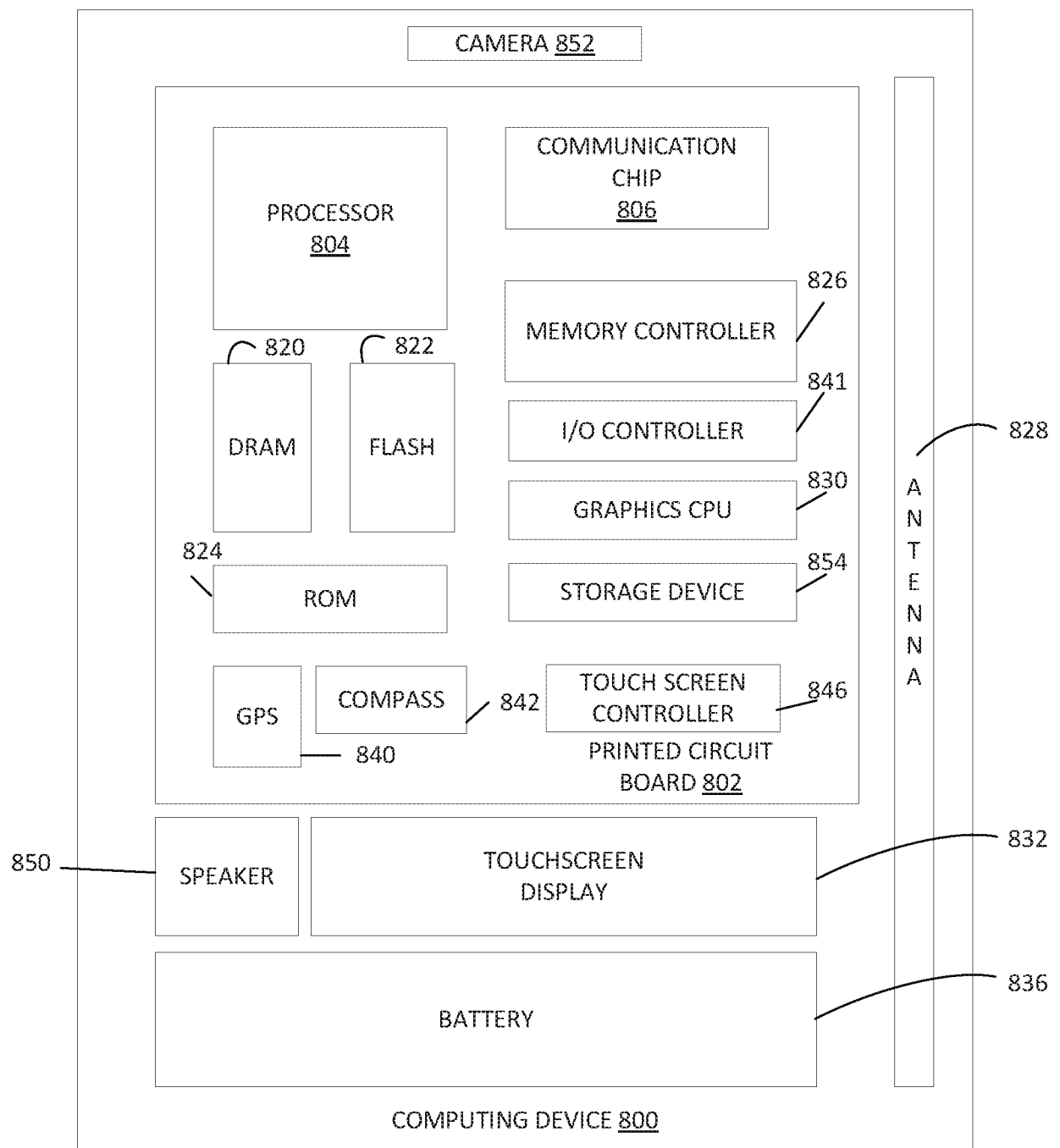


Figure 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/039634

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-17

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/039634

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W28/08 H04W8/22
ADD.

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

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

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/321282 A1 (PRAGADA RAVIKUMAR V [US] ET AL) 30 October 2014 (2014-10-30) paragraphs [0069], [0075], [0088], [0095] - [0097], [0105] - [0106], [0108] - [0114] ----- -/--	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

23 November 2016

Date of mailing of the international search report

25/01/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
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Authorized officer

Stefan, Andrei

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/039634

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>QUALCOMM INCORPORATED: "Introduction of LTE-WLAN Aggregation", 3GPP DRAFT; 36331 CR2008R3 (REL-13) R2-162042, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE</p> <p>, vol. RAN WG2, no. St. Julian; 20160215 - 20160219 16 March 2016 (2016-03-16), XP051081710, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/Specifications/201603_draft_specs_after_RAN_71/History/ [retrieved on 2016-03-16] Section "Summary of change"; Section 6.3.5 "Measurement information"; Section 6.3.6 "Other information elements"</p> <p style="text-align: center;">-----</p>	1-17
Y	<p>INTEL: "Motivation for WI: Enhanced LTE-WLAN Aggregation (eLWA)", 3GPP DRAFT; RP-160441-ELWA-MOTIVATION-PAPER-V1, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE</p> <p>, vol. TSG RAN, no. GÖTEBORG; 20160307 - 20160310 6 March 2016 (2016-03-06), XP051076381, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN/Docs/ [retrieved on 2016-03-06] Slides 3-7</p> <p style="text-align: center;">-----</p>	1-17
A	<p>US 2014/247711 A1 (GANTMAN ALEXANDER [IL] ET AL) 4 September 2014 (2014-09-04) paragraphs [0006], [0019], [0033] - [0036], [0037] - [0041]; figures 2, 3</p> <p style="text-align: center;">-----</p>	1-17

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/039634

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014321282 A1	30-10-2014	CN 103988546 A	13-08-2014
		EP 2789187 A2	15-10-2014
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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-17

Group 1: claims 1-17 related to a UE transmitting to a network node its capabilities in terms of support for the 60Ghz band in the context of LTE - WLAN aggregation

2. claims: 18-20

Group 2: claims 18-20 related to a BS identifying a mobility set of APs that support a 60Ghz band and informing a UE of the respective mobility set in the context of LTE-WLAN aggregation
