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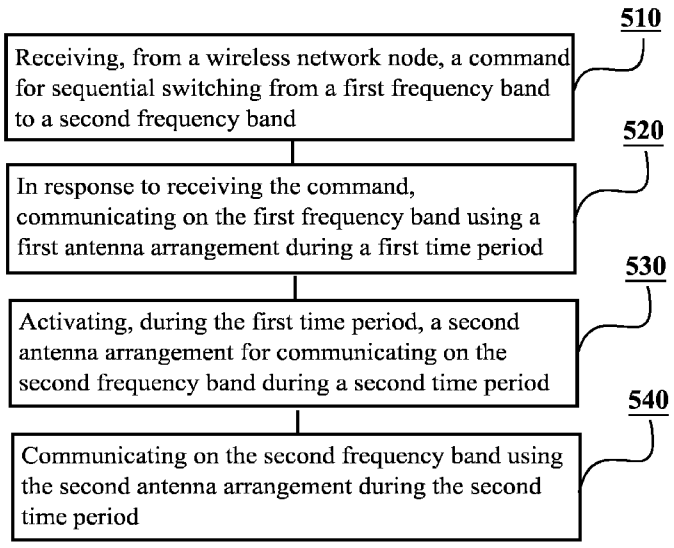

FIGURE 5

(57) Abstract: According to an example aspect of the present invention, there is provided a method comprising receiving, from a wireless network node, a command for sequential switching from a first frequency band to a second frequency band, in response to receiving the command, communicating on the first frequency band using a first antenna arrangement during a first time period, activating, during the first time period, a second antenna arrangement for communicating on the second frequency band during a second time period and communicating on the second frequency band using the second antenna arrangement during the second time period.

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ENHANCING FREQUENCY ADAPTATION IN WIRELESS COMMUNICATION NETWORKS

FIELD

[0001] Various example embodiments relate in general to wireless communication networks, and enhancing frequency adaptation in such networks.

BACKGROUND

[0002] Frequency adaptation may be exploited in various cellular networks, such as, in networks operating according to Long Term Evolution, LTE, and/or 5G radio access technology. 5G radio access technology may also be referred to as New Radio, NR, access technology. 3rd Generation Partnership Project, 3GPP, still develops LTE and also standards for 5G/NR. One of the topics in the 3GPP discussions is accommodation of the wireless communication network for various needs of wireless terminals at different times, which may be enabled using frequency adaptation, and there is still a need to provide improvements for enhancing frequency adaptation. Similar enhancements may also be employed in other cellular networks and in several other wireless communication networks as well, such as, for example, in Wireless Local Area Networks, WLANs.

SUMMARY

[0003] According to some aspects, there is provided the subject-matter of the independent claims. Some embodiments are defined in the dependent claims.

[0004] According to a first aspect, there is provided a first method for a wireless terminal comprising receiving, from a wireless network node, a command for sequential switching from a first frequency band to a second frequency band, in response to receiving the command, communicating on the first frequency band using a first antenna arrangement during a first time period, activating, during the first time period, a second antenna arrangement for communicating on the second frequency band during a second

time period and communicating on the second frequency band using the second antenna arrangement during the second time period.

[0005] According to the first aspect, the first method may comprise deactivating the first antenna arrangement for the second time period.

[0006] According to the first aspect, the first method may comprise receiving a configuration for sequential switching from the first frequency band to the second frequency band, the configuration comprising the first time period and the second time period.

[0007] According to the first aspect, the first method may comprise switching, during the second time period, the first antenna arrangement from operating on the first frequency band to operating on the second frequency band and/or switching, during the first time period, the second antenna arrangement from operating on the first frequency band to operating on the second frequency band.

[0008] According to the first aspect, the first method may comprise transmitting an indication about a capability of a wireless terminal for sequential switching.

[0009] According to the first aspect, the first method may comprise receiving a first reference signal in the beginning of the second time period for time and frequency synchronization of the second antenna arrangement, for communicating during the second time period.

[0010] According to the first aspect, the first method may comprise receiving a second reference signal upon expiry of the second time period for time and frequency synchronization of the first antenna arrangement, for communicating after the second time period.

[0011] According to the first aspect, the first antenna arrangement may comprise at least two first antenna branches and the second antenna arrangement may comprise at least two second antenna branches.

[0012] According to the first aspect, the first method may comprise the first antenna arrangement may comprise at least one first antenna panel and the second antenna arrangement may comprise at least one second antenna panel.

[0013] According to the first aspect, the first and the second frequency bands may be Bandwidth Parts, BWPs.

[0014] According to the first aspect, the wireless terminal may be a User Equipment, UE, operating according to 3rd Generation Partnership Project, 3GPP, standard specifications.

[0015] According to a second aspect, there is provided a second method for a wireless network node comprising transmitting, to a wireless terminal, a command for sequential switching from a first frequency band to a second frequency band, communicating on the first frequency band via a first antenna arrangement of the wireless terminal during a first time period and communicating on the second frequency band via a second antenna arrangement of the wireless terminal during a second time period.

[0016] According to the second aspect, the second method may comprise transmitting a configuration for sequential switching from the first frequency band to the second frequency band, the configuration comprising the first time period and the second time period.

[0017] According to the second aspect, the second method may comprise receiving an indication about a capability of the wireless terminal for sequential switching.

[0018] According to the second aspect, the second method may comprise transmitting a first reference signal in the beginning of the second time period for time and frequency synchronization of the second antenna arrangement, for communicating during the second time period.

[0019] According to the second aspect, the second method may comprise transmitting a second reference signal in response to determining an expiry of the second time period and frequency synchronization of the first antenna arrangement, for communicating after the second time period.

[0020] According to the second aspect, the first and the second frequency bands may be Bandwidth Parts, BWPs.

[0021] According to the second aspect, the wireless network node may be a Base Station, BS, operating according to 3rd Generation Partnership Project, 3GPP, standard specifications.

[0022] According to a third aspect of the present invention, there is provided an apparatus comprising at least one processing core, at least one memory including computer program code, the at least one memory and the computer program code being configured to, with the at least one processing core, cause the apparatus at least to perform the first method.

[0023] According to a fourth aspect of the present invention, there is provided an apparatus comprising at least one processing core, at least one memory including computer program code, the at least one memory and the computer program code being configured to, with the at least one processing core, cause the apparatus at least to perform the second method.

[0024] According to a fifth aspect of the present invention, there is provided an apparatus comprising means for performing the first method. According to a sixth aspect of the present invention, there is provided an apparatus comprising means for performing the second method.

[0025] According to a seventh aspect of the present invention, there is provided non-transitory computer readable medium having stored thereon a set of computer readable instructions that, when executed by at least one processor, cause an apparatus to at least perform the first method. According to an eighth aspect of the present invention, there is provided non-transitory computer readable medium having stored thereon a set of computer readable instructions that, when executed by at least one processor, cause an apparatus to at least perform the second method.

[0026] According to a ninth aspect of the present invention, there is provided a computer program configured to perform the first method. According to a tenth aspect of the present invention, there is provided a computer program configured to perform the second method.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] FIGURE 1 illustrates an exemplary network scenario in accordance with at least some example embodiments;

[0028] FIGURE 2 illustrates an exemplary switching procedure in accordance with at least some embodiments;

[0029] FIGURE 3 illustrates an exemplary signalling graph in accordance with at least some embodiments;

[0030] FIGURE 4 illustrates an example apparatus capable of supporting at least some embodiments;

[0031] FIGURE 5 illustrates a flow graph of a first method in accordance with at least some embodiments;

[0032] FIGURE 6 illustrates a flow graph of a second method in accordance with at least some embodiments.

EMBODIMENTS

[0033] Frequency adaptation in wireless communication networks may be improved by the procedures described herein. More specifically, a wireless terminal may receive, from a wireless network node, a command for sequential switching from a first frequency band to a second frequency band. After transmission of the command, the wireless terminal may first communicate with the wireless network node on the first frequency band using a first antenna arrangement of the wireless terminal and at the same time the wireless terminal may activate/switch a second antenna arrangement for communicating on the second frequency band. Then, the wireless terminal may communicate on the second frequency band using the second antenna arrangement while activating/switching the first antenna arrangement for communicating on the second frequency band. Thus, the wireless terminal may continue communicating with the wireless network node seamlessly by performing sequential switching.

[0034] FIGURE 1 illustrates an exemplary network scenario in accordance with at least some example embodiments. According to the example scenario of FIGURE 1, there may be a wireless communication system, which comprises wireless terminal 110, wireless

network node 120, and core network element 130. Wireless terminal 110 may be connected to wireless network node 120 via air interface 115.

[0035] Wireless terminal 110 may comprise, for example, a User Equipment, UE, a smartphone, a cellular phone, a Machine-to-Machine, M2M, node, Machine-Type Communications node, MTC, an Internet of Things, IoT, node, a car telemetry unit, a laptop computer, a tablet computer or, indeed, another kind of suitable wireless terminal or mobile station. In the example system of FIGURE 1, wireless terminal 110 may communicate wirelessly with wireless network node 120, or with a cell of wireless network node 120, via air interface 115. In some example embodiments, wireless network node 120 may be considered as a serving Base Station, BS, for wireless terminal 110.

[0036] Air interface 115 between wireless terminal 110 and wireless network node 120 may be configured in accordance with a Radio Access Technology, RAT, which wireless terminal 110 and wireless network node 120 are configured to support. Examples of cellular RATs include Long Term Evolution, LTE, New Radio, NR, which may also be known as fifth generation, 5G, radio access technology and MulteFire. On the other hand, examples of non-cellular RATs include Wireless Local Area Network, WLAN, and Worldwide Interoperability for Microwave Access, WiMAX.

[0037] For example, in the context of LTE, wireless network node 120 may be referred to as eNB while wireless network node 120 may be referred to as gNB in the context of NR. Wireless terminal 110 may be similarly referred to as a UE, e.g., in the context of LTE and NR. Also, for example in the context of WLAN, wireless network node 120 may be referred to as an access point. In any case, example embodiments are not restricted to any particular wireless technology. Instead, example embodiments may be exploited in any wireless communication network which uses frequency adaptation, e.g., by switching from one frequency band to another.

[0038] Wireless network node 120 may be connected, directly or via at least one intermediate node, with core network 130 via interface 125. Core network 130 may be, in turn, coupled via interface 135 with another network (not shown in FIGURE 1), via which connectivity to further networks may be obtained, for example via a worldwide interconnection network. Wireless network node 120 may be connected with at least one other wireless network node as well via an inter-base station interface (not shown in FIGURE 1), even though in some example embodiments the inter-base station interface

may be absent. Wireless network node 120 may be connected, directly or via at least one intermediate node, with core network 130 or with another core network.

[0039] Embodiments of the present invention may be used to improve frequency domain adaptation, such as switching between Bandwidth Parts, BWPs, for example in NR networks. In some embodiments, wireless terminal 110 may be configured with multiple frequency bands, i.e., BWPs, wherein one frequency band may be actively used for communicating with wireless network node 120. For example, wireless terminal 110 may be configured with a first and a second frequency band, wherein the first frequency band is active for communicating while the second frequency band is inactive.

[0040] Switching of frequency bands may be used for activating the second frequency band and deactivating the first frequency band. Thus, the second frequency band may be active for communicating after the switching while the first frequency band may be inactive. For instance, switching of BWPs for a serving cell, e.g., a cell of wireless network node 120, may comprise activating a one BWP and deactivating another BWP at a time by the serving cell.

[0041] As an example, in the context of NR, BWP switching functionality may be used to provide efficient means for adapting a bandwidth of wireless terminal 110, such as an UE, to traffic. For instance, wireless terminal 110 may first use narrower bandwidth on a first BWP for monitoring a downlink control channel, such as a Physical Downlink Control Channel, PDCCH, to receive small and medium-sized data transmissions. Wireless terminal 110 may then switch to a second BWP, wherein a bandwidth of the second BWP may be wider than a bandwidth of the first BWP, for receiving large data transmissions, e.g., when a large amount of data is scheduled.

[0042] In general, embodiments of the present invention may be used to minimize latency when switching from one frequency band to another. For example, in case of NR one target is to provide very low latency, such as user plane latency of less than 0.5 milliseconds for downlink and uplink directions, and therefore additional latencies caused by BWP switching may make the BWP switching functionality less attractive.

[0043] Also, it is important to take into account power consumption of wireless terminals. Wireless terminals should be able to use a narrowband receiver on a first BWP for monitoring a downlink control channel to minimize power consumption. Nevertheless,

wireless terminals should also be able to use a wideband receiver on a second BWP for high data rate transmissions. Switching from the first BWP to the second BWP should be therefore as fast as possible to achieve low latencies. Interrupt times when a wireless terminal is not assumed to be able to transmit or receive should be minimized. For example, interruption times in the order of few milliseconds may be unacceptable.

[0044] Using still NR as an example, the BWP switching may be controlled by using the PDCCH to indicate a downlink assignment or an uplink grant, e.g., bwp-InactivityTimer. Alternatively, the BWP switching may be controlled by Radio Resource Control, RRC, signalling, or by a Medium Access Control, MAC, entity upon initiation of a random access procedure. The BWPs may be configured by wireless network node 120, such as a gNB, and one of the configured BWPs may be active at first (e.g., a first BWP) and another one of the configured BWPs may be considered a default (e.g., a second BWP). So, for example, if the bwp-InactivityTimer associated with the active BWP expires and if the default BWP is configured, wireless terminal 110 may perform BWP switching from the active BWP to the default BWP.

[0045] Moreover, the default BWP may be configured with at least one of the following to support power savings:

- the default BWP may be configured with a narrower bandwidth compared to other BWP(s), such as the active BWP, used for data transmission and reception (frequency domain);
- the default BWP may be configured with a scheduling offset between PDCCH carrying Downlink Control Information, DCI, and scheduled Physical Downlink Shared Channel, PDSCH, e.g., K0 > 0, to allow micro-sleep (time domain);
- the default BWP may be configured with a configuration of Control Resource Set(s), CORESET(s), and associated search space set(s) with fewer required blind decodes (fewer candidates per PDCCH occasion and PDCCH occasions with lower periodicity).

[0046] However, there may be delays and associated interruptions in data transmission/reception for BWP switching which should be avoided. More specifically, the delay and interruption times may be dependent on a type of wireless terminal 110, i.e., UE type, and applied sub-carrier spacing. For instance, without improvements the delays in order of slots for different sub-carrier spacings may be 3 slots with sub-carrier spacing of

15 kHz, 5 slots with sub-carrier spacing of 30kHz, 9 slots with sub-carrier spacing of 60 kHz and 17 slots with 120kHz and wireless terminal 110 may not expected to communicate (receive or transmit) data during these times.

[0047] There is therefore a need to provide improvements for minimizing the delays associated with BWP switching in NR. Embodiments of the present invention for example enable zero latency BWP switching for wireless terminal 110 with N receiver branches, where $N > 1$, and also for wireless terminal 110 with at least two antenna panels. However, embodiments of the present invention may also be used in general for minimizing delays when switching from one frequency band to another for wireless terminal 110 with first and second antenna arrangements. So even though NR is used as an example, embodiments of the present invention are not limited to NR and may be exploited in other wireless communication networks as well.

[0048] FIGURE 2 illustrates an exemplary switching procedure in accordance with at least some embodiments. In FIGURE 2, activity on a first frequency band, such as a first BWP, is denoted by 210, switching from the first frequency band to a second frequency band, such as a second BWP, is denoted by 220 and activity on the second frequency band is denoted by 230.

[0049] That is to say, a receiver branch of wireless terminal 110 (RX #0, RX #1, RX #2 and RX #3 in FIGURE 2) may be used for communicating with wireless network node 120 on the first frequency band at 210, a receiver branch of wireless terminal 110 may be switched from the first frequency band to the second frequency band at 220 and a receiver branch of wireless terminal 110 may be used for communicating with wireless network node 120 on the second frequency band at 230. In some embodiments, a bandwidth of the first frequency band may be narrower compared to a bandwidth of the second frequency band.

[0050] Moreover, in the exemplary switching procedure of FIGURE 2, a period before switching from the first frequency band to the second frequency band, wherein wireless terminal 110 may operate with normal, or high, receiver capability is denoted by 215, a first time period of a reduced receiver capability is denoted by 225, a second time period of a reduced receiver capability is denoted by 235 and a period after switching from the first frequency band to the second frequency band, wherein wireless terminal 110 may operate with normal, or high, receiver capability is denoted by 245.

[0051] At time *t1*, wireless network node 120 may transmit a command for sequential switching from the first frequency band to the second frequency band to wireless terminal 110. In some embodiments, the command may be referred to as an activation/triggering command for the BWP switching as well. Upon receiving the command, wireless terminal 110 may perform sequential switching from the first frequency band to the second frequency band for the receiver branches (RX #0, RX #1, RX #2, RX #3).

[0052] For instance, wireless terminal 110, comprising receiver branches RX #0, RX #1, RX #2, RX #3, may first switch receiver branches RX #2 and RX #3 from the first frequency band to the second frequency band during first time period 225, i.e., between time instants *t1* and *t2*. That is to say, wireless terminal 110 may activate, during first time period 225, receiver branches RX #2 and RX #3 for communicating on the second frequency band during second time period 235, i.e., between time instants *t2* and *t3*. In addition, wireless terminal 110 may communicate with wireless network node 120 during first time period 225 using receiver branches RX #0 and RX1, thereby operating in a reduced receiver capability mode. That is to say, wireless terminal 110, comprising 4 receiver branches may perform BWP switching first for two RX branches (RX #2 and RX #3) during first time period 225 and after that wireless terminal 110 may perform BWP switching for rest of the RX branches (RX #0 and RX #1).

[0053] In some embodiments, receiver branches RX #0 and RX #1 may be referred to as a first antenna arrangement while receiver branches RX #2 and RX #3 may be referred to as a second antenna arrangement. Thus, wireless terminal 110 may, in response to receiving the command for sequential switching, communicate with wireless network node 120 using the first antenna arrangement (RX #0 and RX #1) on the first frequency band during first time period 225. Wireless terminal 110 may also activate, during first time period 225, the second antenna arrangement (RX #2 and RX3) for communicating on the second frequency band during second time period 235. Wireless terminal 110 may then communicate with wireless network node 120 using the second antenna arrangement (RX #2 and RX #3) on the second frequency band during second time period 235.

[0054] In some embodiments, wireless terminal 110 may activate the first antenna arrangement (RX #0 and RX #1), during second time period 235, for communicating on the second frequency band after second time period 235. Thus, wireless terminal 110 may

communicate with wireless network node 120 using the first and the second antenna arrangements after second time period 235, i.e., during the period after switching from the first frequency band to the second frequency band (denoted by 245).

[0055] In general, first time period 225 and second time period 235 may be defined, for example, by wireless network node 120 or by a standard, such as a 3GPP standard. Moreover, first time period 225 and second time period 235 may be activated upon receiving the command for sequential switching. In some embodiments, first time period 225 and second time period 235 may be of equal length.

[0056] Alternatively, or in addition, the first time period 225 and the second time period 235 may be the current considered value per sub-carrier spacing. That is to say, each part, i.e., the first time period 225 or the second time period 235, may have a length which is equal to an interruption time, and the interruption time may be sub-carrier specific. For example, the first time period 225 and/or the second time period 235 may have a length which is equal to NR Rel-15 interruption time for BWP switching, the interruption time being sub-carrier specific.

[0057] In some embodiments, wireless terminal 110 may, during first time period 225, apply a configuration of the first frequency band, e.g., first BWP, with the first antenna arrangement, e.g., lowered reception capability (RX #0 and RX #1) for communicating on the first frequency band, while the second antenna arrangement (RX #2 and RX #3) is being activated, i.e., being switched, from the first frequency band to the second frequency band before a BWP switch command.

[0058] Then, wireless terminal 110 may, during the second time period 235, apply a configuration of the second frequency band, e.g., second BWP, with the second antenna arrangement, i.e., a lowered reception capability (RX #2 and RX #3) for communicating on the second frequency band while the first antenna arrangement (RX #0 and RX #1) is being activated, i.e., switching, from the first frequency band to the second frequency band). After the second time period 235, wireless terminal 110 may communicate with wireless network node 120 again with normal capability (RX #0, RX #1, RX #2 and RX #3), i.e., the period after switching from the first frequency band to the second frequency band (denoted by 245), as before reception of the command for sequential switching (denoted by 215).

[0059] In some embodiments, reference signals, such as tracking reference signals or similar, may be used for enabling wireless terminal 110 to fine-tune time and frequency synchronization. The reference signals may be pre-configured. Wireless network node 120 may transmit a first reference signal in the beginning of second time period 235 for time and frequency synchronization of RX #2 and RX #3, i.e., the second antenna arrangement, for communicating during the second time period 235. Alternatively, or in addition, wireless network node 120 may transmit a second reference signal upon expiry of the second time period 235, e.g., right after the second time period 235, for time and frequency synchronization of RX #0 and RX #1, i.e., the first antenna arrangement, for communicating after switching from the first frequency band to the second frequency band (denoted by 245).

[0060] Thus, in some embodiments, wireless terminal 110 with 4 receiver branches may operate with lowered reception capability (using two receiver branches at a time) to preserve power and in such a case the delay associated with switching from the first frequency band to the second frequency band may be minimized as well. For instance, if wireless terminal 110 is operating with lowered reception capability and communicating with wireless network node 120 using a first antenna arrangement (RX #0 and RX #1) before receiving the command for sequential switching at time *t1*, wireless terminal 110 may continue communicating with wireless network node 120 and activate a second antenna arrangement (RX #2 and RX #3) during the first time period 225. Then, wireless terminal 110 may communicate with the wireless network node 120 using the second antenna arrangement and deactivate the first antenna arrangement during the second time period 235. After the expiry of the second time period 235 wireless terminal 110 may continue communicating with the wireless with lowered reception capability using the second antenna arrangement.

[0061] Moreover, in some embodiments, sequential switching from the first frequency band to the second frequency band may be performed jointly with activation/de-activation of an antenna panel of wireless terminal 110, to achieve zero latency. The joint sequential switching and antenna panel activation/de-activation may be for beam-based communication, such as downlink or uplink transmission, e.g., on Frequency Range 2, FR2.

[0062] The joint sequential switching and antenna panel activation/de-activation may comprise transmitting, by wireless network node 120, the command for sequential switching, wherein the command may comprise or be associated with an antenna panel activation command. The antenna panel activation command may be for uplink and/or downlink transmission.

[0063] Upon receiving the panel activation command, wireless terminal 110 may continue communicating with wireless network node 120 for a first pre-configured time duration, such as the first time period 225, using at least one first antenna panel. In general, the at least one first antenna panel may be referred to as a first antenna arrangement. In some embodiments, the at least one first antenna panel may comprise a set of antenna panels, possibly associated with a set of antenna panel identity numbers in conjunction with a configuration of the first frequency band, i.e., existing active BWP configuration.

[0064] During the first pre-configured time duration, such as the first time period 225, the wireless may activate at least one second antenna panel. In general, the at least one second antenna panel may be referred to as a second antenna arrangement. In some embodiments, the at least one second antenna panel may comprise a set of antenna panels, possibly associated with a set of antenna panel identity numbers in conjunction with a configuration of the second frequency band, i.e., new active BWP configuration. The identities of the at least one second antenna panel may also be indicated in the panel activation command. The at least one second antenna panel may be used for communicating with wireless network node 120 during a second pre-configured time period, such as the second time period 235.

[0065] In some embodiments, wireless terminal 110 may activate the at least one first antenna panel, during the first pre-configured time period, for communicating with wireless network node 120 on the second frequency band, i.e., on the new active BWP, after the second pre-configured time period. That is to say, wireless terminal 110 may activate the at least one first antenna panel for communicating with wireless network node 120 on the second frequency band after starting communicating with wireless network node 120 on the second frequency band using the at least one second antenna panel.

[0066] Alternatively, in some embodiments, wireless terminal 110 may not activate the at least one first antenna panel for communicating with wireless network node 120 on the second frequency band, i.e., on the new active BWP. That is to say, wireless terminal

110 may de-activate the at least one first antenna panel for communicating with wireless network node 120 on the second frequency band after starting communicating with wireless network node 120 on the second frequency band using the at least one second antenna panel. In general, communication between wireless terminal 110 and wireless network node 120 may comprise uplink or downlink transmissions.

[0067] FIGURE 3 illustrates an exemplary signalling graph in accordance with at least some embodiments. With reference to FIGURE 1, the exemplary signalling graph may demonstrate signalling between wireless terminal 110 and wireless network node 120. Wireless terminal 110 may comprise a first antenna arrangement, such as two receiver branches RX #0 and RX #1 in FIGURE 2 or at least one first antenna panel, and a second antenna arrangement, such as two receiver branches RX #2 and RX #3 in FIGURE 2 or at least one second antenna panel.

[0068] In some embodiments, wireless terminal 110 may transmit, at step 310, an indication about a capability of wireless terminal 110 for sequential switching. For instance, a multi-RX capable UE may signal capability for zero latency BWP switching with temporary reception capability adaptation. Transmission of the indication at step 310 is an optional step, shown with a dashed line in FIGURE 3.

[0069] In some embodiments, wireless terminal 110 may receive from wireless network node 120, at step 320, a configuration for sequential switching from the first frequency band to the second frequency band. The configuration may comprise first time period 225 and second time period 225 shown in FIGURE 2. Alternatively, or in addition, the configuration may comprise parameters to define which antenna arrangements (i.e., receiver branches or antenna panels) or amount of the antenna arrangements to be used during first time period 225 and second time period 225. For example, a UE may receive configuration for the BWPs and parameters for the switching, including for example time periods, to allow sequential BWP switching among the receiver branches, and parameters to determine which receiver branches, or amount of receiver branches, are to be used at certain time periods.

[0070] Alternatively, or in addition, wireless terminal 110 may receive from wireless network node 120, at step 320, a configuration for a first reference signal that may be used for communicating during the second time period 235 and/or a configuration for a second reference signal that may be used for communicating after switching from the first

frequency band to the second frequency band (denoted by 245 in FIGURE 2). That is to say, the configuration of the first reference signal may be used for communicating with wireless network node 120 using a second antenna arrangement (such as RX #2 and RX #3 in FIGURE 2) on the second frequency band during a second time period 235, i.e., from the beginning of the second time period 235. The configuration of the second reference signal may be used for communicating with wireless network node 120 using a first antenna arrangement (such as RX #0 and RX #1 in FIGURE 2) on the second frequency band right after second time period 235. Transmission of the configuration at step 320 is an optional step as well, shown with a dashed line in FIGURE 3.

[0071] At step 330, wireless terminal 110 may receive from wireless network node 120 a command for sequential switching from the first frequency band to the second frequency band. For instance, a UE may receive BWP switching command for zero latency switching with temporary reception capability reduction.

[0072] In response to receiving the command for sequential switching, wireless terminal 110 may communicate with wireless network node 120 using a first antenna arrangement (such as receiver branches RX #0 and RX #1 or at least one first antenna panel) on the first frequency band during first time period 225. Also, wireless terminal 110 may activate, during first time period 225, a second antenna arrangement (such as receiver branches RX #2 and RX #3 or at least one second antenna panel) for communicating on the second frequency band during second time period 235. For instance, a UE may receive using first set of receiver branches on the first, existing BWP and perform BWP switching to the second, new BWP for the second set of receiver branches during first time period 225.

[0073] In some embodiments, wireless terminal 110 may receive the first reference signal in the beginning of the second time period 235 for time and frequency synchronization of the second antenna arrangement, for communicating during the second time period 235. Wireless terminal 110 may hence perform time and frequency synchronization for the second antenna arrangement (e.g., RX #2 and RX #3) during the second time period 235 based on the first reference signal received in the beginning of the second time period 235.

[0074] At step 340, wireless terminal may communicate with wireless network node 120 using the second antenna arrangement (e.g., RX #2 and RX #3 or at least one second

antenna panel) on the second frequency band during second time period 235. Wireless terminal 110 may also switch, during second time period 235, the first antenna arrangement (e.g., RX #0 and RX #1 or at least one first antenna panel) from communicating on the first frequency band to communicating on the second frequency band. That is to say, a UE may perform BWP switching to the second, new BWP for a first set of receiver branches during second time period 235 and receive using a second set of receiver branches during second time period 235 on the second, new BWP.

[0075] In some embodiments, wireless terminal 110 may receive the second reference signal upon expiry of second time period 235 for time and frequency synchronization of the first antenna arrangement, for communicating after second time period 235 on the second frequency band. Wireless terminal 110 may hence perform time and frequency synchronization for the first antenna arrangement (e.g., RX #2 and RX #3) after switching from the first frequency band to the second frequency band (denoted by 245) based on the second reference signal received right after second time period 235.

[0076] In some embodiments, wireless terminal 110 may communicate, at step 350, with wireless network node 120 using the first antenna arrangement (RX #0 and RX #1 or the at least one first antenna panel) and the second antenna arrangement (RX #2 and RX #3 or the at least one second antenna panel) on the second frequency band, i.e., new BWP, upon expiry of the second time period 235. Alternatively, wireless terminal 110 may communicate, at step 350, with wireless network node 120 using the second antenna arrangement (RX #2 and RX #3 or the at least one second antenna panel) on the second frequency band, i.e., new BWP, upon expiry of the second time period 235, but not use the first antenna arrangement (RX #0 and RX #1, or the at least one first antenna panel) for communication after the second time period 235.

[0077] Embodiments of the present invention therefore minimize latency associated with switching from one frequency band to another. Consequently, use of frequency adaptation, such as BWP switching, is enabled without sacrificing latency.

[0078] FIGURE 4 illustrates an example apparatus capable of supporting at least some example embodiments. Illustrated is device 400, which may comprise, for example, wireless terminal 110 or wireless network node 120, or a device controlling wireless terminal 110 or wireless network node 120. Comprised in device 400 is processor 410, which may comprise, for example, a single- or multi-core processor wherein a single-core

processor comprises one processing core and a multi-core processor comprises more than one processing core. Processor 410 may comprise, in general, a control device. Processor 410 may comprise more than one processor. Processor 410 may be a control device. A processing core may comprise, for example, a Cortex-A8 processing core manufactured by ARM Holdings or a Steamroller processing core produced by Advanced Micro Devices Corporation. Processor 410 may comprise at least one Qualcomm Snapdragon and/or Intel Atom processor. Processor 410 may comprise at least one application-specific integrated circuit, ASIC. Processor 410 may comprise at least one field-programmable gate array, FPGA. Processor 410 may be means for performing method steps in device 400. Processor 410 may be configured, at least in part by computer instructions, to perform actions.

[0079] A processor may comprise circuitry, or be constituted as circuitry or circuitries, the circuitry or circuitries being configured to perform phases of methods in accordance with example embodiments described herein. As used in this application, the term "circuitry" may refer to one or more or all of the following: (a) hardware-only circuit implementations, such as implementations in only analog and/or digital circuitry, and (b) combinations of hardware circuits and software, such as, as applicable: (i) a combination of analog and/or digital hardware circuit(s) with software/firmware and (ii) any portions of hardware processor(s) with software (including digital signal processor(s)), software, and memory(ies) that work together to cause an apparatus, such as a mobile phone or server, to perform various functions) and (c) hardware circuit(s) and or processor(s), such as a microprocessor(s) or a portion of a microprocessor(s), that requires software (e.g., firmware) for operation, but the software may not be present when it is not needed for operation.

[0080] This definition of circuitry applies to all uses of this term in this application, including in any claims. As a further example, as used in this application, the term circuitry also covers an implementation of merely a hardware circuit or processor (or multiple processors) or portion of a hardware circuit or processor and its (or their) accompanying software and/or firmware. The term circuitry also covers, for example and if applicable to the particular claim element, a baseband integrated circuit or processor integrated circuit for a mobile device or a similar integrated circuit in server, a cellular network device, or other computing or network device.

[0081] Device 400 may comprise memory 420. Memory 420 may comprise random-access memory and/or permanent memory. Memory 420 may comprise at least one RAM chip. Memory 420 may comprise solid-state, magnetic, optical and/or holographic memory, for example. Memory 420 may be at least in part accessible to processor 410. Memory 420 may be at least in part comprised in processor 410. Memory 420 may be means for storing information. Memory 420 may comprise computer instructions that processor 410 is configured to execute. When computer instructions configured to cause processor 410 to perform certain actions are stored in memory 420, and device 400 overall is configured to run under the direction of processor 410 using computer instructions from memory 420, processor 410 and/or its at least one processing core may be considered to be configured to perform said certain actions. Memory 420 may be at least in part comprised in processor 410. Memory 420 may be at least in part external to device 400 but accessible to device 400.

[0082] Device 400 may comprise a transmitter 430. Device 400 may comprise a receiver 440. Transmitter 430 and receiver 440 may be configured to transmit and receive, respectively, information in accordance with at least one cellular or non-cellular standard. Transmitter 430 may comprise more than one transmitter. Receiver 440 may comprise more than one receiver. Transmitter 430 and/or receiver 440 may be configured to operate in accordance with Global System for Mobile communication, GSM, Wideband Code Division Multiple Access, WCDMA, 5G/NR, Long Term Evolution, LTE, IS-95, Wireless Local Area Network, WLAN, Ethernet and/or Worldwide Interoperability for Microwave Access, WiMAX, standards, for example.

[0083] Device 400 may comprise a Near-Field Communication, NFC, transceiver 450. NFC transceiver 450 may support at least one NFC technology, such as Bluetooth, or similar technologies.

[0084] Device 400 may comprise User Interface, UI, 460. UI 460 may comprise at least one of a display, a keyboard, a touchscreen, a vibrator arranged to signal to a user by causing device 400 to vibrate, a speaker and a microphone. A user may be able to operate device 400 via UI 460, for example to accept incoming telephone calls, to originate telephone calls or video calls, to browse the Internet, to manage digital files stored in memory 420 or on a cloud accessible via transmitter 430 and receiver 440, or via NFC transceiver 450, and/or to play games.

[0085] Device 400 may comprise or be arranged to accept a user identity module 470. User identity module 470 may comprise, for example, a Subscriber Identity Module, SIM, card installable in device 400. A user identity module 470 may comprise information identifying a subscription of a user of device 400. A user identity module 470 may comprise cryptographic information usable to verify the identity of a user of device 400 and/or to facilitate encryption of communicated information and billing of the user of device 400 for communication effected via device 400.

[0086] Processor 410 may be furnished with a transmitter arranged to output information from processor 410, via electrical leads internal to device 400, to other devices comprised in device 400. Such a transmitter may comprise a serial bus transmitter arranged to, for example, output information via at least one electrical lead to memory 420 for storage therein. Alternatively to a serial bus, the transmitter may comprise a parallel bus transmitter. Likewise processor 410 may comprise a receiver arranged to receive information in processor 410, via electrical leads internal to device 400, from other devices comprised in device 400. Such a receiver may comprise a serial bus receiver arranged to, for example, receive information via at least one electrical lead from receiver 440 for processing in processor 410. Alternatively to a serial bus, the receiver may comprise a parallel bus receiver.

[0087] Device 400 may comprise further devices not illustrated in FIGURE 4. For example, where device 400 comprises a smartphone, it may comprise at least one digital camera. Some devices 400 may comprise a back-facing camera and a front-facing camera, wherein the back-facing camera may be intended for digital photography and the front-facing camera for video telephony. Device 400 may comprise a fingerprint sensor arranged to authenticate, at least in part, a user of device 400. In some example embodiments, device 400 lacks at least one device described above. For example, some devices 400 may lack a NFC transceiver 450 and/or user identity module 470.

[0088] Processor 410, memory 420, transmitter 430, receiver 440, NFC transceiver 450, UI 460 and/or user identity module 470 may be interconnected by electrical leads internal to device 400 in a multitude of different ways. For example, each of the aforementioned devices may be separately connected to a master bus internal to device 400, to allow for the devices to exchange information. However, as the skilled person will appreciate, this is only one example and depending on the example embodiment various

ways of interconnecting at least two of the aforementioned devices may be selected without departing from the scope of the example embodiments.

[0089] FIGURE 5 illustrates a flow graph of a first method in accordance with at least some embodiments. The phases of the illustrated first method may be performed by wireless terminal 110, or by a control device configured to control the functioning thereof, possibly when installed therein.

[0090] The first method may comprise, at step 510, receiving, from wireless network node 120, a command for sequential switching from a first frequency band to a second frequency band. The first method may also comprise, at step 520, in response to receiving the command, communicating on the first frequency band using a first antenna arrangement during a first time period. Moreover, the first method may comprise, at step 530, activating, during the first time period, a second antenna arrangement for communicating on the second frequency band during a second time period. Finally, the first method may comprise, at step 540, communicating on the second frequency band using the second antenna arrangement during the second time period.

[0091] FIGURE 6 illustrates a flow graph of a second method in accordance with at least some embodiments. The phases of the illustrated second method may be performed by wireless network node 120, or by a control device configured to control the functioning thereof, possibly when installed therein.

[0092] The second method may comprise, at step 610, transmitting, to wireless terminal 110, a command for sequential switching from a first frequency band to a second frequency band. The second method may also comprise, at step 620, communicating on the first frequency band via a first antenna arrangement of wireless terminal 110 during a first time period. Finally, the second method may comprise, at step 630, communicating on the second frequency band via a second antenna arrangement of wireless terminal 110 during a second time period.

[0093] It is to be understood that the embodiments disclosed are not limited to the particular structures, process steps, or materials disclosed herein, but are extended to equivalents thereof as would be recognized by those ordinarily skilled in the relevant arts. It should also be understood that terminology employed herein is used for the purpose of describing particular embodiments only and is not intended to be limiting.

[0094] Reference throughout this specification to one embodiment or an embodiment means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Where reference is made to a numerical value using a term such as, for example, about or substantially, the exact numerical value is also disclosed.

[0095] As used herein, a plurality of items, structural elements, compositional elements, and/or materials may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member. Thus, no individual member of such list should be construed as a de facto equivalent of any other member of the same list solely based on their presentation in a common group without indications to the contrary. In addition, various embodiments and examples may be referred to herein along with alternatives for the various components thereof. It is understood that such embodiments, examples, and alternatives are not to be construed as de facto equivalents of one another, but are to be considered as separate and autonomous representations.

[0096] In an exemplary embodiment, an apparatus, such as, for example, a wireless terminal 110 or a wireless network node 120, or a control device configured to control the functioning thereof, possibly when installed therein, may comprise means for carrying out the embodiments described above and any combination thereof.

[0097] In an exemplary embodiment, a computer program may be configured to cause a method in accordance with the embodiments described above and any combination thereof. In an exemplary embodiment, a computer program product, embodied on a non-transitory computer readable medium, may be configured to control a processor to perform a process comprising the embodiments described above and any combination thereof.

[0098] In an exemplary embodiment, an apparatus, such as, for example, wireless terminal 110 or wireless network node 120, or a control device configured to control the functioning thereof, possibly when installed therein, may comprise at least one processor, and at least one memory including computer program code, wherein the at least one memory and the computer program code are configured to, with the at least one processor,

cause the apparatus at least to perform the embodiments described above and any combination thereof.

[0099] Furthermore, the described features, structures, or characteristics may be combined in any suitable manner in one or more embodiments. In the preceding description, numerous specific details are provided, such as examples of lengths, widths, shapes, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention can be practiced without one or more of the specific details, or with other methods, components, materials, etc. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

[00100] While the forgoing examples are illustrative of the principles of the embodiments in one or more particular applications, it will be apparent to those of ordinary skill in the art that numerous modifications in form, usage and details of implementation can be made without the exercise of inventive faculty, and without departing from the principles and concepts of the invention. Accordingly, it is not intended that the invention be limited, except as by the claims set forth below.

[00101] The verbs “to comprise” and “to include” are used in this document as open limitations that neither exclude nor require the existence of also un-recited features. The features recited in depending claims are mutually freely combinable unless otherwise explicitly stated. Furthermore, it is to be understood that the use of "a" or "an", that is, a singular form, throughout this document does not exclude a plurality.

INDUSTRIAL APPLICABILITY

[00102] At least some embodiments find industrial application in wireless communication networks, wherein frequency adaptation is used. More specifically, at least some embodiments find industrial application in cellular communication networks, such as in 5G/NR networks, wherein multiple BWPs are used.

ACRONYMS LIST

3GPP	3rd Generation Partnership Project
BS	Base Station
BWP	Bandwidth Part
CORESET	Control Resource Set
DCI	Downlink Control Information
GSM	Global System for Mobile communication
IoT	Internet of Things
LTE	Long-Term Evolution
M2M	Machine-to-Machine
MAC	Medium Access Control
MTC	Machine-Type Communications
NFC	Near-Field Communication
NR	New Radio
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
RAT	Radio Access Technology
RRC	Radio Resource Control
SIM	Subscriber Identity Module
UE	User Equipment
UI	User Interface
WCDMA	Wideband Code Division Multiple Access

WiMAX Worldwide Interoperability for Microwave Access

WLAN Wireless Local Area Network

REFERENCE SIGNS LIST

110	Wireless terminal, e.g., UE
120	Wireless network node, e.g., BS
130	Core network
115, 125, 135	Interfaces
210	Activity on the first frequency band, i.e., first BWP
220	Switching from the first to the second frequency band
230	Activity on the second frequency band, i.e., second BWP
215	Period before switching
225	First time period
235	Second time period
245	Period after switching
310 – 350	Signaling steps in FIGURE 3
400 – 470	Structure of the apparatus of FIGURE 4
510 – 540	Phases of the first method in FIGURE 5
610 – 630	Phases of the second method in FIGURE 6

CLAIMS:

1. A method, comprising:
   - receiving, from a wireless network node, a command for sequential switching from a first frequency band to a second frequency band;
   - in response to receiving the command, communicating on the first frequency band using a first antenna arrangement during a first time period;
   - activating, during the first time period, a second antenna arrangement for communicating on the second frequency band during a second time period; and
   - communicating on the second frequency band using the second antenna arrangement during the second time period.

2. A method according to claim 1, further comprising:
   - deactivating the first antenna arrangement for the second time period.

3. A method according to claim 1 or claim 2, further comprising:
   - receiving a configuration for sequential switching from the first frequency band to the second frequency band, the configuration comprising the first time period and the second time period.

4. A method according to any of the preceding claims, further comprising:
   - switching, during the second time period, the first antenna arrangement from operating on the first frequency band to operating on the second frequency band and/or switching, during the first time period, the second antenna arrangement from operating on the first frequency band to operating on the second frequency band.

5. A method according to any of the preceding claims, further comprising:
   - transmitting an indication about a capability of a wireless terminal for sequential switching.

6. A method according to any of the preceding claims, further comprising:

- receiving a first reference signal in the beginning of the second time period for time and frequency synchronization of the second antenna arrangement, for communicating during the second time period.

7. A method according to any of the preceding claims, further comprising:

- receiving a second reference signal upon expiry of the second time period for time and frequency synchronization of the first antenna arrangement, for communicating after the second time period.

8. A method according to any of the preceding claims, wherein the first antenna arrangement comprises at least two first antenna branches and the second antenna arrangement comprises at least two second antenna branches.

9. A method according to any of claims 1 to 8, wherein the first antenna arrangement comprises at least one first antenna panel and the second antenna arrangement comprises at least one second antenna panel.

10. A method according to any of the preceding claims, wherein the first and the second frequency bands are Bandwidth Parts, BWPs.

11. A method according to any of the preceding claims wherein the wireless terminal is a User Equipment, UE, operating according to 3rd Generation Partnership Project, 3GPP, standard specifications.

12. A method, comprising:

- transmitting, to a wireless terminal, a command for sequential switching from a first frequency band to a second frequency band;
- communicating on the first frequency band via a first antenna arrangement of the wireless terminal during a first time period; and
- communicating on the second frequency band via a second antenna arrangement of the wireless terminal during a second time period.

13. A method according to claim 12, further comprising:

- transmitting a configuration for sequential switching from the first frequency band to the second frequency band, the configuration comprising the first time period and the second time period.

14. A method according to claim 12 or claim 13, further comprising:

- receiving an indication about a capability of the wireless terminal for sequential switching.

15. A method according to any of claims 12 to 14, further comprising:

- transmitting a first reference signal in the beginning of the second time period for time and frequency synchronization of the second antenna arrangement, for communicating during the second time period.

16. A method according to any of claims 12 to 15, further comprising:

- transmitting a second reference signal in response to determining an expiry of the second time period and frequency synchronization of the first antenna arrangement, for communicating after the second time period.

17. A method according to any of claims 12 to 16, wherein the first and the second frequency bands are Bandwidth Parts, BWPs.

18. A method according to any of claims 12 to 17, wherein the wireless network node is a Base Station, BS, operating according to 3rd Generation Partnership Project, 3GPP, standard specifications.

19. An apparatus comprising at least one processing core, at least one memory including computer program code, the at least one memory and the computer program code being configured to, with the at least one processing core, cause the apparatus at least to perform:

- receive, from a wireless network node, a command for sequential switching from a first frequency band to a second frequency band; and
- communicate, in response to receiving the command, on the first frequency band using a first antenna arrangement during a first time period;

- activate, during the first time period, a second antenna arrangement for communicating on the second frequency band during a second time period; and
- communicate on the second frequency band using the second antenna arrangement during the second time period.

20. An apparatus according to claim 19, wherein the at least one memory and the computer program code are further configured to, with the at least one processing core, cause the apparatus at least to perform a method according to any of claims 2 – 11.

21. An apparatus comprising at least one processing core, at least one memory including computer program code, the at least one memory and the computer program code being configured to, with the at least one processing core, cause the apparatus at least to perform:

- transmit, to a wireless terminal, a command for sequential switching from a first frequency band to a second frequency band;
- communicate on the first frequency band via a first antenna arrangement of the wireless terminal during a first time period; and
- communicate on the second frequency band via a second antenna arrangement of the wireless terminal during a second time period.

22. An apparatus according to claim 21, wherein the at least one memory and the computer program code are further configured to, with the at least one processing core, cause the apparatus at least to perform a method according to any of claims 13 – 18.

23. An apparatus comprising:

- means for receiving, from a wireless network node, a command for sequential switching from a first frequency band to a second frequency band; and
- means for communicating, in response to receiving the command, on the first frequency band using a first antenna arrangement during a first time period;
- means for activating, during the first time period, a second antenna arrangement for communicating on the second frequency band during a second time period; and
- means for communicating on the second frequency band using the second antenna arrangement during the second time period.

24. An apparatus according to claim 23, further comprising means for performing a method according to any of claims 2 – 11.

25. An apparatus comprising:

- means for transmitting, to a wireless terminal, a command for sequential switching from a first frequency band to a second frequency band;
- means for communicating on the first frequency band via a first antenna arrangement of the wireless terminal during a first time period; and
- means for communicating on the second frequency band via a second antenna arrangement of the wireless terminal during a second time period.

26. A apparatus according to claim 31, further comprising means for performing a method according to any of claims 13 – 18.

27. A non-transitory computer readable medium having stored thereon a set of computer readable instructions that, when executed by at least one processor, cause an apparatus to at least perform a method according to any of claims 1 – 11 or 12 – 18.

28. A computer program configured to perform a method according to any of claims 1 – 11 or 12 – 18.

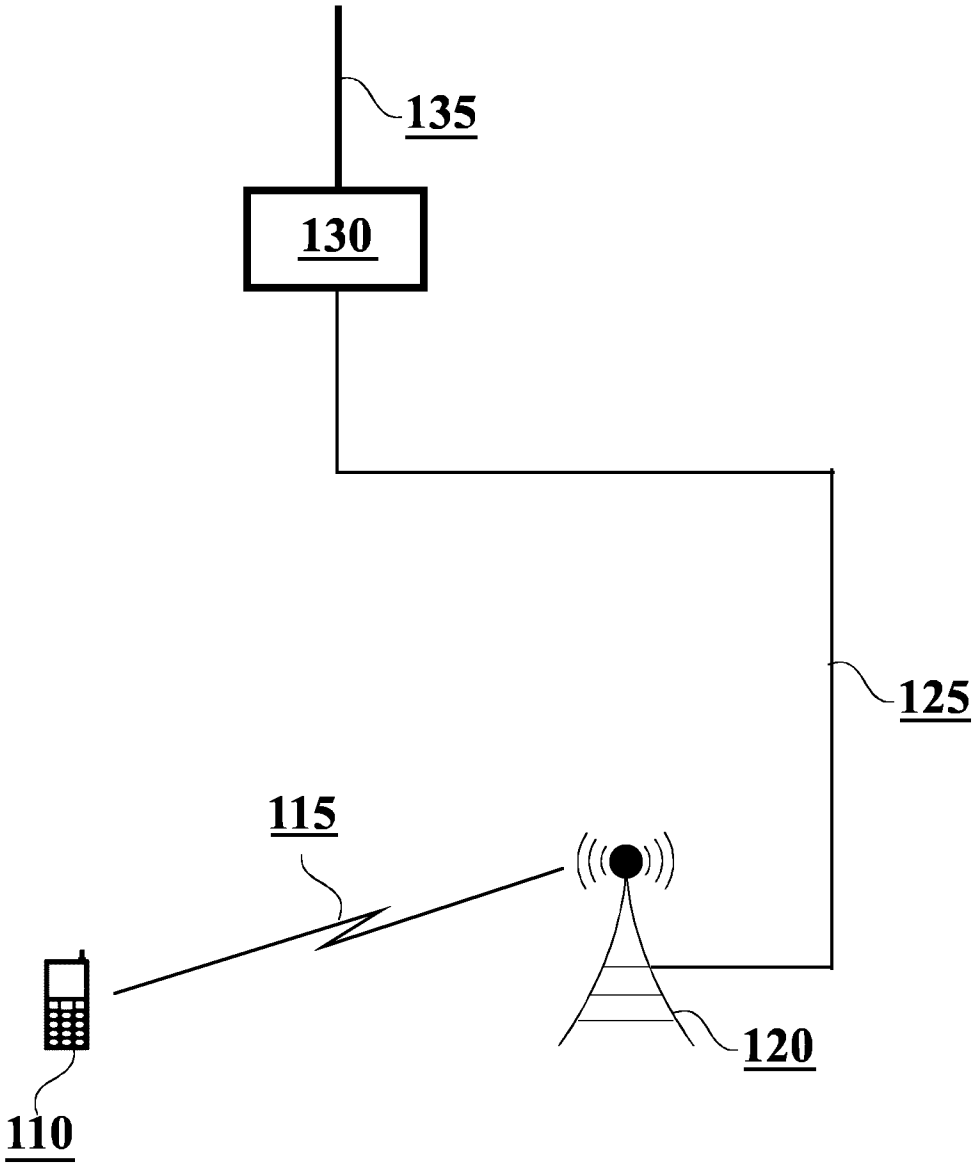
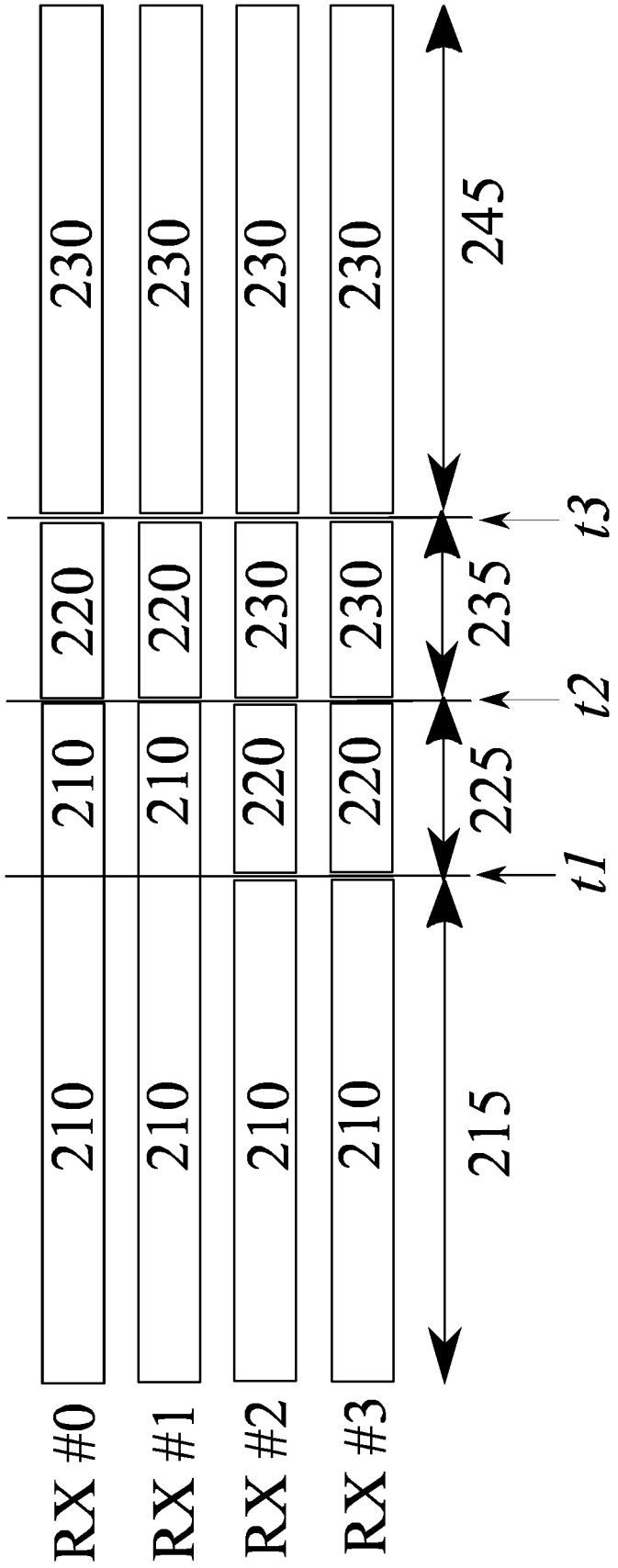


FIGURE 1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RX #2
RX #3

FIGURE 2

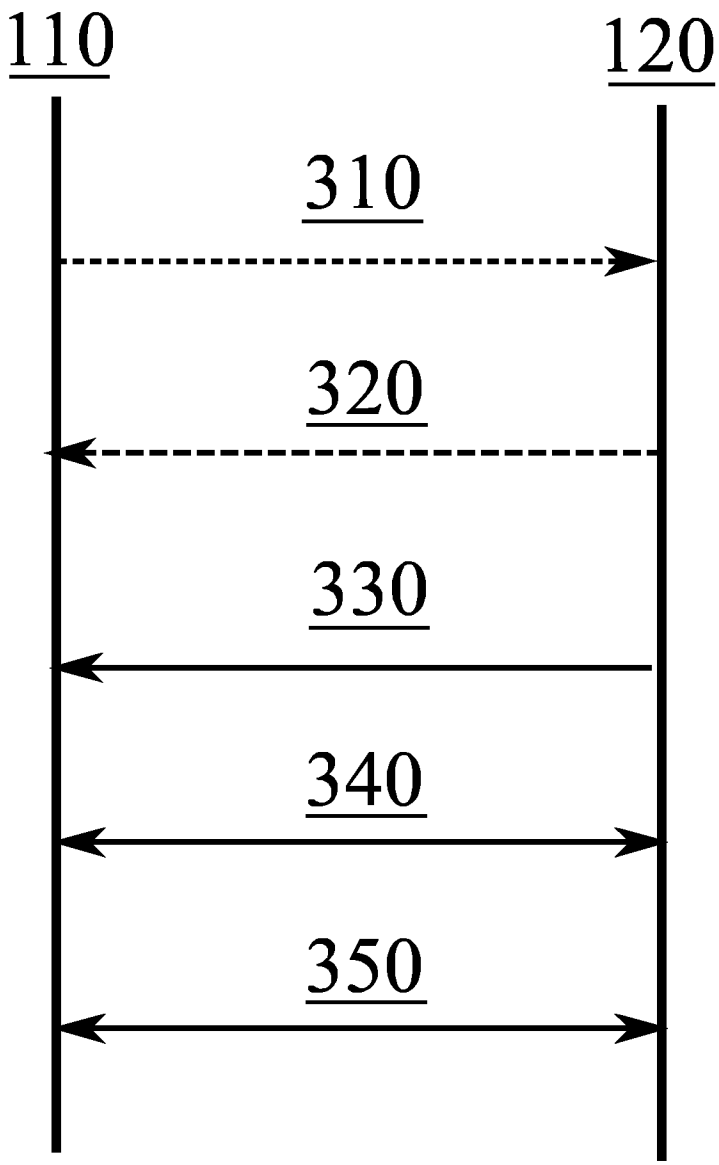

FIGURE 3

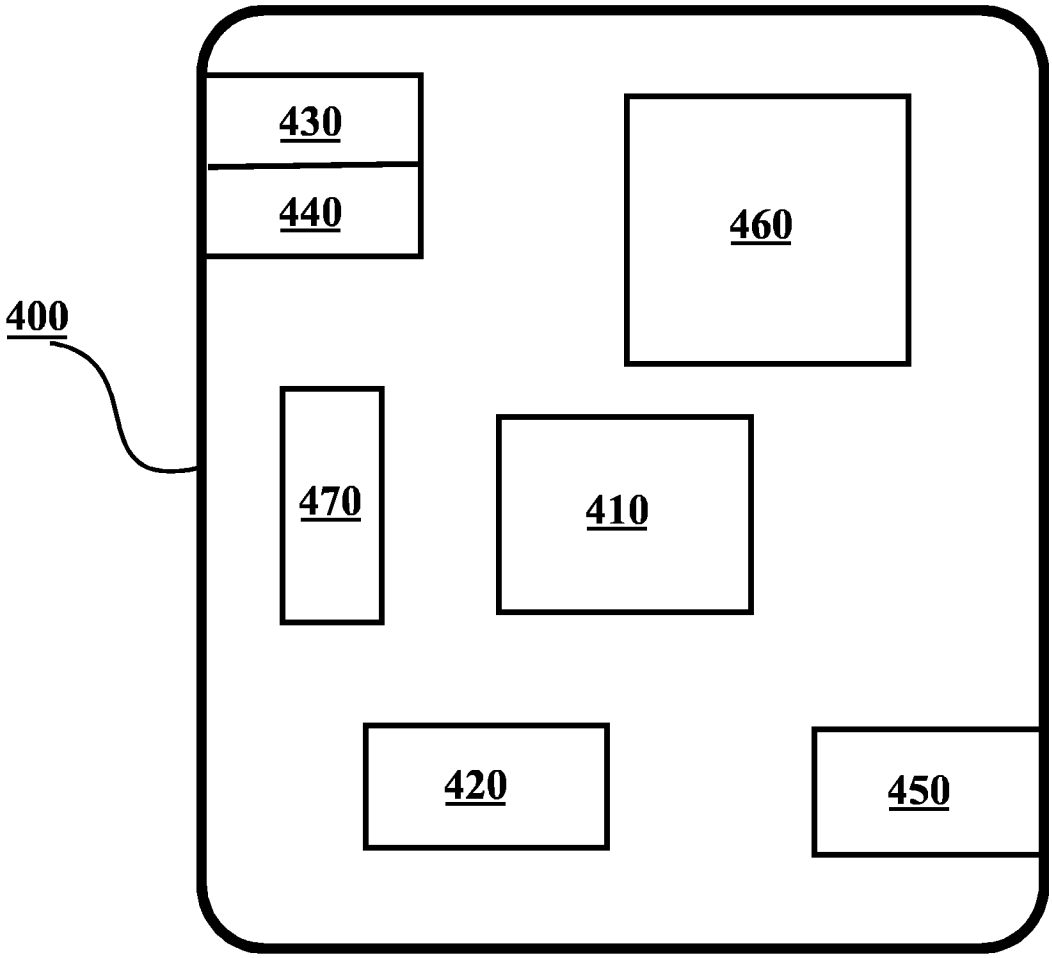

FIGURE 4

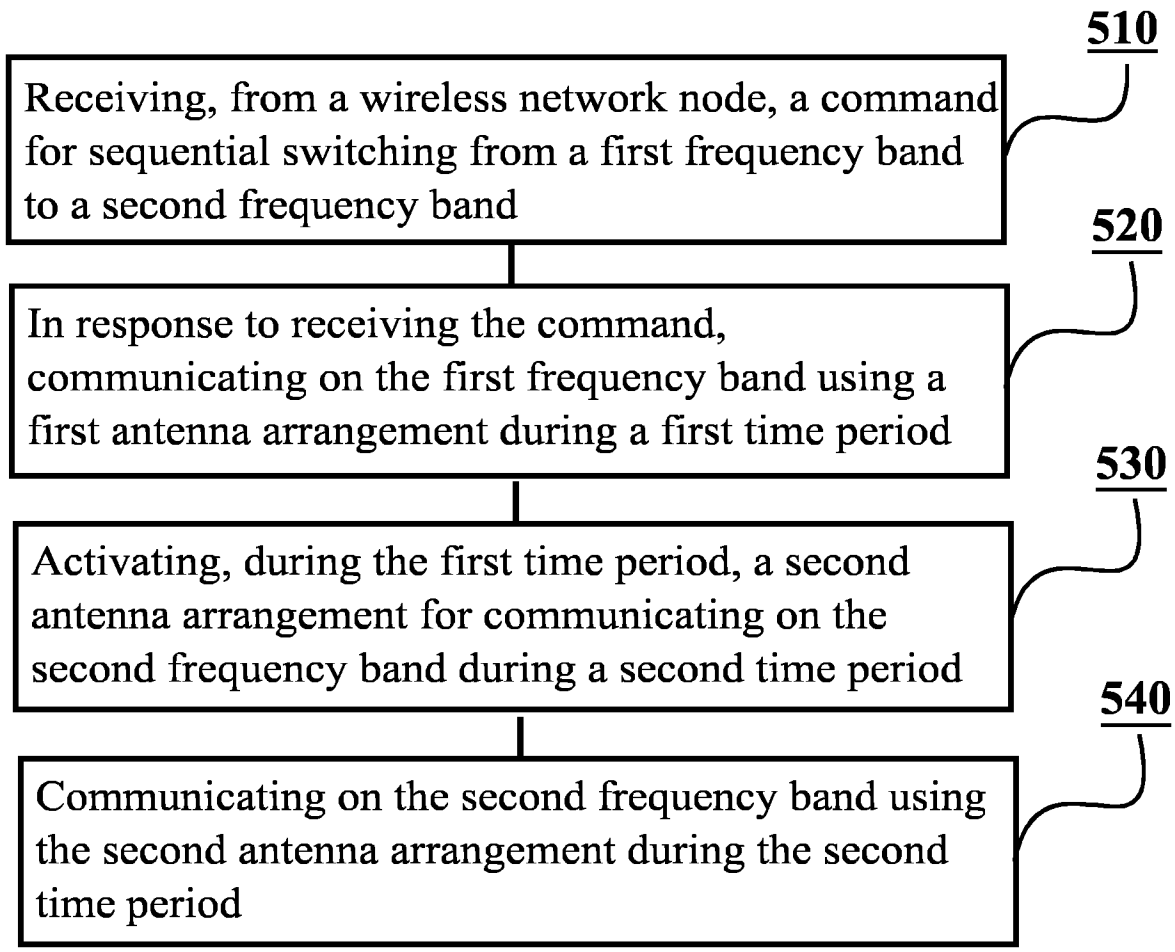
510
Receiving, from a wireless network node, a command for sequential switching from a first frequency band to a second frequency band
520
In response to receiving the command, communicating on the first frequency band using a first antenna arrangement during a first time period
530
Activating, during the first time period, a second antenna arrangement for communicating on the second frequency band during a second time period
540
Communicating on the second frequency band using the second antenna arrangement during the second time period

FIGURE 5

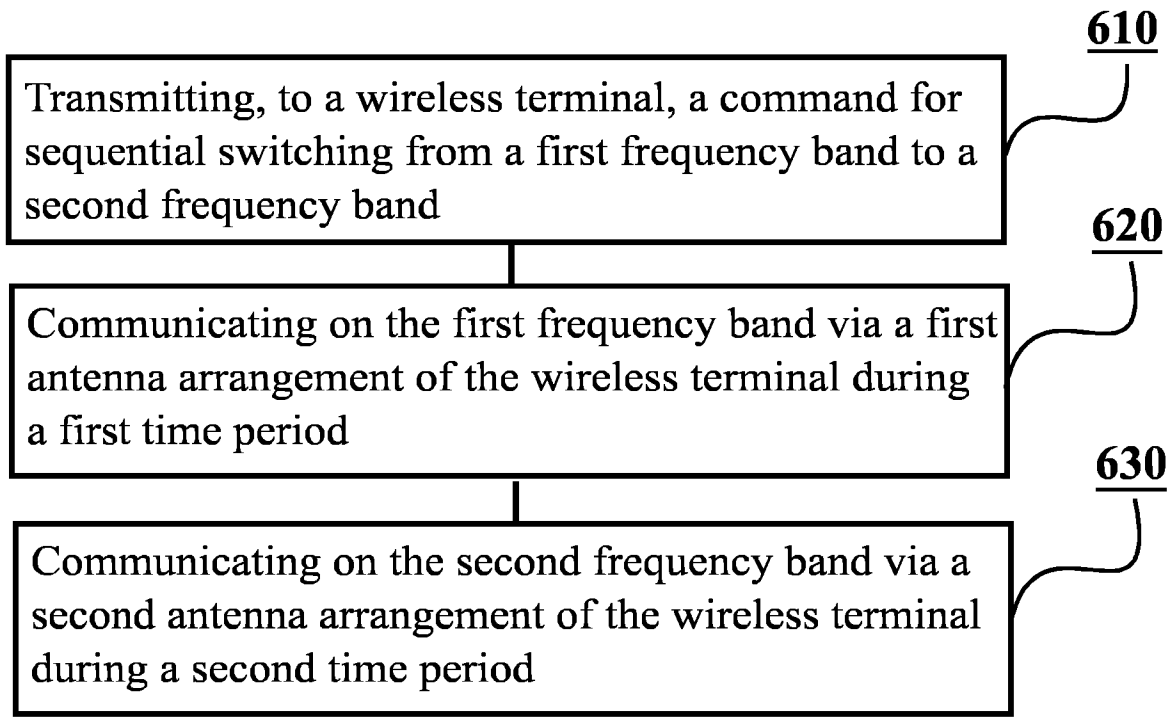
610
Transmitting, to a wireless terminal, a command for sequential switching from a first frequency band to a second frequency band
620
Communicating on the first frequency band via a first antenna arrangement of the wireless terminal during a first time period
630
Communicating on the second frequency band via a second antenna arrangement of the wireless terminal during a second time period

FIGURE 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/053593

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L5/00
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)
H04L

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)

EPO-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 2013/148636 A1 (LUM NICHOLAS W [US] ET AL) 13 June 2013 (2013-06-13)	1,3,4,8, 9,12,13, 19-28
Y	paragraphs [0009], [0048], [0049] paragraphs [0056], [0058], [0065] abstract; claims 1-21; figures 3-7	2,5-7, 10,11, 14-18

-/--

[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
24 October 2019	31/10/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Coppieters, Stefaan

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/053593

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	NOKIA ET AL: "On UE adaptation to the traffic", 3GPP DRAFT; R1-1901188, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG1, no. Taipei, Taiwan; 20180121 - 20180125 20 January 2019 (2019-01-20), XP051594031, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings%5F3GPP%5FSYNC/RAN1/Docs/R1%2D1901188%2Ezip [retrieved on 2019-01-20] 2.3 and 2.4 -----	2,5,10, 11,14, 17,18
Y	KR 2018 0038978 A (KT CORP [KR]) 17 April 2018 (2018-04-17) abstract -& EP 3 525 408 A1 (KT CORP [KR]) 14 August 2019 (2019-08-14) paragraphs [0094], [0105], [0110] -----	6,7,15, 16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2019/053593

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013148636 A1	13-06-2013	CN 103166667 A	19-06-2013
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		HK 1186011 A1	30-06-2017
		JP 5963221 B2	03-08-2016
		JP 2015506142 A	26-02-2015
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