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(54) **ANTENNA SYSTEM AND BASE STATION**

(57) Embodiments of the present invention provide an antenna system and a base station. The antenna system according to the present invention includes a first antenna array configured to form wide beam coverage and a second antenna array configured to form narrow beam coverage. The first antenna array includes at least one column of antennas, where each column of antennas provide at least one wide beam port; the second antenna array includes at least two columns of antennas, and the second antenna array provides at least one narrow beam port. The embodiments of the present invention resolve a problem that close-spaced multi-column antennas can provide only a narrow beam, and satisfy a requirement that an antenna system should provide both a wide beam and a narrow beam.

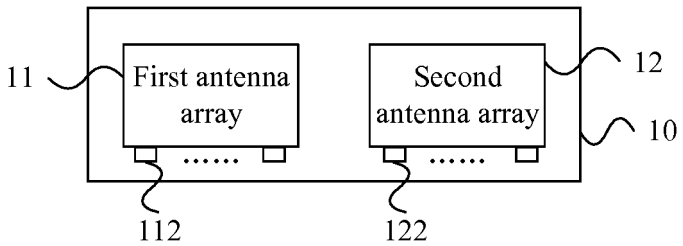

FIG. 1

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Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to communications technologies, and in particular, to an antenna system and a base station.

BACKGROUND

[0002] With the development of communications technologies, antenna deployment is faced with dual challenges: limited space and a small capacity of a site. It has become an inevitable trend that an antenna supports multiple systems. For example, an antenna supports a Global System for Mobile Communications (Global System For Mobile Communications, hereinafter referred to as GSM), a Universal Mobile Telecommunications System (Universal Mobile Telecommunications System, hereinafter referred to as UMTS), and a Long Term Evolution (Long Term Evolution, hereinafter referred to as LTE) system. In an existing technology of deploying closely-spaced multi-column antennas, a single beam is split into multiple beams to implement space division multiple access, thereby achieving an objective of improving an antenna capacity.

[0003] However, this antenna deployment technology can provide only narrow beam coverage, which cannot satisfy a requirement that an antenna system should provide both a wide beam and a narrow beam.

SUMMARY

[0004] Embodiments of the present invention provides an antenna system and a base station, to resolve a problem that close-spaced multi-column antennas can provide only a narrow beam, and to satisfy a requirement that an antenna system should provide both a wide beam and a narrow beam.

[0005] According to a first aspect, an embodiment of the present invention provides an antenna system, including:

a first antenna array configured to form wide beam coverage and a second antenna array configured to form narrow beam coverage, where:
the first antenna array includes at least one column of antennas, where each column of antennas provide at least one wide beam port; the second antenna array includes at least two columns of antennas, and the second antenna array provides at least one narrow beam port.

[0006] With reference to the first aspect, in a first possible implementation manner of the first aspect, an interval between the first antenna array and the second antenna array is greater than a column interval of the second antenna array, and/or, an isolation apparatus is disposed between the first antenna array and the second antenna array.

[0007] With reference to the first aspect or the first possible implementation manner of the first aspect, in a second possible implementation manner of the first aspect, when the first antenna array includes at least two columns of antennas, a column interval of the first antenna array is greater than the column interval of the second antenna array.

[0008] With reference to the first aspect and either one of the first to second possible implementation manners of the first aspect, in a third possible implementation manner of the first aspect, the antenna system further includes a multi-beam forming device, where the second antenna array forms at least one narrow beam by using the multi-beam forming device, and the at least one narrow beam is led out through the narrow beam port.

[0009] With reference to the first aspect, and any one of the first to third possible implementation manners of the first aspect, in a fourth possible implementation manner of the first aspect, the antenna system further includes a multi-band combiner, where the multi-band combiner is connected to the narrow beam port and/or the wide beam port.

[0010] According to a second aspect, an embodiment of the present invention provides a base station, including:

the antenna system according to the first aspect and the first to fourth possible implementation manners of the first aspect, and at least one radio frequency module, where:

the radio frequency module is connected to the antenna system by using at least one wide beam port and/or at least one narrow beam port.

[0011] With reference to the second aspect, in a first possible implementation manner of the second aspect, the at least one wide beam port is connected to one first radio frequency module; or,
the at least one wide beam port is connected to at least two first radio frequency modules by using a multi-band combiner; or,
one of the at least one wide beam port is connected to one first radio frequency module, and the other of the at least one wide beam port are connected to at least two first radio frequency modules by using the multi-band combiner.

[0012] With reference to the second aspect, in a second possible implementation manner of the second aspect, the at least one narrow beam port is connected to one second radio frequency module; or,
the at least one narrow beam port is connected to at least two second radio frequency modules by using the multi-band combiner;or,
one of the at least one narrow beam port is connected to one second radio frequency module, and the other of

the at least one narrow beam port are connected to at least two second radio frequency modules by using the multi-band combiner.

[0013] With reference to the second aspect, in a third possible implementation manner of the second aspect, the at least one wide beam port is connected to one third radio frequency module, and the at least one narrow beam port is connected to the one third radio frequency module;

or,

the at least one wide beam port is connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to one of the third radio frequency modules;

or,

one of the at least one wide beam port is connected to one third radio frequency module, the other of the at least one wide beam port are connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to one of the third radio frequency modules; or,

the at least one wide beam port is connected to one third radio frequency module, and the at least one narrow beam port is connected to at least two third radio frequency modules by using the multi-band combiner; or,

the at least one wide beam port is connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to the at least two third radio frequency modules by using the multi-band combiner; or,

one of the at least one wide beam port is connected to one third radio frequency module, the other of the at least one wide beam port are connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to the at least two third radio frequency modules by using the multi-band combiner; or,

the at least one wide beam port is connected to one third radio frequency module, one of the at least one narrow beam port is connected to the one third radio frequency module, and the other of the at least one narrow beam port are connected to at least two third radio frequency modules by using the multi-band combiner; or,

the at least one wide beam port is connected to at least two third radio frequency modules by using the multi-band combiner, one of the at least one narrow beam port is connected to one of the third radio frequency modules, and the other of the at least one narrow beam port are connected to the at least two third radio frequency modules by using the multi-band combiner; or,

one of the at least one wide beam port is connected to one third radio frequency module, the other of the at least one wide beam port are connected to at least two third radio frequency modules by using the multi-band combiner, one of the at least one narrow beam port is connected to the one third radio frequency module, and the other of the at least one narrow beam port are connected to the at least two third radio frequency modules by using the multi-band combiner.

[0014] The embodiments of the present invention provide an antenna system and a base station, where the antenna system includes a first antenna array configured to form wide beam coverage and a second antenna array configured to form narrow beam coverage. The first antenna array includes at least one column of antennas, where each column of antennas provide at least one wide beam port; the second antenna array includes at least two columns of antennas, and the second antenna array provides at least one narrow beam port. A wide beam formed by the antenna system is led out through the at least one wide beam port, and a narrow beam formed by the antenna system is led out through the at least one narrow beam port. In this way, a problem that close-spaced multi-column antennas can provide only a narrow beam is resolved, and a requirement that an antenna system should provide both a wide beam and a narrow beam is satisfied.

BRIEF DESCRIPTION OF DRAWINGS

[0015] To describe the technical solutions in the embodiments of the present invention or in the prior art more clearly, the following briefly introduces the accompanying drawings required for describing the embodiments or the prior art. Apparently, the accompanying drawings in the following description show some embodiments of the present invention, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a schematic structural diagram of an antenna system according to a first embodiment of the present invention;

FIG. 2 is an example of a schematic structural diagram of an antenna system according to the first embodiment of the present invention;

FIG. 3 is a schematic diagram of a wide beam in an antenna system according to the first embodiment of the present invention;

FIG. 4 is a schematic diagram of a narrow beam in an antenna system according to the first embodiment of the present invention;

FIG. 5 is a schematic structural diagram of an antenna system according to a second embodiment of the present invention;

FIG. 6 is a schematic structural diagram of an antenna system according to a third embodiment of the present invention;

FIG. 7 is a schematic structural diagram of an antenna system according to a fourth embodiment of the present invention;

FIG. 8 is a schematic structural diagram of a base station according to a first embodiment of the present invention;

FIG. 9 is a schematic structural diagram of a base station according to a second embodiment of the

present invention;

FIG. 10 is a schematic structural diagram of a base station according to a third embodiment of the present invention;

FIG. 11 is a schematic structural diagram of a base station according to a fourth embodiment of the present invention;

FIG. 12 is a schematic diagram of a wide/narrow beam 1 in a base station according to the fourth embodiment of the present invention; and

FIG. 13 is a schematic diagram of a wide/narrow beam 2 in a base station according to the fourth embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0016] To make the objectives, technical solutions, and advantages of the embodiments of the present invention clearer, the following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are some but not all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0017] FIG. 1 is a schematic structural diagram of an antenna system according to a first embodiment of the present invention. As shown in FIG. 1, the antenna system 10 in this embodiment may include: a first antenna array 11 and a second antenna array 12, where the first antenna array 11 is configured to form wide beam coverage, and the second antenna array 12 is configured to form narrow beam coverage. The first antenna array 11 includes at least one column of antennas, where each column of antennas provide at least one wide beam port 112; the second antenna array 12 includes at least two columns of antennas, and the second antenna array provides at least one narrow beam port 122.

[0018] FIG. 2 is an example of a schematic structural diagram of an antenna system according to the first embodiment of the present invention. As shown in FIG. 2, the antenna system 10 includes a first antenna array 11 and a second antenna array 12, where the first antenna array 11 includes one column of antennas 111 and provides a wide beam port 112; the second antenna array 12 includes four columns of antennas 121, and provides three narrow beam ports: 122a, 122b, and 122c. A narrow beam is led out through a narrow beam port.

[0019] FIG. 3 is a schematic diagram of a wide beam in an antenna system according to the first embodiment of the present invention. As shown in FIG. 3, a wide beam formed by one column of antennas 111 of the first antenna array 11 in FIG. 2, that is, an omnidirectional beam, may cover a relatively large range. FIG. 4 is a schematic diagram of a narrow beam in an antenna system according to the first embodiment of the present invention. As shown in FIG. 4, the four columns of antennas 121 of the second antenna array 12 in FIG. 2 form coverage of three narrow beams, which are respectively led out through the three narrow beam ports 122a, 122b and 122c of the second antenna array 12. A coverage range of each narrow beam is less than a coverage range of a wide beam. By using a technology of deploying close-spaced multi-column antennas, the second antenna array 12 splits a single beam into multiple beams to implement space division multiple access, thereby improving an antenna capacity.

[0020] The antenna system according to this embodiment includes a first antenna array configured to form a wide beam and a second antenna array configured to form a narrow beam. The first antenna array includes at least one column of antennas, where each column of antennas provide at least one wide beam port; the second antenna array includes at least two columns of antennas, and the second antenna array provides at least one narrow beam port. The wide beam formed by the antenna system is led out through the at least one wide beam port, and the narrow beam formed by the antenna system is led out through the at least one narrow beam port. In this way, a problem that close-spaced multi-column antennas can provide only a narrow beam is resolved, and a requirement that an antenna system should provide both a wide beam and a narrow beam is satisfied.

[0021] Further, on the basis of the antenna structure shown in FIG. 1, in the antenna system 10 according to this embodiment, an interval between the first antenna array 11 and the second antenna array 12 is greater than a column interval of the second antenna array 12, and/or, an isolation apparatus is disposed between the first antenna array 11 and the second antenna array 12, to reduce mutual coupling between the first antenna array 11 and the second antenna array 12. FIG. 5 is a schematic structural diagram of an antenna system according to a second embodiment of the present invention. As shown in FIG. 5, on the basis of the antenna structure shown in FIG. 1, further, an isolation apparatus 21 is disposed between the first antenna array 11 and the second antenna array 12, where the isolation apparatus 21 is configured to reduce mutual coupling between the first antenna array 11 and the second antenna array 12, thereby ensuring beam quality of a wide beam. For example, the isolation apparatus 21 may be an isolation wall or an isolation plate, which is not specifically limited in this embodiment.

[0022] Further, when the first antenna array includes at least two columns of antennas, a column interval of the first antenna array is greater than the column interval of the second antenna array.

[0023] In this embodiment, the first antenna array forms wide beam coverage by setting a column interval of multiple columns of antennas of a first antenna array to be greater than a column interval of a second antenna array. A greater column interval of the first antenna array may reduce interference between the columns of anten-

nas that provide the wide beam coverage.

[0024] FIG. 6 is a schematic structural diagram of an antenna system according to a third embodiment of the present invention. As shown in FIG. 6, on the basis of the antenna structure shown in the foregoing two embodiments, the antenna system 10 according to this embodiment may further include a multi-beam forming device 31, where the multi-beam forming device 31 is connected to the second antenna array 12, the second antenna array 12 forms at least one narrow beam by using the multi-beam forming device 31, and the at least one narrow beam is led out through the narrow beam port 122.

[0025] In this embodiment, the second antenna array 12 is configured to form coverage of a narrow beam, where a specific direction, a specific coverage area, a specific quantity of beams, and the like of the narrow beam may be controlled by the multi-beam forming device 31. For example, the multi-beam forming device 31 may adjust parameters such as a phase and an amplitude of an antenna array, thereby forming coverage of multiple narrow beams.

[0026] In this embodiment, a multi-beam forming device is integrated into an antenna system, and no multi-beam forming device needs to be additionally configured for the antenna system; therefore, a function of forming wide and narrow beams by the antenna system becomes more intelligent. In addition, in the antenna system, a wide beam is led out through a wide beam port and a narrow beam is led out through a narrow beam port, so that the antenna system can provide only a wide beam or only a narrow beam as required, or provide both a wide beam and a narrow beam.

[0027] FIG. 7 is a schematic structural diagram of an antenna system according to a fourth embodiment of the present invention. On the basis of the antenna structure shown in FIG. 1, the antenna system 10 according to this embodiment may further include a multi-band combiner 41, where the multi-band combiner 41 is connected to a wide beam port and/or a narrow beam port, and the antenna system 10 combines signals of different frequency bands into a mixed signal by using the multi-band combiner 4 or divides the mixed signal into the signals of the different frequency bands.

[0028] In this embodiment, the multi-band combiner 41 may combine signals of different frequency bands into a mixed signal, or divide the mixed signal into the signals of the different frequency bands, so that the antenna system can perform processing on the signals of the different frequency bands simultaneously. For example, the antenna system can combine a signal of a frequency band supported by a GSM system and a signal of a frequency band supported by an LTE system, and feed a combined signal into the antenna system, thereby implementing processing of the two signals of the different frequency bands by the antenna system.

[0029] In this embodiment, a multi-band combiner is integrated into an antenna system, and a port for transmitting a mixed signal is directly provided for a radio frequency module, thereby simplifying a connection structure between the antenna system and the radio frequency module.

[0030] Further, as shown in FIG. 7, the multi-band combiner 41 may be integrated into the antenna system and serve as a component of the antenna system, or may not be integrated into the antenna system, but serve as an independent structure, and be connected to the antenna system 10, which is not specifically limited herein.

[0031] FIG. 8 is a schematic structural diagram of a base station according to a first embodiment of the present invention. As shown in FIG. 8, a system of this embodiment includes an antenna system 10 and at least one radio frequency module 20, where the antenna system 10 may use a structure of any one of the antenna system embodiments in FIG. 1 to FIG. 7 (except FIG. 3 and FIG. 4), and the radio frequency module 20 is connected to the antenna system 10 by using at least one wide beam port and/or at least one narrow beam port.

[0032] By using several specific embodiments, the following describes in detail the structure of the base station in the embodiment shown in FIG. 8.

[0033] FIG. 9 is a schematic structural diagram of a base station according to a second embodiment of the present invention. As shown in FIG. 9, the antenna system 10 includes a first antenna array 11 and a second antenna array 12, where the first antenna array 11 includes one column of antennas 111a and another column of antennas 111b, the column of antennas 111a provides a wide beam port 112a, and the column of antennas 111b provides a wide beam port 112b; the second antenna array 12 includes four columns of antennas 121, and provides three narrow beam ports 122a, 122b, and 122c, where three narrow beams formed by the second antenna array 12 are led out through the narrow beam ports 122a, 122b, and 122c, respectively.

[0034] The antenna system is connected to a first radio frequency module by using a wide beam port. A connection manner may be that a wide beam port is connected to one first radio frequency module, or that a wide beam port is connected, by using a multi-band combiner, to two or more first radio frequency modules that support different frequency bands. In this embodiment, a first radio frequency module is connected to a wide beam port; therefore, the first radio frequency module is a radio frequency module that supports a wide beam. As shown in FIG. 9, in this embodiment, there are three first radio frequency modules that support different frequency bands, which are a first radio frequency module 21 that supports a frequency band 1, a first radio frequency module 22 that supports a frequency band 2, and a first radio frequency module 23 that supports a frequency band 3, respectively.

[0035] In this embodiment, the wide beam port 112a is connected to the first radio frequency module 21 that supports the frequency band 1 and the first radio frequency module 22 that supports the frequency band 2 by using a multi-band combiner 40, and the other wide beam port

112b is connected to the first radio frequency module 23 that supports the frequency band 3. In this connection manner, the column of antennas 111a can receive and send a mixed signal obtained by combining a signal of the frequency band 1 and a signal of the frequency band 2, the column of antennas 111b can receive and send a signal of the frequency band 3, where the frequency band 1, the frequency band 2, and the frequency band 3 herein may be any communication frequency band, which is not specifically limited herein. In the foregoing connection manner, the antenna system can provide coverage of wide beams of different frequency bands, and a coverage range of the wide beams may be a range shown in FIG. 3.

[0036] FIG. 10 is a schematic structural diagram of a base station according to a third embodiment of the present invention. As shown in FIG. 10, an antenna system 10 includes a first antenna array 11 and a second antenna array 12, where the first antenna array 11 includes one column of antennas 111a and another column of antennas 111b, the column of antennas 111a provides a wide beam port 112a, and the column of antennas 111b provides a wide beam port 112b; the second antenna array 12 includes four columns of antennas 121, and provides three narrow beam ports 122a, 122b, and 122c, where three narrow beams formed by the second antenna array 12 are led out through the narrow beam ports 122a, 122b, and 122c, respectively.

[0037] The antenna system is connected to a second radio frequency module by using a wide beam port. A connection manner may be that a narrow beam port is connected to one second radio frequency module, or that a narrow beam port is connected, by using a multi-band combiner, to two or more second radio frequency modules that support different frequency bands. In this embodiment, a second radio frequency module is connected to a narrow beam port; therefore, the second radio frequency module is a radio frequency module that supports a narrow beam. As shown in FIG. 10, in this embodiment, there are three second radio frequency modules that support different frequency bands, which are a second radio frequency module 31 that supports a frequency band 1, a second radio frequency module 32 that supports a frequency band 2, and a second radio frequency module 33 that supports a frequency band 3, respectively.

[0038] In this embodiment, the narrow beam port 122a is connected to the second radio frequency module 31 that supports the frequency band 1, the second radio frequency module 32 that supports the frequency band 2, and the second radio frequency module 33 that supports the frequency band 3 by using a multi-band combiner 40a, the narrow beam port 122b is connected to the second radio frequency module 31 that supports the frequency band 1, the second radio frequency module 32 that supports the frequency band 2, and the second radio frequency module 33 that supports the frequency band 3 by using a multi-band combiner 40b, and the narrow beam port 122c is connected to the second radio frequency module 31 that supports the frequency band 1, the second radio frequency module 32 that supports the frequency band 2, and the second radio frequency module 33 that supports the frequency band 3 by using a multi-band combiner 40c. In this connection manner, the second antenna array 12 can receive and send a mixed signal obtained by combining a signal of the frequency band 1, a signal of the frequency band 2, and a signal of the frequency band 3, where the frequency band 1, the frequency band 2, and the frequency band 3 herein may be any communication frequency band, which is not specifically limited herein. In the foregoing connection manner, the antenna system can provide coverage of narrow beams of different frequency bands, and a coverage range of the narrow beams may be a range shown in FIG. 4.

[0039] FIG. 11 is a schematic structural diagram of a base station according to a fourth embodiment of the present invention. As shown in FIG. 11, an antenna system 10 includes a first antenna array 11 and a second antenna array 12, where the first antenna array 11 includes one column of antennas 111a and another column of antennas 111b, the column of antennas 111a provides a wide beam port 112a, and the column of antennas 111b provides a wide beam port 112b; the second antenna array 12 includes four columns of antennas 121, and provides three narrow beam ports 122a, 122b, and 122c, where three narrow beams formed by the second antenna array 12 are led out through the narrow beam ports 122a, 122b, and 122c, respectively.

[0040] Both a wide beam port and a narrow beam port of the antenna system are connected to a third radio frequency module. A connection manner may be that both a wide beam port and a narrow beam port are connected to one third radio frequency module, or that a wide beam port is connected, by using a multi-band combiner, to two or more third radio frequency modules that support different frequency bands, and a narrow beam port is connected, by using a multi-band combiner, to the foregoing two or more third radio frequency modules that support the different frequency bands. In this embodiment, a third radio frequency module is connected to both a wide beam port and a narrow beam port; therefore, the third radio frequency module is a radio frequency module that supports both a wide beam and a narrow beam. As shown in FIG. 11, in this embodiment, there are three third radio frequency modules that support different frequency bands, which are a third radio frequency module 41 that supports a frequency band 1, a third radio frequency module 42 that supports a frequency band 2, and a third radio frequency module 43 that supports a frequency band 3.

[0041] In this embodiment, the wide beam port 112a is connected to the third radio frequency module 41 that supports the frequency band 1, and the other wide beam port 112b is connected to the third radio frequency module 42 that supports the frequency band 2 and the third radio frequency module 43 that supports the frequency band 3 by using a multi-band combiner 40a; the narrow

beam port 122a is connected to the third radio frequency module 41 that supports the frequency band 1 and the third radio frequency module 42 that supports the frequency band 2 by using a multi-band combiner 40b, and the other two narrow beam ports 122b and 122c are both connected to the third radio frequency module 43 that supports the frequency band 3. In this connection manner, the column of antennas 111a can receive and send a signal of the frequency band 1, and the column of antennas 111b may receive and send a mixed signal obtained by combining a signal of the frequency band 2 and a signal of the frequency band 3, where the frequency band 1, the frequency band 2, and the frequency band 3 may be any communication frequency band, which is not specifically limited herein. In the foregoing connection manner, the antenna system can provide coverage of wide beams of different frequency bands, and both the third radio frequency module 41 that supports the frequency band 1 and the third radio frequency module 42 that supports the frequency band 2 are connected to the narrow beam port 122a; therefore, a coverage range of wide and narrow beams provided by the antenna system to the two third radio frequency modules may be a range shown in FIG. 12. A wide beam provides a larger coverage area, and a narrow beam led out through the narrow beam port 122a provides key area coverage. FIG. 12 is a schematic diagram of a wide/narrow beam 1 according to a fourth embodiment of the present invention. The third radio frequency module 42 that supports the frequency band 3 is connected to both the narrow beam ports 122b and 122c; therefore, a coverage range of wide and narrow beams provided by the antenna system to the third radio frequency module may be a range shown in FIG. 13. A wide beam provides a larger coverage area, and narrow beams led out through the narrow beam ports 122b and 122c provide key area coverage. FIG. 13 is a schematic diagram of a wide/narrow beam 2 according to the fourth embodiment of the present invention.

[0042] Persons of ordinary skill in the art may understand that all or some of the steps of the method embodiments may be implemented by a program instructing related hardware. The program may be stored in a computer-readable storage medium. When the program runs, the steps of the method embodiments are performed. The foregoing storage medium includes: any medium that can store program code, such as a ROM, a RAM, a magnetic disk, or an optical disc.

[0043] Finally, it should be noted that the foregoing embodiments are merely intended for describing the technical solutions of the present invention, but not for limiting the present invention. Although the present invention is described in detail with reference to the foregoing embodiments, persons of ordinary skill in the art should understand that they may still make modifications to the technical solutions described in the foregoing embodiments or make equivalent replacements to some or all technical features thereof, without departing from the scope of the technical solutions of the embodiments of the present invention.

Claims

1. An antenna system, comprising:

   a first antenna array configured to form wide beam coverage and a second antenna array configured to form narrow beam coverage, wherein:

   the first antenna array comprises at least one column of antennas, wherein each column of antennas provide at least one wide beam port; the second antenna array comprises at least two columns of antennas, and the second antenna array provides at least one narrow beam port.

2. The antenna system according to claim 1, wherein an interval between the first antenna array and the second antenna array is greater than a column interval of the second antenna array, and/or, an isolation apparatus is disposed between the first antenna array and the second antenna array.

3. The antenna system according to claim 1 or 2, wherein when the first antenna array comprises at least two columns of antennas, a column interval of the first antenna array is greater than the column interval of the second antenna array.

4. The antenna system according to any one of claims 1 to 3, further comprising a multi-beam forming device, wherein the second antenna array forms at least one narrow beam by using the multi-beam forming device, and the at least one narrow beam is led out through the narrow beam port.

5. The antenna system according to any one of claims 1 to 4, further comprising a multi-band combiner, wherein the multi-band combiner is connected to the narrow beam port and/or the wide beam port.

6. A base station, comprising the antenna system according to any one of claims 1 to 5 and at least one radio frequency module, wherein:

   the radio frequency module is connected to the antenna system by using the at least one wide beam port and/or the at least one narrow beam port.

7. The base station according to claim 6, wherein the at least one wide beam port is connected to one first radio frequency module; or,
   the at least one wide beam port is connected to at

least two first radio frequency modules by using a multi-band combiner; or,
one of the at least one wide beam port is connected to one first radio frequency module, and the other of the at least one wide beam port are connected to at least two first radio frequency modules by using the multi-band combiner.

8. The base station according to claim 6, wherein the at least one narrow beam port is connected to one second radio frequency module; or,
the at least one narrow beam port is connected to at least two second radio frequency modules by using the multi-band combiner; or,
one of the at least one narrow beam port is connected to one second radio frequency module, and the other of the at least one narrow beam port are connected to at least two second radio frequency modules by using the multi-band combiner.

9. The base station according to claim 6, wherein the at least one wide beam port is connected to one third radio frequency module, and the at least one narrow beam port is connected to the one third radio frequency module; or,
the at least one wide beam port is connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to one of the third radio frequency modules; or,
one of the at least one wide beam port is connected to one third radio frequency module, the other of the at least one wide beam port are connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to one of the third radio frequency modules; or,
the at least one wide beam port is connected to one third radio frequency module, and the at least one narrow beam port is connected to at least two third radio frequency modules by using the multi-band combiner; or,
the at least one wide beam port is connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to the at least two third radio frequency modules by using the multi-band combiner; or,
one of the at least one wide beam port is connected to one third radio frequency module, the other of the at least one wide beam port are connected to at least two third radio frequency modules by using the multi-band combiner, and the at least one narrow beam port is connected to the at least two third radio frequency modules by using the multi-band combiner; or,
the at least one wide beam port is connected to one third radio frequency module, one of the at least one narrow beam port is connected to the one third radio frequency module, and the other of the at least one narrow beam port are connected to at least two third radio frequency modules by using the multi-band combiner; or,
the at least one wide beam port is connected to at least two third radio frequency modules by using the multi-band combiner, one of the at least one narrow beam port is connected to one of the third radio frequency modules, and the other of the at least one narrow beam port are connected to the at least two third radio frequency modules by using the multi-band combiner; or,
one of the at least one wide beam port is connected to one third radio frequency module, the other of the at least one wide beam port are connected to at least two third radio frequency modules by using the multi-band combiner, one of the at least one narrow beam port is connected to the one third radio frequency module, and the other of the at least one narrow beam port are connected to the at least two third radio frequency modules by using the multi-band combiner.

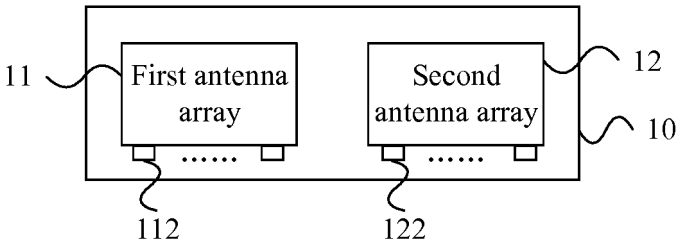
11
First antenna array
Second antenna array
12
10
112
122

FIG. 1

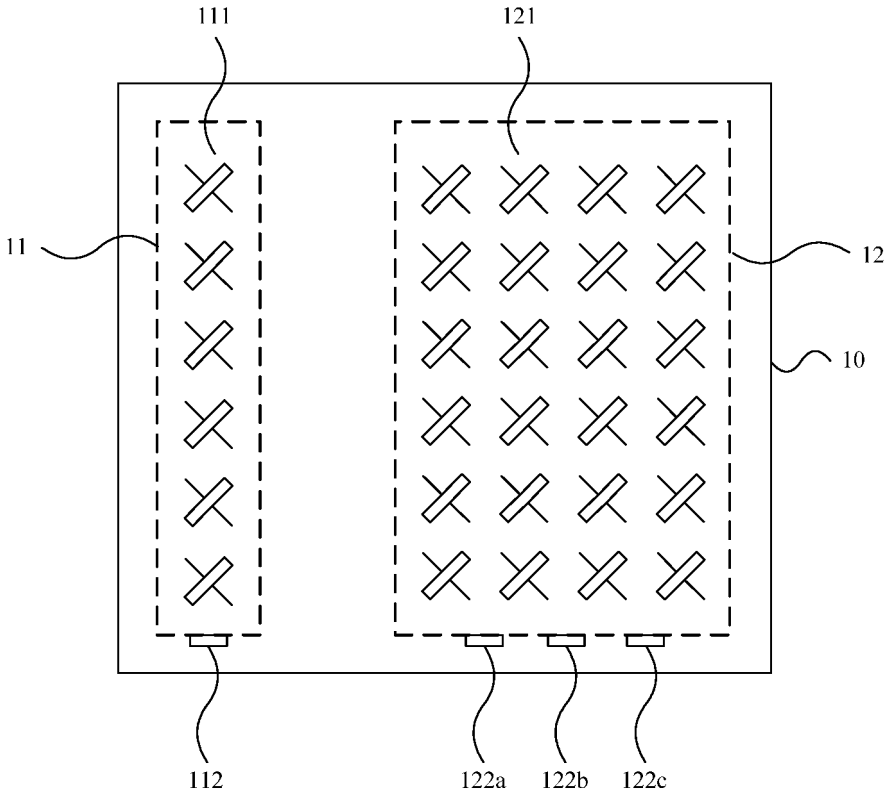
111
121
11
12
10
112
122a
122b
122c

FIG. 2

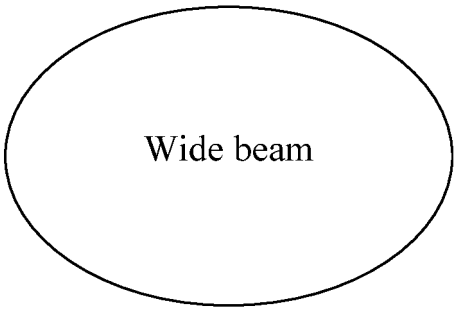

FIG. 3

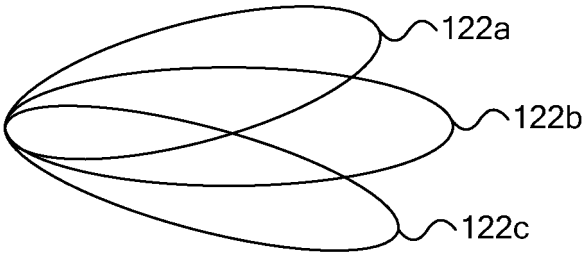

FIG. 4

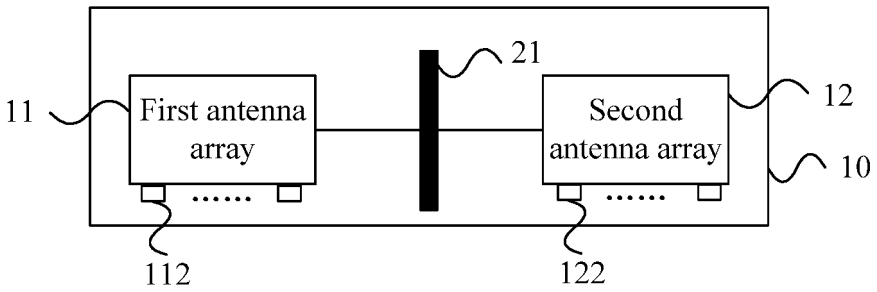

FIG. 5

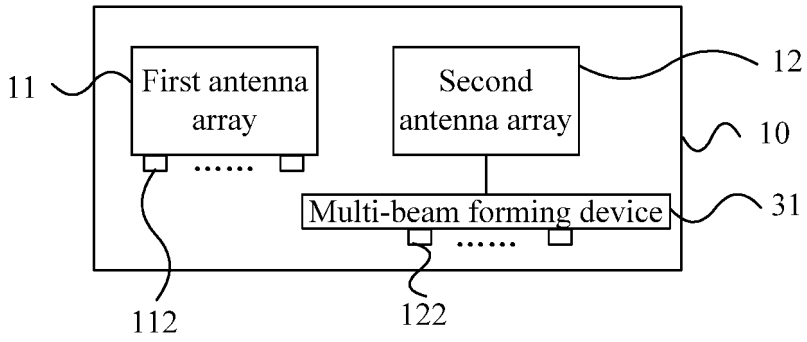

FIG. 6

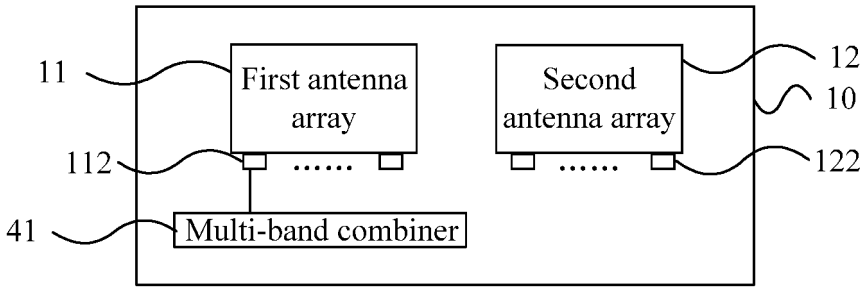

FIG. 7

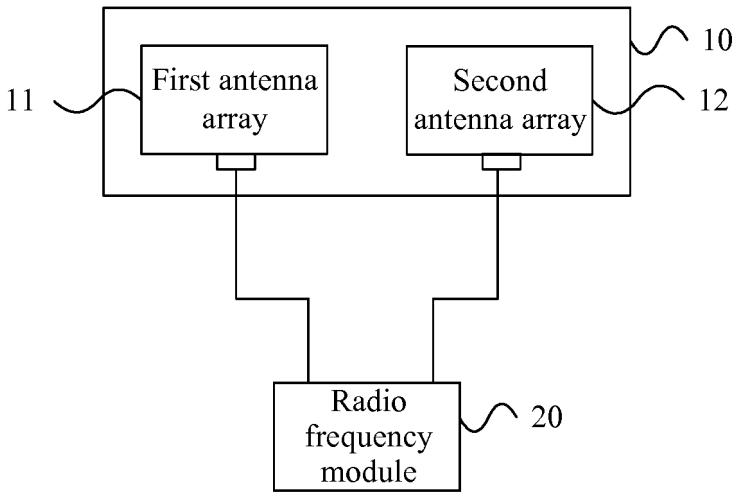

FIG. 8

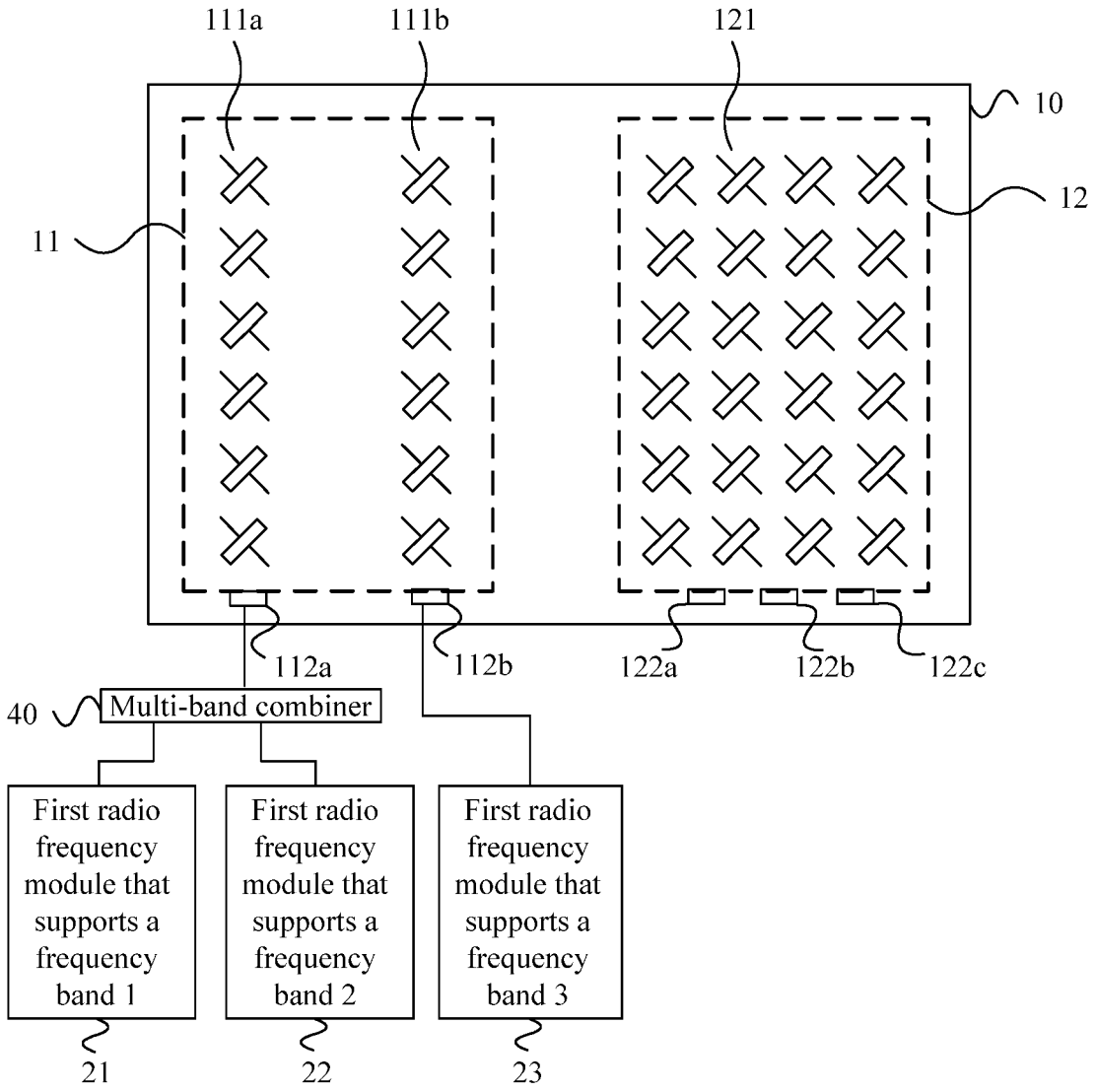
111a
111b
121
10
12
11
112a
112b
122a
122b
122c
40
Multi-band combiner
First radio frequency module that supports a frequency band 1
First radio frequency module that supports a frequency band 2
First radio frequency module that supports a frequency band 3
21
22
23

FIG. 9

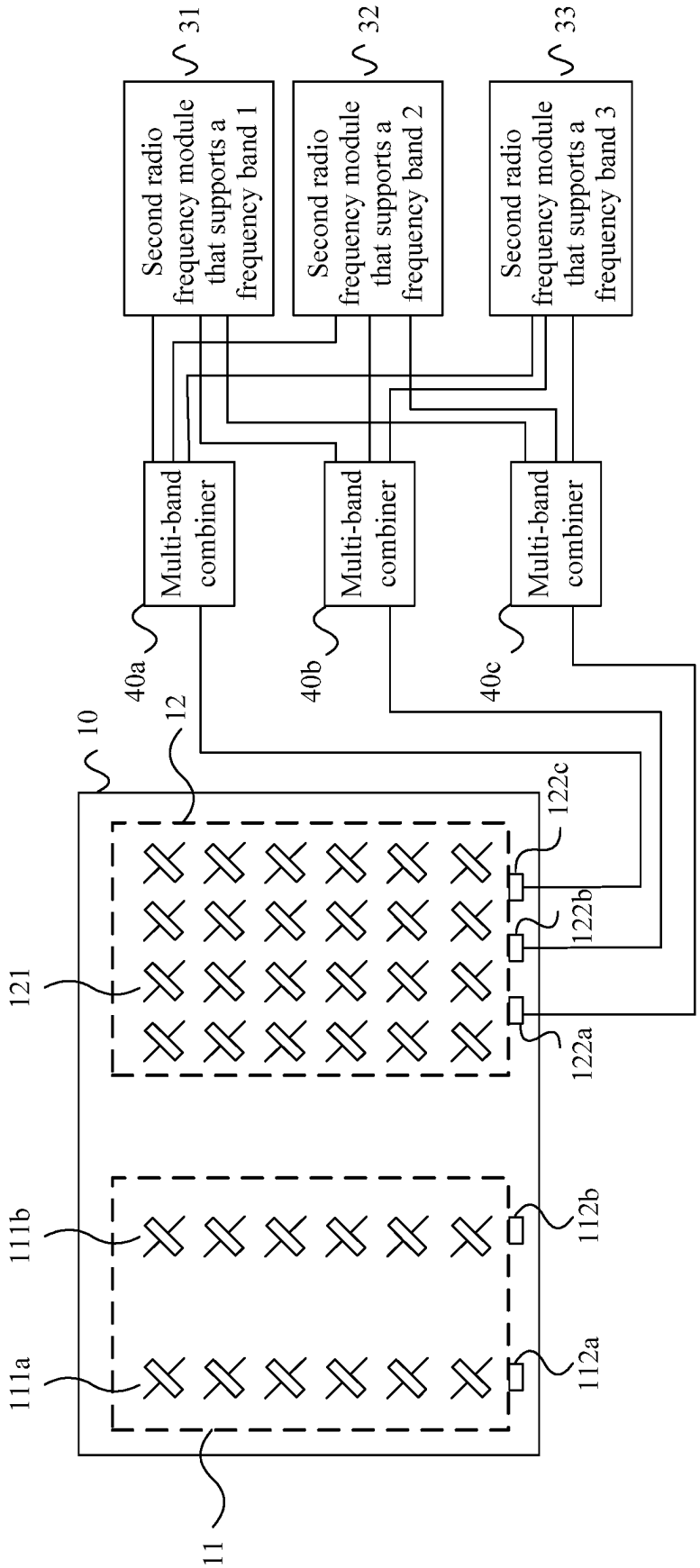
Second radio frequency module that supports a frequency band 1
Second radio frequency module that supports a frequency band 2
Second radio frequency module that supports a frequency band 3
31
32
33
Multi-band combiner
Multi-band combiner
Multi-band combiner
40a
40b
40c
10
12
121
122c
122b
122a
111b
111a
112b
112a
11

FIG. 10

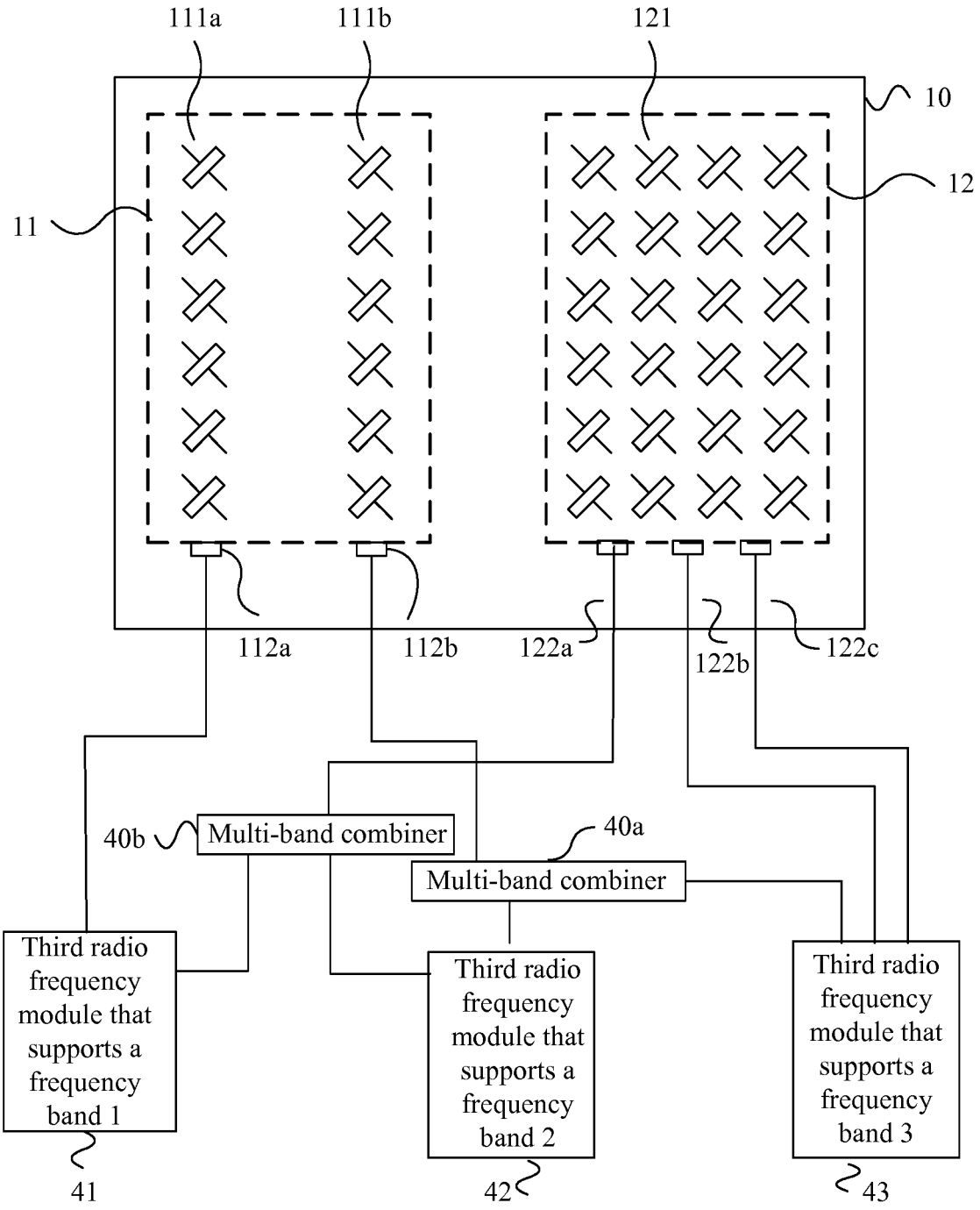
111a
111b
121
10
12
11
112a
112b
122a
122b
122c
40b
Multi-band combiner
40a
Multi-band combiner
Third radio frequency module that supports a frequency band 1
Third radio frequency module that supports a frequency band 2
Third radio frequency module that supports a frequency band 3
41
42
43

FIG. 11

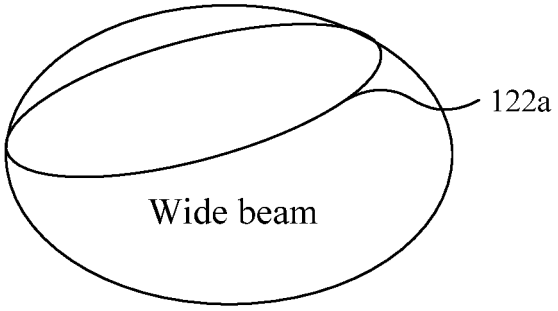

FIG. 12

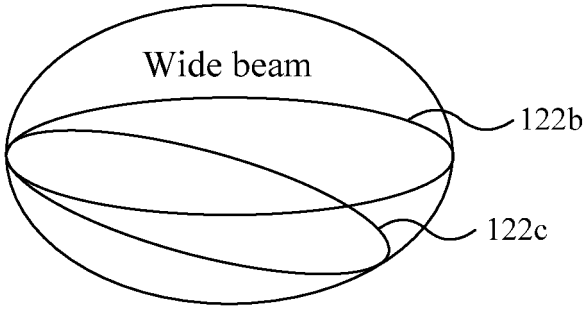

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/084275

A. CLASSIFICATION OF SUBJECT MATTER

H01Q 25/00 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01Q

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)

CNABS, CNTXT, VEN: isolate, wide beam, narrow beam, antenna, space, beam port

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 1985187 A (FUJITSU TEN LIMITED), 20 June 2007 (20.06.2007), description, page 9, line 23 to page 10, line 17 and page 11, line 21 to page 12, line 19, and figures 1 and 4	1-9
X	CN 201233956 Y (NO. 54 RESEARCH INSTITUTE OF CHINA ELECTRONICS TECHNOLOGY GROUP CORP.), 06 May 2009 (06.05.2009), claim 1, and figure 1	1, 6
X	CN 101562817 A (BEIJING INSTITUTE OF TECHNOLOGY), 21 October 2009 (21.10.2009), claim 1	1, 6
A	CN 1553725 A (ZTE CORP.), 08 December 2004 (08.12.2004), the whole document	1-9

☐ 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	Date of mailing of the international search report
15 September 2014 (15.09.2014)	**29 September 2014 (29.09.2014)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **WU, Lijun** Telephone No.: (86-10) **62089402**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2014/084275

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 1985187 A	20 June 2007	WO 2006009122 A1	26 January 2006
		CN 1985187 B	16 May 2012
		EP 1788408 A4	16 January 2013
		US 7612706 B2	03 November 2009
		US 2007182619 A1	09 August 2007
		EP 1788408 B1	05 March 2014
		EP 1788408 A1	23 May 2007
CN 201233956 Y	06 May 2009	None	
CN 101562817 A	21 October 2009	None	
CN 1553725 A	08 December 2004	CN 00455075 C	21 January 2009

Form PCT/ISA/210 (patent family annex) (July 2009)