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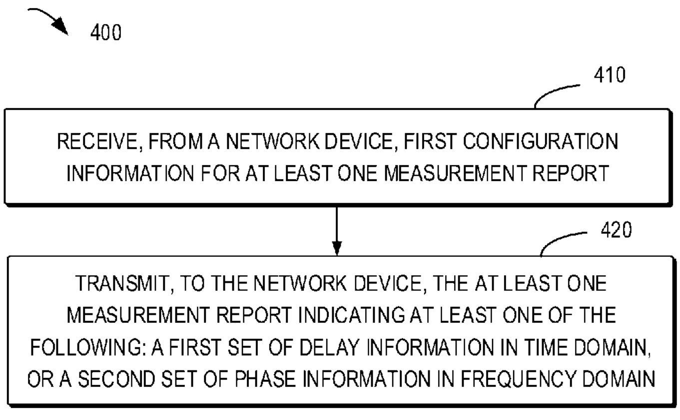

FIG. 4

(57) Abstract: Embodiments of the present disclosure provide a solution for configurating and transmitting a measurement report (s). In a solution, a terminal device receives, from a network device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI) -reference signal (RS) resources; and transmit, to the network device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, or a second set of phase information in frequency domain.

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DEVICES AND METHODS FOR COMMUNICATION

FIELDS

[1] Example embodiments of the present disclosure generally relate to the field of communication techniques and in particular, to devices and methods for configurating and transmitting a measurement report(s).

BACKGROUND

[2] Technology of multiple input multiple output (MIMO) has been widely used in current wireless communication system, where a large number of antenna elements are used by a network device for communicating with a terminal device for both sub-6GHz and over-6GHz frequency bands. Further, in order to improve the reliability and robustness of the communication between the network device and the terminal device, technology of multi-transmission and reception point (multi-TRP/M-TRP) has been proposed and discussed.

[3] In release 19, user equipment (UE) assistance/report for non-ideal backhaul/synchronization for coherent joint transmission (CJT) may be introduced. However, the backhaul/synchronization among the TRPs are non-ideal. In this event, impairments such as inter-TRP phase/delay and frequency offsets are present, especially for inter-site M-TRP, causing large throughput degradation. In view of this, in case of non-ideal backhaul/synchronized multi-TRP for CJT, if CJT assistance information may be reported to the network device in advance, the network performance may be improved accordingly.

SUMMARY

[4] In general, embodiments of the present disclosure provide a solution for configurating and transmitting a measurement report(s).

[5] In a first aspect, there is provided a terminal device comprising: a processor configured to cause the terminal device to: receive, from a network device, first

configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and transmit, to the network device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is the same as or a part of the first plurality of CSI-RS resources.

[6] In a second aspect, there is provided a network device comprising: a processor configured to cause the network device to: transmit, to a terminal device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and receive , from the terminal device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is a same as or a part of the first plurality of CSI-RS resources.

[7] In a third aspect, there is provided a communication method performed by a terminal device. The method comprises: receiving, from a network device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and transmitting, to the network device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase

information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is the same as or a part of the first plurality of CSI-RS resources.

[8] In a fourth aspect, there is provided a communication method performed by a network device. The method comprises: transmitting, to a terminal device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and receiving , from the terminal device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is a same as or a part of the first plurality of CSI-RS resources.

[9] In a fifth aspect, there is provided a computer readable medium having instructions stored thereon, the instructions, when executed on at least one processor, causing the at least one processor to carry out the method according to the third, or fourth aspect.

[10] Other features of the present disclosure will become easily comprehensible through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[11] Through the more detailed description of some example embodiments of the present disclosure in the accompanying drawings, the above and other objects, features and advantages of the present disclosure will become more apparent, wherein:

[12] FIG. 1A to 1C illustrate example communication environments in which example embodiments of the present disclosure can be implemented;

[13] FIG. 2 illustrates a signaling flow of uplink codebook in accordance with some

embodiments of the present disclosure;

[14] FIG. 3A illustrates an example of delay information;

[15] FIG. 3B illustrates an example of phrase information;

[16] FIG. 4 illustrates a flowchart of a method implemented at a terminal device according to some example embodiments of the present disclosure;

[17] FIG. 5 illustrates a flowchart of a method implemented at a network device according to some example embodiments of the present disclosure; and

[18] FIG. 6 illustrates a simplified block diagram of an apparatus that is suitable for implementing example embodiments of the present disclosure.

[19] Throughout the drawings, the same or similar reference numerals represent the same or similar element.

DETAILED DESCRIPTION

[20] Principle of the present disclosure will now be described with reference to some example embodiments. It is to be understood that these embodiments are described only for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. Embodiments described herein can be implemented in various manners other than the ones described below.

[21] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[22] As used herein, the term 'terminal device' refers to any device having wireless or wired communication capabilities. Examples of the terminal device include, but not limited to, user equipment (UE), personal computers, desktops, mobile phones, cellular phones, smart phones, personal digital assistants (PDAs), portable computers, tablets, wearable devices, internet of things (IoT) devices, Ultra-reliable and Low Latency Communications (URLLC) devices, Internet of Everything (IoE) devices, machine type communication (MTC) devices, devices on vehicle for V2X communication where X means pedestrian, vehicle, or infrastructure/network, devices for Integrated Access and

Backhaul (IAB), Space borne vehicles or Air borne vehicles in Non-terrestrial networks (NTN) including Satellites and High Altitude Platforms (HAPs) encompassing Unmanned Aircraft Systems (UAS), eXtended Reality (XR) devices including different types of realities such as Augmented Reality (AR), Mixed Reality (MR) and Virtual Reality (VR), the unmanned aerial vehicle (UAV) commonly known as a drone which is an aircraft without any human pilot, devices on high speed train (HST), or image capture devices such as digital cameras, sensors, gaming devices, music storage and playback appliances, or Internet appliances enabling wireless or wired Internet access and browsing and the like. The 'terminal device' can further has 'multicast/broadcast' feature, to support public safety and mission critical, V2X applications, transparent IPv4/IPv6 multicast delivery, IPTV, smart TV, radio services, software delivery over wireless, group communications and IoT applications. It may also incorporate one or multiple Subscriber Identity Module (SIM) as known as Multi-SIM. The term "terminal device" can be used interchangeably with a UE, a mobile station, a subscriber station, a mobile terminal, a user terminal or a wireless device.

[23] The term "network device" refers to a device which is capable of providing or hosting a cell or coverage where terminal devices can communicate. Examples of a network device include, but not limited to, a Node B (NodeB or NB), an evolved NodeB (eNodeB or eNB), a next generation NodeB (gNB), a transmission reception point (TRP), a remote radio unit (RRU), a radio head (RH), a remote radio head (RRH), an IAB node, a low power node such as a femto node, a pico node, a reconfigurable intelligent surface (RIS), and the like.

[24] The terminal device or the network device may have Artificial intelligence (AI) or Machine learning capability. It generally includes a model which has been trained from numerous collected data for a specific function, and can be used to predict some information.

[25] The terminal or the network device may work on several frequency ranges, e.g., FR1 (e.g., 450 MHz to 6000 MHz), FR2 (e.g., 24.25GHz to 52.6GHz), frequency band larger than 100 GHz as well as Tera Hertz (THz). It can further work on licensed/unlicensed/shared spectrum. The terminal device may have more than one connection with the network devices under Multi-Radio Dual Connectivity (MR-DC) application scenario. The terminal device or the network device can work on full duplex, flexible duplex and cross division duplex modes.

[26] The embodiments of the present disclosure may be performed in test equipment, e.g., signal generator, signal analyzer, spectrum analyzer, network analyzer, test terminal device, test network device, channel emulator. In some embodiments, the terminal device may be connected with a first network device and a second network device. One of the first network device and the second network device may be a master node and the other one may be a secondary node. The first network device and the second network device may use different radio access technologies (RATs). In some embodiments, the first network device may be a first RAT device and the second network device may be a second RAT device. In some embodiments, the first RAT device is eNB and the second RAT device is gNB. Information related with different RATs may be transmitted to the terminal device from at least one of the first network device or the second network device. In some embodiments, first information may be transmitted to the terminal device from the first network device and second information may be transmitted to the terminal device from the second network device directly or via the first network device. In some embodiments, information related with configuration for the terminal device configured by the second network device may be transmitted from the second network device via the first network device. Information related with reconfiguration for the terminal device configured by the second network device may be transmitted to the terminal device from the second network device directly or via the first network device.

[27] As used herein, the singular forms 'a', 'an' and 'the' are intended to include the plural forms as well, unless the context clearly indicates otherwise. The term 'includes' and its variants are to be read as open terms that mean 'includes, but is not limited to.' The term 'based on' is to be read as 'at least in part based on.' The term 'one embodiment' and 'an embodiment' are to be read as 'at least one embodiment.' The term 'another embodiment' is to be read as 'at least one other embodiment.' The terms 'first,' 'second,' and the like may refer to different or same objects. Other definitions, explicit and implicit, may be included below.

[28] In some examples, values, procedures, or apparatus are referred to as 'best,' 'lowest,' 'highest,' 'minimum,' 'maximum,' or the like. It will be appreciated that such descriptions are intended to indicate that a selection among many used functional alternatives can be made, and such selections need not be better, smaller, higher, or otherwise preferable to other selections.

[29] As used herein, the term "resource," "transmission resource," "uplink (UL)

resource," or "downlink (DL) resource" may refer to any resource for performing a communication, such as a resource in time domain, a resource in frequency domain, a resource in space domain, a resource in code domain, or any other resource enabling a communication, and the like. In the following, unless explicitly stated, a resource in both frequency domain and time domain will be used as an example of a transmission resource for describing some example embodiments of the present disclosure. It is noted that example embodiments of the present disclosure are equally applicable to other resources in other domains.

[30] As used herein, the term "TRP" or panel may refer to an antenna port or a plurality of antenna ports or an antenna array (with one or more antenna elements) available to the network device located at a specific geographical location. For example, a network device may be coupled with multiple TRPs or multiple panels in different geographical locations to achieve better coverage. Alternatively, or in addition, multiple TRPs or multiple panels may be incorporated into a network device, or in other words, the network device may comprise the multiple TRPs or multiple panels. The term "TRP" or panel may be also referred to as a cell, such as a macro-cell, a small cell, a pico-cell, a femto-cell, a remote radio head, a relay node, etc. It is to be understood that the term "TRP" or panel may refer to a logical concept which may be physically implemented by various manner.

[31] There may be no explicit TRP identification (ID). In some embodiments, the TRP ID may be implicitly identified via control resource set (CORESET) Pool Index (*CORESETPoolIndex*). For example, multi-downlink control information (M-DCI) is assumed. In some embodiments, the TRP ID may implicitly identified via sounding reference signal (SRS) resource set ID for uplink (UL) transmission or via CSI-RS resource ID or CSI-RS resource set ID. Therefore, the term "TRP" can be used interchangeably with the terms "*CORESETPoolIndex*" and SRS resource set.

[32] In the case of M-DCI, a terminal device is configured by a higher layer parameter PDCCH-Config that contains two different values of *CORESETPoolIndex* in *ControlResourceSet* for the active bandwidth part (BWP) of a serving cell.

[33] In the case of S-DCI, there may be only one value of *CORESETPoolIndex* in *ControlResourceSet* or the parameter *CORESETPoolIndex* may not be configured.

[34] In some embodiments, one CSI-RS resource in a plurality of CSI-RS resources may be associated with or may correspond to one TRP or one panel or one TRP group.

[35] As used herein, the terms "UE expects", "UE does not expect, "terminal device expects", "terminal device does not expect" may imply restrictions on a configuration of a network device (also referred to as NW configuration). The terms "UE is not expected to" and "terminal device is not expected to" may imply a terminal implementation, also referred to as UE implementation. In some embodiments, the terms "UE does not expect" and "UE is not expected to" may be used equally.

[36] As discussed above, multi-TRP has been proposed and discussed in order to improve the reliability and robustness of the communication between the network device and the terminal device. However, the backhaul/synchronization among the TRPs are non-ideal. Specifically, in case of non-ideal synchronized multi-TRP for coherent joint transmission (CJT), there may be delay and/or frequency offset between the TRPs, which will impact the performance of CJT. In view of this, in case of non-ideal backhaul/synchronized multi-TRP for CJT, if CJT assistance information may be reported to the network device in advance, the network performance may be improved accordingly.

[37] In addition, the channel characteristics may be obtained by the terminal device, and some information may be reported to the network device for assistance. For example, the information may comprise at least one of: delay spread, frequency unit for precoding and hypothesis for multi-TRP transmission.

[38] So far, there is no details on how to report the assistance information (such as, delay information, frequency offset and so on). For example, the assistance information may be for CJT transmission.

[39] According to the present disclosure, the terminal device receives first configuration information for at least one measurement report from the network device, where the first configuration information indicates a first plurality of channel state information (CSI)-reference signal (RS) resources. The terminal device further transmits at least one measurement report to the network device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain or a second set of phase information in frequency domain. The first/second sets are corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, and the delay/phase information comprised in the first/second set may be corresponding to a CSI-RS resource of the second plurality of CSI-RS resources.

[40] In this way, the delay/phase information may be reported to the network device,

such that the network device may understanding the delay-related information (i.e., the delay/phase information) and determine proper joint transmission (JT) (either CJT or NCJT) transmission decision for the terminal device.

[41] In addition, there may be different scenarios, such as, different delay spreads, and thus a single granularity may not satisfy all reporting requirements of the different scenarios. According to some embodiments of the present disclosure, the relayed report granularity(ies) may be more flexible.

[42] In addition to the delay-related information, the terminal device may obtain more accurate information on the channel characteristics, such as, the frequency offset, the delay spread, the frequency selection characteristics or the subband size, whether the TRP is suitable for CJT or NCJT and so on. According to some embodiments of the present discourse, the above assistant information also may be comprised in the measurements report(s) and transmitted to the network device.

[43] As used herein, the terms "precoder", "precoding", "precoding matrix", "beam", "beamforming", "vector", "basis", "first vector", "first basis", "first basis vector", "codebook", "UL codebook", "spatial domain-related information", "SD-related information", "spatial relation information", "spatial relation info", "precoding information", "precoding information and number of layers", "precoding matrix indicator (PMI)", "precoding matrix indicator", "transmission precoding matrix indication", "precoding matrix indication", "transmission configuration indication state (TCI state)", "UL TCI state", "joint TCI state", "transmission configuration indicator", "quasi co-location (QCL)", "quasi-co-location", "QCL parameter", "QCL assumption", "QCL relationship" and "spatial relation" can be used interchangeably.

[44] As used herein, the terms "vector", "vectors", "bases" and "basis" can be used interchangeably.

[45] As used herein, the terms "index", "indicator", "indication", "field", "bit field" and "bitmap" can be used interchangeably. The terms "physical resource block", "resource block", "PRB" and "RB" can be used interchangeably. The terms "bit size", "size of bits", "number of bits", "size of field", "bitwidth" and "field size" can be used interchangeably. The terms "size of", "number of RBs", "number of subcarriers" and "number of PRBs" can be used interchangeably.

[46] As used herein, the terms "a TRP index", "a panel index", "a TRP group index", "an CSI-RS resource index" , "a group of CSI-RS port indexes", "a CSI-RS resource set" and "a set of CSI-RS resources" can be used interchangeably.

[47] As used herein, the terms "element of indication field", "information", "parameter" and "indication" can be used interchangeably.

[48] As used herein, the terms "TRP", "panel", "CSI-RS resource", "SRS resource", "TCI state", "TCI", "CORESET", "CORESET pool", "UL TCI state", "DL TCI state", "joint TCI state", "separate TCI state" may be used interchangeably.

[49] As used herein, the terms "multiple TRPs", "multiple panels", "multiple CSI-RS resources", "plurality of CSI-RS resources", "multiple TCI states", "multiple CORESETs" and "multiple control resource set pools", "multi-TRP", "multi-TCI state", "multi-TCI", "multi-CORESET" and "multi-control resource set pool", "M-TRP" and "M-TCI", "M-TRP" may be used interchangeably.

[50] As used herein, the terms "vector", "basis", "frequency domain/FD basis vector", "frequency domain/FD vector", "frequency domain/FD basis", "first vector" and "first basis" may be used interchangeably.

[51] As used herein, the terms "measurement report", "calibration report", "assistant information report", "report for assistance" or "pre CSI report" may be used interchangeably. Further, a message structure of the measurement report may have a similar message structure with the measurement report (such as, including two parts, i.e., part 1 and part 2). In some embodiments, the transmission procedure (such as, omission) of the CSI report also may be reused by the measurement report.

[52] In the following, a layer 1- reference signal received power (L1- RSRP)/L1-signal to interference and noise ratio (L1-SINR) will be used as an example of channel quality for describing some specific example embodiments of the present disclosure. It is to be understood that example embodiments described with regard to the L1-RSRP may be equally applicable to other type of beam quality, including but not limited to L1/L3-RSRP, L1/L3- SINR, L1/L3 received signal strength indicator (RSSI), L1/L3 reference signal received quality (RSRQ), and so on. The present disclosure is not limited in this regard.

[53] It is noted that when the term "a set of" is used, it may mean one or more elements/items, which may be replaced by terms of "at least one", "a group of" or "a list

of". For example, "a set of X" means "at least one X" or "one or more Xs".

[54] For ease of discussion, some parameters used in the following description are listed as below:

➢ μ refers to subcarrier spacing configuration; For example, the value of μ may be at least one of {0, 1, 2, 3, 4, 5, 6}; For example, $\mu = 0$ refers to subcarrier spacing 15kHz or $15 \cdot 10^3$Hz; $\mu = 1$ refers to subcarrier spacing 30kHz or $30 \cdot 10^3$Hz; $\mu = 2$ refers to subcarrier spacing 60kHz or $60 \cdot 10^3$ Hz; $\mu = 3$ refers to subcarrier spacing 120kHz or $120 \cdot 10^3$ Hz; $\mu = 4$ refers to subcarrier spacing 240kHz or $240 \cdot 10^3$ Hz; $\mu = 5$ refers to subcarrier spacing 480kHz or $480 \cdot 10^3$Hz; $\mu = 6$ refers to subcarrier spacing 960kHz or $960 \cdot 10^3$Hz;

➢ P or P_t refers to the number of ports associated with or comprised in one CSI-RS resource, where P or P_t may be 1 or 2 or 4 or 8 or 12 or 16 or 24 or 32 or 64 or 96 or 128 or 256 or 512; For example, the CSI-RS resource may be comprised in the first plurality of CSI-RS resources. In some embodiments, different CSI-RS resources in the first plurality of CSI-RS resources may be associated with or may comprise different or same number of ports;

➢ T_u refers to time unit;

➢ F_u refers to frequency unit;

➢ X refers to a multiple of the time unit;

➢ f refers to an index of the frequency domain basis;

➢ α refers to a phase information in frequency domain, where $0 \leq \alpha < 1$;

➢ M or M_{CP} refers to a positive integer;

➢ S refers to the number of RBs or subcarriers, S may be positive integer. For example, 1<=S<=64. For another example, 1<=S<=128. For another example, 1<=S<=1536;

➢ Tc/Ts refers to time unit used in the communication;

➢ $\triangle f_{max}$ refers to a value of subcarrier spacing. For example, $\triangle f_{max}$ may be 480kHz or $480 \cdot 10^3$Hz or 960kHz or $960 \cdot 10^3$Hz;

➢ N_f refers to a positive integer. For example, N_f refers to a number of time units Tc or Ts. For example, N_f may be 2048 or 4096;

➢ $\triangle f_{ref}$ refers to a value of subcarrier spacing. For example, a value of a reference subcarrier spacing. For example, $\triangle f_{ref}$ may be 15 kHz or $15 \cdot 10^3$Hz;

➢ $N_{f,ref}$ refers to a positive integer. For example, $N_{f,ref}$ may refer to a number of time units Tc or Ts. For example, $N_{f,ref}$ may be 2048 or 4096;

➢ $k_{l,p}^{(1)}$ refers to an index of indication of the amplitude coefficient;

➢ $P_{l,p}^{(1)}$ refers to a value of the amplitude coefficient;

➢ T_{max} refers to a time duration. For example, T_{max} may be a length of cyclic prefix (CP) or a duration of maximum receive timing difference;

➢ Y refers to a positive integer;

➢ X refers to a positive integer;

➢ Z refers to a positive integer, Z may be positive integer, e.g., 4<=Z<=360;

➢ W refers to a non-negative integer, 0<=W<=Z-1;

➢ i_{fu} refers to the index of frequency unit or frequency domain basis;

➢ B_{size} refers to the number of resource blocks (RBs) in the reporting band or BWP;

➢ F refers to the number of frequency units or frequency domain bases in the reporting band or BWP, F may be positive integer, e.g., $1 \leq F \leq 275$;

➢ N^{size} refers to a reporting band. For example, N^{size} may be a positive integer. For example, $24 \leq N^{size} \leq 275$;

➢ N^{start} refers to a starting position of the BWP or a reporting band. For example, N^{start} may be a non-negative integer. For example, $0 \leq N^{start} \leq 275$;

➢ N_{PRB}^{SB} refers to the size of one subband or the number of PRBs of one subband. N_{PRB}^{SB} is a positive integer. For example, $1 \leq N_{PRB}^{SB} \leq 32$. For example, N_{PRB}^{SB} may be at least one of {4, 8, 16, 32};

➢ c_p refers to a value of one indicator or one field for the phase information. In some embodiments, c_p may be a non-negative integer. In some embodiments, $0 \leq c_p \leq N_{PSK} - 1$. In some embodiments, $0 \leq c_p \leq 255$. In some embodiments, c_p may be at least one of {0,1,2,3} or {0,1,2,3,4,5,6,7} or {0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15}. In some embodiments, N_{PSK} may be the size for indication of c_p. In some embodiments, N_{PSK} may be a positive integer. In some embodiments, N_{PSK} may be at least one of {2, 4, 8, 16, 32, 64, 128, 256}.

[55] Principles and implementations of the present disclosure will be described in detail below with reference to the figures.

Example environment

[56] FIG. 1A illustrates an example communication network 100 in which embodiments of the present disclosure can be implemented. The communication network 100 includes a network device 120-1 and an optionally network device 120-2 (collectively or individually referred to as network devices 120). For purpose of discussion, the network device 120-1 is referred to as the first network device 120-1, and the network device 120-2 is referred to as the second network device 120-2. Further, the first network device 120-1 and the second network device 120-2 can communicate with each other. The network device 120 can provide services to a terminal device 110.

[57] In the following, for the purpose of illustration, some example embodiments are described with the terminal device 110 operating as a UE and the network device 120 operating as a base station. However, in some example embodiments, operations described in connection with a terminal device may be implemented at a network device or other device, and operations described in connection with a network device may be implemented at a terminal device or other device.

[58] In the environment network 100, a link from the network devices 120 (such as, a first network device 120-1 or the second network device 120-2) to the terminal device 110 is referred to as a DL, while a link from the terminal device 110 to the network devices 120 (such as, a first network device 120-1 or the second network device 120-2) is referred to as an UL. In DL, the first network device 120-1 or the second network device 120-2 is a transmitting (TX) device (or a transmitter) and the terminal device 110 is a receiving (RX) device (or a receiver). In UL, the terminal device 110 is a transmitting TX device

(or a transmitter) and the first network device 120-1 or the second network device 120-2 is a RX device (or a receiver).

[59] In addition, in order to support multi-TRP and/or multi-panel, the network device 120 may be equipped with one or more TRPs/panels. For example, the network device 120 may be coupled with multiple TRPs/panels in different geographical locations to achieve better coverage. In one specific example embodiment, the first network device 120-1 is equipped with the first TRP 130-1 and the second TRP 130-2. Alternatively, in another specific example embodiment, the first network device 120-1 and the second network device 120-2 are equipped with the first TRP 130-1 and the second 130-2, respectively. In one specific example embodiment, the first network device 120-1 may be associated with at least one of the first TRP 130-1, the second TRP 130-2, the third TRP 130-3 and the fourth TRP 130-4.

[60] In some embodiments, the first TRP 130-1 and the second TRP 130-2 are associated with different control resource set pools (CORESET pools). For example, the first TRP 130-1 is associated with a first control resource set pool while the second TRP 130-2 is associated with a second control resource set pool. In some embodiments, the first TRP 130-1 and the second TRP 130-2 and the third TRP 130-3 and the fourth TRP 130-4 may be associated with different CSI-RS resources in the first plurality of CSI-RS resources. For example, the first TRP 130-1 may be associated with a first CSI-RS resource. For example, the second TRP 130-2 may be associated with a second CSI-RS resource. For example, the third TRP 130-3 may be associated with a third CSI-RS resource. For example, the fourth TRP 130-4 may be associated with a fourth CSI-RS resource.

[61] Further, both a single TRP mode and multi-TRP mode are supported by the specific embodiment of FIG. 1A. Specifically, in case of the single TRP mode, the terminal device 110 communicates with the network via the first TRP 130-1 or the second TRP 130-2 or via one of the first TRP 130-1, the second TRP 130-2, the third TRP 130-3 and the fourth TRP 130-4. For example, the transmission may be performed based on the first or the second control resource set pool, and one TCI state accordingly. Similarly, in case of the multi-TRP mode, the terminal device 110 communicates with the network via the first TRP 130-1 and the second TRP 130-2 or via more than one TRP 130 from the first TRP 130-1, second TRP 130-2, third TRP 130-3 and fourth TRP 130-4. For example, the transmission may be performed based on the first and second control resource set pools, and two TCI states accordingly.

[62] Further, both a single DCI and multi-DCI mode are supported in communication network 100. As illustrated in FIG. 1A, when a single DCI mode is applied, the terminal device 110 receives a single DCI message from the first TRP 130-1 or the second TRP 130-2 or the third TRP 130-3 or the fourth TRP 130-4. It should be understood that the single DCI message also may be received from the second TRP 130-2. Alternatively, when a multi-DCI mode is applied, the terminal device 110 may receive more than one DCI message from more than one of the first TRP 130-1, the second TRP 130-2, the third TRP 130-3 and the fourth TRP 130-4, respectively.

[63] It should be understood that the number of TRPs comprised in the communication network 100 may be larger than two. As illustrated in the FIG. 1A, the communication network 100 may further additionally comprise the TRP 130-3 and 130-4, and any of the TRP 130-3 and 130-4 may be equipped to the first network device 120-1 or the second network device 120-2.

[64] Further, the network device(s) 120 may provide one or more serving cells and the first TRP 130-1 and/or the second TRP 130-2 and/or the third TRP 130-3 and/or the fourth TRP 130-4 may be included in a same serving cell or different serving cells. In other words, both an inter-cell transmission and an intra-cell transmission are supported by the specific example of FIG. 1A.

[65] FIG. 1B shows an example scenario of the communication network 100 as shown in FIG. 1A. In the specific example of FIG. 1B, the first TRP 130-1 and the second TRP 130-2 are included in a same serving cell 140. In this event, the multi-TRP transmission is performed as an intra-cell transmission.

[66] FIG. 1C shows another example scenario of the communication network 100 as shown in FIG. 1A. In the specific example of FIG. 1C, the first TRP 130-1 and the second TRP 130-2 are included in different serving cells 140-1 and 140-2. In this event, the multi-TRP transmission is performed as an inter-cell transmission.

[67] The communications in the communication environment 100 may conform to any suitable standards including, but not limited to, Global System for Mobile Communications (GSM), Long Term Evolution (LTE), LTE-Evolution, LTE-Advanced (LTE-A), New Radio (NR), Wideband Code Division Multiple Access (WCDMA), Code Division Multiple Access (CDMA), GSM EDGE Radio Access Network (GERAN), Machine Type Communication (MTC) and the like. The embodiments of the present

disclosure may be performed according to any generation communication protocols either currently known or to be developed in the future. Examples of the communication protocols include, but not limited to, the first generation (1G), the second generation (2G), 2.5G, 2.75G, the third generation (3G), the fourth generation (4G), 4.5G, the fifth generation (5G) communication protocols, 5.5G, 5G-Advanced networks, or the sixth generation (6G) networks.

[68] It is to be understood that the numbers of devices (i.e., the terminal device 110, the network device 120, the TRP 130 and the cell 140) and their connection relationships and types shown in FIGS. 1A to 1C are only for the purpose of illustration without suggesting any limitation. The communication network 100 may include any suitable numbers of devices adapted for implementing embodiments of the present disclosure.

Example processes

[69] In the following descriptions, while operations are depicted in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Likewise, while several specific implementation details are contained in the above discussions, these should not be construed as limitations on the scope of the present disclosure, but rather as descriptions of features that may be specific to particular embodiments. Certain features that are described in the context of separate embodiments may also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment may also be implemented in multiple embodiments separately or in any suitable sub-combination.

[70] It is to be understood that the operations at the terminal device 110 and the network device 120 should be coordinated. In other words, the network device 120 and the terminal device 110 should have common understanding about configurations, parameters and so on. Such common understanding may be implemented by any suitable interactions between the network device 120 and the terminal device 110 or both the network device 120 and the terminal device 110 applying the same rule/policy. In the following, although some operations are described from a perspective of the terminal device 110, it is to be

understood that the corresponding operations should be performed by the network device 120. Similarly, although some operations are described from a perspective of the network device 120, it is to be understood that the corresponding operations should be performed by the terminal device 110. Merely for brevity, some of the same or similar contents are omitted here.

[71] In addition, in the following description, some interactions are performed among the terminal device 110 and the network device 120 (such as, exchanging configuration(s) and so on). It is to be understood that the interactions may be implemented either in one single signaling/message/configuration or multiple signaling/messages/configurations, including system information, radio resource control (RRC) message, downlink control information (DCI) message, uplink control information (UCI) message, media access control (MAC) control element (CE) and so on. The present disclosure is not limited in this regard.

[72] Reference is made to FIG. 2, which illustrates a signaling flow 200 of communication in accordance with some embodiments of the present disclosure. For the purposes of discussion, the signaling flow 200 will be discussed with reference to FIG. 1A to FIG. 1C, for example, by using the terminal device 110 and the network device 120.

[73] In some embodiments, the terminal device may receive 210 first configuration information for at least one measurement report from the network device 120, where the first configuration information at least indicates a first plurality of CSI-RS resources (For example, be represented as $N_{candidate}$ CSI-RS resources in the following, for example, CSI-RS resources #1, #2, #3 and #4). In some embodiments, the first plurality of CSI-RS resources may comprise $N_{candidate}$ CSI-RS resources. In some embodiments, $N_{candidate}$ may be a positive integer. For example, $1 <= N_{candidate} <= 8$. For another example, $2 <= N_{candidate} <= 8$. For another example, $1 <= N_{candidate} <= 4$. For another example, $2 <= N_{candidate} <= 4$.

[74] Some details about the first configuration information are discussed as below. In some embodiments, the first configuration information may comprise information indicating the first plurality of CSI-RS resources for channel measurement or for the measurement report. For example, the terminal device 110 may be configured with the first plurality of CSI-RS resources for the measurement report.

[75] In some embodiments, each CSI-RS resource may correspond to one TRP or TRP group, where an index of the CSI-RS resource may be represented as t. For example, t

may be integer. For example, $t \in \{0,1,...N_{candidate} -1\}$. For another example, $0 <= t <= N_{candidate} -1$.

[76] In some embodiments, the first plurality of CSI-RS resources may be in one slot or T adjacent slots or T slots, where T may be a positive integer. For example, 1<=T<=4. For another example, 1<=T<=8.

[77] In some embodiments, for each CSI-RS resource in the first plurality of CSI-RS resources, there may be P or P_t ports for one CSI-RS resource, where P or P_t may be 1 or 2 or 4 or 8 or 12 or 16 or 24 or 32 or 64 or 96 or 128 or 256 or 512. In some embodiments, for each CSI-RS resource in the first plurality of CSI-RS resources, there may be one port. For example, each CSI-RS resource in the first plurality of CSI-RS resources may be CSI-RS for tracking, e.g. tracking RS (TRS).

[78] Based on the first configuration information, the terminal device 110 may perform 220 measurements with the network device 120, such as, receive and measure CSI-RS from the network device 120.

[79] In some embodiments, the terminal device 110 may obtain some assistant information based on the first plurality of CSI-RS resources, such as, delay-related information. The terminal device 110 may report such measurement results and other information which may assist transmission between the terminal device 110 and the network device 120. As illustrated in FIG. 2, the terminal device 110 may further transmit 230 at least one measurement report to the network device 120. In some embodiments, the at least one measurement report may comprise at least one of the following: a first set of delay information in time domain or a second set of phase information in frequency domain. In some embodiments, the first set and/or the second set may be corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, and the delay/phase information comprised in the first/second set may be corresponding to a CSI-RS resource of the second plurality of CSI-RS resources. In some embodiments, the first set and/or the second set may be corresponding to the first plurality of CSI-RS resources with a reference CSI-RS included or excluded, and each delay/phase indication/information comprised in the first/second set may be corresponding to a CSI-RS resource of the first plurality of CSI-RS resources.

[80] In some embodiments, the second plurality of CSI-RS resources may be the same as or a part of the first plurality of CSI-RS resources. For example, in case that the first

plurality of CSI-RS resources is {CSI-RS resource #1, CSI-RS resource #2, CSI-RS resource #3 and CSI-RS resource #4}, the second plurality of CSI-RS resources may be {CSI-RS resource #1, CSI-RS resource #2, CSI-RS resource #3 and CSI-RS resource #4} or a subset of {CSI-RS resource #1, CSI-RS resource #2, CSI-RS resource #3 and CSI-RS resource #4}. For example, the second plurality of CSI-RS may be determined by the terminal device based on the measurement results.

[81] In some embodiments, the reference CSI-RS resource may be a default CSI-RS resource, such as, the first CSI-RS resource or the CSI-RS resource with lowest ID or the first CSI-RS resource in time domain or the last CSI-RS resource in time domain in the first plurality of CSI-RS resources. For example, the information used for indicating the reference CSI-RS may be omitted.

[82] In some embodiments, the reference CSI-RS resource may be a CSI-RS resource with the minimum value of the delay information or the phase information. In some embodiments, the reference CSI-RS resource may be a CSI-RS resource with the largest value of amplitude coefficient or with largest value of RSRP.

[83] Specifically, in some embodiments, the reference CSI-RS resource may be the one CSI-RS resource in the first or the second plurality with the lowest value of delay (such as, with the lowest value of delay of the first path or lowest average delay). For example, the measurement values comprised in the measurement report may be a positive value or a non-negative integer. For example, the values of delay information comprised in the measurement report may be a positive value or a non-negative value.

[84] In some embodiments, the at least one measurement report may comprise at least one of the following:

➢ the first set of delay information in time domain,

➢ the second set of phase information in frequency domain,

➢ a first granularity of the delay information corresponding to the first set,

➢ a second granularity of the phase information corresponding to the second set,

➢ a third set of doppler information in time domain, the third set corresponding to the first plurality or the second plurality of CSI-RS resources, the doppler information comprised in the third set corresponding to a CSI-RS resource of the first plurality or the second plurality of CSI-RS resources,

➢ a third granularity of the doppler information,

➢ a size of subband,

➢ a frequency unit,

➢ at least one frequency offset,

➢ at least one amplitude coefficient corresponding to the first plurality or the second plurality of CSI-RS resources,

➢ a first indication indicating the second plurality of CSI-RS resources,

➢ a second indication indicating a transmission type of coherent joint transmission (CJT) or non-CJT (NCJT), or

➢ a third indication indicating the reference CSI-RS resource.

[85] In some embodiments, the measurement report may comprise a first part and a second part associated with the first part. In some embodiments, the first part may indicate at least one of the following: the first granularity, the second granularity, the third granularity, the size of subband, the frequency unit, the first indication of the second plurality of CSI-RS resources, the second indication or the third indication. In some embodiments, the second part may indicate at least one of the following: the first set, the second set, the third set, the at least one frequency offset, the at least one amplitude coefficient or the third indication.

[86] In some example embodiments, the measurement report may comprise a single part. Alternatively, in some example embodiments, the measurement report may comprise two parts (e.g., first part and second part, or part 1 and part 2). Specifically, in some embodiments, the first part may have a fixed payload size and may be used to identify the number of information bits in the second part or the size of the second part. In some embodiments, the first part may be transmitted in its entirety before the second part.

[87] More details about the information comprised in the measurement report will be discussed as below.

[88] In some embodiments, the terminal device 110 may report (i.e., the measurement report may comprise) at least one delay indication/information (e.g., delay offset) or at

least one phase indication/information in frequency domain.

[89] Additionally, in some embodiments, the terminal device 110 may further report at least one of: a granularity of delay information (e.g. time unit, i.e. the first granularity), a granularity of phase indication/information (i.e. the second granularity), a size of subband, a frequency unit, at least one frequency offset, at least one phase indication/information in time domain (i.e., doppler information), a third granularity of the doppler information, at least one amplitude coefficient, at least one L1-RSRP or L1-SINR, a second plurality of CSI-RS resources, a type of CJT or NCJT, whether suitable for CJT and/or NCJT (i.e., the second indication), whether suitable for multi-TRP transmission (i.e., the second indication), and a reference CSI-RS resource (i.e., the third indication).

[90] In some embodiments, the number of the second plurality of CSI-RS resources may be represented as $N_{selected}$, where the $N_{selected}$ may be positive integer. In some embodiments, the value of $N_{selected}$ may be no larger than the value of $N_{candidate}$. For example, $1<=N_{selected}<=N_{candidate}$. For another example, $1<=N_{selected}<=4$. For another example, $1<=N_{selected}<=8$.

[91] In some embodiments, the number of the at least one delay indication/information and/or the number of the at least one phase indication/information and/or the number of the at least one phase indication/information in frequency domain and/or the number of the at least one phase indication/information in time domain and/or the number of the at least one doppler indication/information and/or the number of the at least one amplitude coefficient and/or the number of the at least one frequency offset and/or the number of the at least one L1-RSRP or L1-SINR may be based on the number of CSI-RS resources in the first plurality of CSI-RS resources (e.g. $N_{candidate}$ or $N_{candidate}-1$) or based on the number of CSI-RS resources in the second plurality of CSI-RS resources (e.g., $N_{selected}$ or $N_{selected}-1$).

[92] In some embodiments, the number of the at least one delay indication/information and/or the number of the at least one phase indication/information and/or the number of the at least one phase indication/information in frequency domain and/or the number of the at least one phase indication/information in time domain and/or the number of the at least one doppler indication/information and/or the number of the at least one amplitude coefficient and/or the number of the at least one frequency offset and/or the number of the at least one L1-RSRP or L1-SINR may be $N_{selected}$ or $N_{candidate}$ (For example, in case

that the reference CSI-RS is included or in case that the measurement report comprises at least one of one delay indication/information, one phase indication/information, one phase indication/information in frequency domain, one phase indication/information in time domain, one doppler indication/information, one amplitude coefficient, one frequency offset and one L1-RSRP or L1-SINR corresponding to the reference CSI-RS resource).

[93] In some embodiments, the number of the at least one delay indication/information and/or the number of the at least one phase indication/information and/or the number of the at least one phase indication/information in frequency domain and/or the number of the at least one phase indication/information in time domain and/or the number of the at least one doppler indication/information and/or the number of the at least one amplitude coefficient and/or the number of the at least one frequency offset and/or the number of the at least one L1-RSRP or L1-SINR may be $N_{selected}$-1 or $N_{candidate}$-1 (For example, in case that the reference CSI-RS is excluded or in case that the measurement report does not comprise one delay indication/information and/or one phase indication/information and/or one phase indication/information in frequency domain and/or one phase indication/information in time domain and/or one doppler indication/information and/or one amplitude coefficient and/or one frequency offset and/or one L1-RSRP or L1-SINR corresponding to the reference CSI-RS resource. For example, the measurement value of the delay information or the phase information or the doppler information corresponding to the reference CSI-RS is 0 and thus may not be comprised in the measurement report. For another example, the measurement value of the amplitude coefficient corresponding to the reference CSI-RS is 1 and thus may not be comprised in the measurement report).

[94] In some embodiments, the delay indication/information may be represented as a multiple of a time unit. In some embodiments, the terminal device may report at least one delay information or the measurement report may comprise the at least one delay information, wherein each delay information may correspond to one CSI-RS resource in the first plurality or the second plurality of CSI-RS resources (For example, including or excluding the reference CSI-RS resource). In some embodiments, the terminal device 110 may report at least one delay indication/information or the measurement report may comprise the at least one delay indication/information, wherein each delay indication/information may correspond to one CSI-RS resource in the first plurality or the second plurality of CSI-RS resources excluding the reference CSI-RS resource.

[95] In some embodiments, the delay indication/information corresponding to a CSI-RS

resource may be an absolute value of a delay between the network device 120 and the terminal device 110. Alternatively, in some embodiments, the delay information of a CSI-RS resource may be a delay difference or a delay offset between the CSI-RS resource and the reference CSI-RS resource.

[96] In some embodiments, the delay indication/information may be a delay difference or a delay offset between the first path of the CSI-RS resource and the first path of the reference CSI-RS resource, or a delay difference or a delay offset between the average delay of the CSI-RS resource and the average delay of the reference CSI-RS resource, as illustrated in FIG. 3A, which illustrates an example of delay information 300A.

[97] In some embodiments, the phase indication/information may be a phase rotation or an index of frequency domain basis. For example, the frequency domain basis may correspond to a basis with a first length. For example, the first length may be a positive integer. For example, the first length may be no less than 1 and no larger than 275 or no larger than 2048.

[98] In some embodiments, the terminal device 110 may report at least one phase indication/information in frequency domain or the measurement report may comprise the at least one phase indication/information in frequency domain, where each phase indication/information in frequency domain may be a phase rotation corresponding to one CSI-RS resource in the first or second plurality of CSI-RS resources (For example, including or excluding the reference CSI-RS resource). In some embodiments, the terminal device 110 may report at least one phase indication/information in frequency domain or the measurement report may comprise the at least one phase indication/information in frequency domain, wherein each delay information may correspond to one CSI-RS resource in the first plurality or the second plurality of CSI-RS resources excluding the reference CSI-RS resource. For example, as illustrated in FIG. 3B, which illustrates an example of phrase information 300B.

[99] In some embodiments, the delay indication/information may be based on or may correspond to the first granularity and/or at least one first parameter. In some embodiments, the phase information may be based on or may correspond to the second granularity and/or the at least one first parameter. In some embodiments, the doppler information may be based on or may correspond to the third granularity and/or the at least one first parameter. In some embodiments, at least one of the first granularity, the second

granularity or the third granularity may be based on the at least one first parameter. According to some embodiments of the present disclosure, the at least one first parameter may be configured by the network device 120 or reported by the terminal device 110.

[100] In some embodiments, the at least one first parameter may comprise at least one of the following:

➢ a size of reporting band,

➢ a size of bandwidth part (BWP),

➢ a number of RBs in the reporting band or in the BWP,

➢ a value of subcarrier spacing,

➢ whether the measurement report may be an initial measurement report or a subsequent measurement report,

➢ a size of subband,

➢ a number of RBs in one subband,

➢ a value of time unit,

➢ a value of frequency unit, or

➢ the number of precoding matrix indicators (PMIs) per subband.

[101] In some embodiments, the at least one first parameter may comprise at least one of: a type of the measurement report (the type may be absolute value or relative value corresponding to the measurement report, or the type may be the initial measurement report or subsequent measurement report), first granularity information, second granularity information, third granularity information, a time unit, a frequency unit, a size of subband (e.g., for PMI or precoding matrix or CQI), the value of M or M_{CP}, a frequency unit (such as, the number of RBs or subcarriers, which may be represented as S) or a parameter R for codebook (e.g., *numberOfPMI-SubbandsPerCQI-Subband*) and so on.

[102] In some embodiments, the delay indication/information and/or the phase indication/information and/or the frequency offset indication/information and/or the doppler indication/information may be reported conditioned on the reported granularity of delay information (e.g., time unit) and/or the granularity of phase information and/or the granularity of doppler information and/or size of subband (or frequency unit) and/or

the at least one first parameter.

[103] In some embodiments, the terminal device may determine or report at least one delay indication/information (i.e., the first set) or the measurement report may comprise at least one delay indication/information. In some embodiments, each delay information may be represented as $X * T_u$ (for example, in time domain, e.g., each delay information may be represented in multiples of the time unit T_u). In some embodiments, each delay information may be represented as frequency domain (FD) basis f. In some embodiments, the terminal device 110 may determine or report at least one phase indication/information (e.g. in frequency domain) or the measurement report may comprise at least one phase indication/information. In some embodiments, each phase information may be represented as α (e.g., in frequency domain, $0 \leq \alpha < 1$). In some embodiments, the value of X or the value of f or the value of α may be comprised in the measurement report (e.g., in the second part of the measurement report).

[104] In some embodiments, the value or the range or the size of the indication field of X or α or f and/or the value of time unit and/or the value of M or M_{CP} and/or the value of a frequency unit (for example, represented as F_u) may be based on the at least one first parameter and/or at least one of: size of reporting band, size of BWP, a value of subcarrier spacing. In some embodiments, the value or the range or the size of the indication field of X may be based on the value of M or M_{CP}. In some embodiments, M or M_{CP} may be a positive integer.

[105] In some embodiments, the value or the range or the size of the indication field of α or f may be based on the value of the number of RBs (e.g., represented as S) or the value of the number of subcarriers (e.g. represented as S) or the value of frequency unit or the size of subband.

[106] In some embodiments, the value of M may be predefined/fixed. For example, the value of M may be at least one of 1 or 2 or 4 or 6 or 8 or 12 or 16 or 32 or 64.In some embodiments, the value of M may be configured by the network device 120. In some embodiments, the value of M may be determined/reported by the terminal device 110 or may be comprised in the measurement report.

[107] In some embodiments, the reporting band may be for the measurement report.

[108] In some embodiments, the terminal device 110 may be configured with a number of

PRBs for a bandwidth part (BWP) or with a size for the BWP or a number of PRBs for a reporting band for the measurement report. In some embodiments, the number of PRBs for the BWP or for the reporting band (e.g. represented as N^{size}) may be a positive integer. For example, N^{size} may be a positive integer. For example, $24 \leq N^{size} \leq 275$. In some embodiments, the terminal device may be configured with a starting position of the BWP or the reporting band (e.g. represented as N^{start}). For example, N^{start} may be a non-negative integer. For example, $0 \leq N^{start} \leq 275$. In some embodiments, the starting position of the BWP or the reporting band and the number of PRBs for the BWP or the reporting band may be configured in one higher layer parameter.

[109] In some embodiments, the subband may correspond to a subband for CQI or CQI subband or CSI subband. In some embodiments, the subband may correspond to a subband for PMI or PMI subband d.

[110] In some embodiments, the size of one subband or the number of PRBs of one subband may be represented as N_{PRB}^{SB}, and N_{PRB}^{SB} is a positive integer. For example, $1 \leq N_{PRB}^{SB} \leq 32$. For example, N_{PRB}^{SB} may be at least one of {4, 8, 16, 32}. In some embodiments, N_{PRB}^{SB} may be based on the value of N^{size}. In some embodiments, if $24 \leq N_{BWP} \leq 72$, N_{PRB}^{SB} may be 4 or 8. For example, N_{PRB}^{SB} may be configured to be 4 or 8 based on one higher layer parameter for subband. In some embodiments, if $73 \leq N^{size} \leq 144$, N_{PRB}^{SB} may be 8 or 16. For example, N_{PRB}^{SB} may be configured to be 8 or 16 based on the higher layer parameter for subband. In some embodiments, if $145 \leq N^{size} \leq 275$, N_{PRB}^{SB} may be 16 or 32. For example, N_{PRB}^{SB} may be configured to be 16 or 32 based on the higher layer parameter for subband.

[111] In some embodiments, the total number of precoding matrices F or the number of frequency domain bases or the number of frequency units may be a positive integer. For example, $9 \leq F \leq 36$. For another example, $1 \leq F \leq 38$. For another example, $1 \leq F \leq 275$. For example, $F = R * N^{size}/N_{PRB}^{SB}$. For another example, $F = R * \lfloor N^{size}/N_{PRB}^{SB} \rfloor$. For another example, $F = R * \lceil N^{size}/N_{PRB}^{SB} \rceil$. For another example, $F = R * \lfloor N^{size}/N_{PRB}^{SB} \rfloor$+1. For another example, $F = R * \lfloor N^{size}/N_{PRB}^{SB} \rfloor$+2. For another example, $F = R * \lfloor N^{size}/N_{PRB}^{SB} \rfloor$+3. For another example, $F = R * \lfloor N^{size}/N_{PRB}^{SB} \rfloor$+4.

[112] In some embodiments, the first configuration information or the at least one first parameter may comprise the parameter R. In some embodiments, the parameter R (for

example, represented as R) may be a positive integer. For example, R may be a positive integer. For example, R may be one of {1, 2}. In some embodiments, the value of F may be determined based on the parameter R and the number of subbands and/or the size of subband and/or the number of PRBs of BWP or reporting band.

[113] In some embodiments, when $R = 1$, there may be one precoding matrix for each subband. In some embodiments, when $R = 2$, for one first subband that is not the first/beginning one or the last/ending one of the plurality of subbands, there may be two precoding matrixes indicated for the one of the plurality of subbands. For example, the first precoding matrix corresponds to the first $N_{PRB}^{SB}/2$ PRBs of the one of the plurality of subbands, and the second precoding matrix corresponds to the last $N_{PRB}^{SB}/2$ PRBs of the one of the plurality of subbands. In some embodiments, when $R = 2$, for one subband that is the first/beginning one or the last/ending one of the plurality of subbands in the BWP, if $(N^{start} \bmod N_{PRB}^{SB}) \geq \frac{N_{PRB}^{SB}}{2}$, there may be one precoding matrix indicated corresponding to the first/beginning one of the plurality of subbands.

[114] In some embodiments, when $R = 2$, for one subband that is the first/beginning one or the last/ending one of the plurality of subbands, if $(N^{start} \bmod N_{PRB}^{SB}) < \frac{N_{PRB}^{SB}}{2}$, there may be two precoding matrices indicated corresponding to the first/beginning one of the plurality of subbands. For example, the first precoding matrix may correspond to the first $\frac{N_{PRB}^{SB}}{2} - (N^{start} \bmod N_{PRB}^{SB})$ PRBs of the first/beginning one of the plurality of subbands and the second precoding matrix corresponds to the last $\frac{N_{PRB}^{SB}}{2}$ PRBs of the first/beginning one of the plurality of subbands.

[115] In some embodiments, when $R = 2$, for one subband that is the first/beginning one or the last/ending one of the plurality of subbands in the BWP, if $1 + \left(N^{start} + N^{size} - 1\right) \bmod N_{PRB}^{SB} \leq \frac{N_{PRB}^{SB}}{2}$, there may be one precoding matrix indicated corresponding to the last/ending one of the plurality of subbands.

[116] In some embodiments, when $R = 2$, for one subband that is the first/beginning one or the last/ending one of the plurality of subbands, if $1 + \left(N^{start} + N^{size} - 1\right) \bmod N_{PRB}^{SB} > \frac{N_{PRB}^{SB}}{2}$, there may be two precoding matrices indicated corresponding to the last/ending one of the plurality of subbands. For example, the first precoding matrix may correspond to

the first $\frac{N_{PRB}^{SB}}{2}$ PRBs of the last/ending one of the plurality of subbands and the second precoding matrix may correspond to the last $1 + \left(N^{start} + N^{size} - 1\right) \text{mod}\, N_{PRB}^{SB} - \frac{N_{PRB}^{SB}}{2}$ PRBs of the last/ending one of the plurality of subbands.

[117] In some embodiments, the measurement report may comprise the value of frequency unit (or the value of F) and the value of f.

[118] In some embodiments, one frequency domain basis or one first vector may be represented as $e^{j\frac{2\pi*i*f}{F}}$, wherein $0 \leq i \leq F-1$. In some embodiments, one frequency domain basis or one first vector may be represented as $[1\ e^{j\frac{2\pi*1*f}{F}}\ e^{j\frac{2\pi*2*f}{F}}\ \ldots\ e^{j\frac{2\pi*(F-1)*f}{F}}]$.

[119] In some embodiments, the measurement report may comprise the indication of value of frequency unit F_u (or the indication of the value of F or the indication of the value of S or the indication of the value of R) and the indication of the value of f.

[120] In some embodiments, the measurement report may comprise the indication of value of M (or the indication of the value of M_{CP} or the indication of the value of Y or the indication of the value of T_u) and the indication of the value of X.

[121] In some embodiments, the measurement report may comprise the indication of value of Z (or the indication of value of frequency unit F_u or the indication of the value of F or the indication of the value of S or the indication of the value of R) and the indication of the value of α (or the indication of the value of W).

[122] In this way, with different value of subband sizes, the frequency domain basis resolution is different. Considering the complexity and overhead, the granularity for delay/frequency information can be different , e.g., in case of large delay spread, the granularity for delay/phase information may be large.

[123] In some embodiments, the terminal device 110 may report or the measurement report may comprise the at least one first parameter (e.g. the time unit-related information or the frequency unit-related information) and the delay indication/information (or phase indication/information) corresponding to the at least one first parameter (e.g. the time unit-related information or the frequency unit-related information) to the network device 120 (e.g., the first and second sets and/or the first granularity and the second granularity).

[124] In some embodiments, the time unit T_u may be any of below: $M * 64 * T_c$ or $M * T_s$

or $M * 64 * T_c/2^{\mu}$ or $M * T_s/2^{\mu}$. In some embodiments, μ may be index of subcarrier spacing. In some embodiments, X may be an integer. For example, $0 \leq X \leq 2048$. In some embodiments, M may be a positive integer. For example, 1<=M<=64. For another example, 1<=M<=768. In some embodiments, T_c may be defined as $T_c = {}^{1}/_{(\Delta f_{max} \cdot N_f)}$. For example, $\Delta f_{max} = 480 \cdot 10^3$Hz, and $N_f = 4096$. In some embodiments, T_s may be defined as $T_c = {}^{1}/_{(\Delta f_{ref} \cdot N_{f,ref})}$. For example, $\Delta f_{ref} = 15 \cdot 10^3$Hz, and $N_{f,ref} = 2048$.

[125] In some embodiments, the association between the index of subcarrier spacing μ and the value of subcarrier spacing Δf is listed in below table 1.

Table 1 association between μ and △f

μ	$\Delta f = 2^{\mu} \cdot 15$ [kHz]
0	15
1	30
2	60
3	120
4	240
5	480
6	960

[126] In some embodiments, the time unit T_u may be $\lfloor T_{max}/M_{CP} \rfloor$ or $\lceil T_{max}/M_{CP} \rceil$. In some embodiments, T_{max} may be a time duration. In some embodiments, the T_{max} may be $Y * T_s/2^{\mu}$ or $Y/2^{\mu}$ or $Y * T_c/2^{\mu}$. In some embodiments, Y may be an integer. For example, $0 \leq Y \leq 2048$. In some embodiments, T_{max} may be the length of cyclic prefix. For example, Y= 144 or 512 or 160. In some embodiments, the T_{max} may be the duration of maximum receive timing difference, e.g., 33us or 8us or 500us. In some embodiments, Y may be 1012 or 1013 or 1000 or 1024 or 2048. In a further example, the M_{CP} may be a positive integer (e.g., 1<=M_{CP}<=Y).

[127] In some embodiments, in case of different values of the at least one first parameter (e.g. different values of first granularity and/or different values of second granularity and/or different values of third granularity and/or different values of frequency unit and/or different values of time unit and/or different values of subband size), the value of M and/or the value of the value of F and/or the value of M_{CP} and/or the value or range of X and/or the value or range of α and/or the value or range of f may be different.

[128] In some embodiments, in case of the subband size for PMI or for Channel Quality Indicator (CQI) or the value of S is small, the value of M may be large (e.g., coarse adjustment based on the first report, and finer report can be based on CJT CSI with finer frequency domain basis offset). In some embodiments, in case of subband size for PMI or for CQI or the value of S is large, the value of M may be small. Below Table 2 illustrates example values of X. In some embodiments, all or a subset of rows and/or all or a subset of columns in Table 2 may be applied.

Table 2 example values of X

Subband size (PRBs)	Value of R	Value of S	Value of M	Range of X
		1	$M \in \{128, 169, 170, 171, 256\}$ or {64, 85, 86,128}	Up to 5 bits, 0<=X<=31
4	1	4	$M \in \{32,42,43,64\}$ or {16,21,22,32}	up to 7 bits, 0<=X<=127
4	2	2	$M \in \{64,85,86,128\}$ or {32, 42, 43, 64}	Up to 6 bits, 0<=X<=63
8	1	8	$M \in \{16,21,22,32\}$ or {8, 10,11,16}	Up to 8 bits, 0<=X<=255
8	2	4	$M \in \{32,42,43,64\}$ or {16,21,22,32}	up to 7 bits, 0<=X<=127
16	1	16	$M \in \{8, 10,11,16\}$ or {4, 5,6,7,8}	Up to 9 bits, 0<=X<=511
16	2	8	$M \in \{16,21,22,32\}$ or {8, 10,11,16}	Up to 8 bits, 0<=X<=255
32	1	32	$M \in \{4,5,6,7,8\}$ or {2,3,4}	Up to 10 bits, 0<=X<=1023
32	2	16	$M \in \{8, 10,11,16\}$ or {4, 5,6,7,8}	Up to 9 bits, 0<=X<=511

[129] In some embodiments, $2\pi\alpha$ may be phase rotation corresponding to the frequency unit F_u, wherein the frequency unit F_u may be the frequency bands (e.g., in term of hertz or Hz) of a number of resource blocks (RBs) S or a number of subcarriers S. For example, S may be positive integer, 1<=S<=64.

[130] In some embodiments, α may be W/Z, wherein Z may be positive integer. For example, 4<=Z<=360. In some embodiments, the value of Z may depend on the at least one first parameter. In some embodiments, W may be the value of phase information comprised in the measurement report, and W may be a non-negative integer. For example, 0<=W<=Z-1. In some embodiments, Z may be same as the number of frequency units F.

[131] In some embodiments, a value of one phase information may be $e^{j2\pi \cdot c_p/N_{PSK}}$. In some embodiments, c_p may be a value of one indicator or one field for the phase information. In some embodiments, c_p may be a non-negative integer. In some embodiments, $0 \le c_p \le N_{PSK} - 1$. In some embodiments, $0 \le c_p \le 255$. In some embodiments, c_p may be at least one of {0,1,2,3} or {0,1,2,3,4,5,6,7} or {0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15}. In some embodiments, N_{PSK} may be the size for

indication of c_p. In some embodiments, N_{PSK} may be a positive integer. In some embodiments, N_{PSK} may be at least one of {2, 4, 8, 16, 32, 64, 128, 256}.

[132] In some embodiments, the reporting band or BWP or the number or RBs of the reporting band or BWP may be divided into a plurality of frequency units. In some embodiments, each frequency unit may be associated with or may correspond to one index i_{fu}. In some embodiments, i_{fu} may be a non-negative integer. For example, $0 \leq i_{fu} \leq 275$ or $i_{fu} = f$. In some embodiments, the phase rotation for a frequency unit with index i_{fu} may be represented as $e^{j2\pi\alpha \cdot i_{fu}}$.

[133] In some embodiments, the delay information may be represented as index of FD basis f. In some embodiments, f may be non-negative integer. For example, $0 \leq f \leq F - 1$. In some embodiments, F may be the number of frequency units (e.g., in the reporting band or BWP). In some embodiments, F may be positive integer. For example, $1 \leq F \leq 275$.

[134] In some embodiments, $F = \lceil B_{size}/S \rceil$, wherein B_{size} may be the number of RBs in the reporting band or BWP. Below table 3 and table 4 illustrates example values of F. In some embodiments, all or a subset of rows and/or all or a subset of columns in Table 3 may be applied. In some embodiments, all or a subset of rows and/or all or a subset of columns in Table 4 may be applied.

Table 3 example values of F

B_{size}	Subband size (PRBs)	Value of R	Value of S	Value of F
24 – 72	4	1	4	6<=F<=18
24 – 72	4	2	2	12<=F<=36
24 – 72	8	1	8	3<=F<=9
24 – 72	8	2	4	6<=F<=18
73 – 144	8	1	8	10<=F<=18
73 – 144	8	2	4	18<=F<=36
73 – 144	16	1	16	5<=F<=9
73 – 144	16	2	8	10<=F<=18
145 – 275	16	1	16	10<=F<=18
145 – 275	16	2	8	18<=F<=36
145 – 275	32	1	32	5<=F<=9
145 – 275	32	2	16	10<=F<=18

Table 4 example values of F

B_{size}	Value of S	Value of F
24 – 72	1	24<=F<=72
24 – 72	2	12<=F<=36
24 – 72	4	6<=F<=18
24 – 72	8	3<=F<=9
73 – 144	1	73<=F<=144
73 – 144	2	37<=F<=72
73 – 144	4	19<=F<=36
73 – 144	8	10<=F<=18
73 – 144	16	5<=F<=9
145 – 275	1	145<=F<=275
145 – 275	2	73<=F<=138
145 – 275	4	37<=F<=69
145 – 275	8	19<=F<=35
145 – 275	16	10<=F<=18
145 – 275	24	7<=F<=12
145 – 275	32	5<=F<=9

[135] In some embodiments, the second plurality of CSI-RS resources may be indicated by a bitmap corresponding to the first plurality of CSI-RS resources, where each bit value may indicate whether a corresponding CSI-RS resource is selected by the terminal device 110.

[136] In some embodiments, the first indication of the second plurality of CSI-RS resources may be a bitmap with $N_{candidate}$ bits, wherein each bit corresponds to one CSI-RS resource in the first plurality of CSI-RS resources. In some embodiments, the third indication of the reference CSI-RS resource may be a field with $\lceil log_2(N_{selected})\rceil$ bits. In some embodiments, the first indication of the second plurality of CSI-RS resources may be in the first part of the measurement report, and the third indication of the reference CSI-RS resource may be in the second part of the measurement report.

[137] In some embodiments, the first indication of the second plurality of CSI-RS resources may be a bitmap with $N_{candidate}$ -1 bits, wherein each bit corresponds to one CSI-RS resource except the reference CSI-RS resource in the first plurality of CSI-RS resources. In some embodiments, the third indication of the reference CSI-RS resource may be a field with $\lceil log_2(N_{candidate})\rceil$ bits. In some embodiments, the first indication of the second plurality of CSI-RS resources and the third indication of the reference CSI-RS resource may be in first part or in the one part of the measurement report.

[138] Alternatively, in some embodiments, a measurement value of CSI-RS resource (such as, a value of the delay information, a value of the phase information, a value of the doppler information, a value of the amplitude coefficient, or a value of the frequency offset) may be a pre-defined abnormal value, where the pre-defined abnormal value may

be used for indicating the CSI-RS resource not selected by the terminal device 110 or the CSI-RS resource is not suitable of a joint transmission or multi-TRP transmission.

[139] In some embodiments, the candidate value of delay/phase/amplitude information may comprise a codepoint indicating invalid value for the information, e.g., indicating of "out of range" or "N/A" or the corresponding CSI-RS resource is not selected. In this case, there is no need of reporting of the second plurality of CSI-RS resources. That is, the above mentioned measurement value may imply the selection of the second plurality of CSI-RS resource.

[140] In some embodiments, the frequency offset and/or the phase information in time domain may indicate whether the offset is large or not, e.g., whether the related CSI-RS resource is suitable for CJT and/or NCJT transmission.

[141] In some embodiments, the frequency offset may be represented as $F_{offset} * 15000 * 2^{\mu}/F_{granularity}$, where the F_{offset} may be the frequency offset information in the measurement report, $F_{granularity}$ may be a positive integer, e.g., $1 \leq F_{granularity} \leq 15000$, and F_{offset} may be integer, $0 \leq F_{offset} \leq F_{granularity} - 1$.

[142] In some embodiments, the value of amplitude coefficient in the measurement report may be at least one of $\{\frac{1}{8\sqrt{2}}, \frac{1}{8}, \frac{1}{4\sqrt{2}}, \frac{1}{4}, \frac{1}{2\sqrt{2}}, \frac{1}{2}, \frac{1}{\sqrt{2}}, 1\}$ or $\{0, \frac{1}{\sqrt{128}}, \left(\frac{1}{8192}\right)^{1/4}, \frac{1}{8}, \left(\frac{1}{2048}\right)^{1/4}, \frac{1}{2\sqrt{8}}, \left(\frac{1}{512}\right)^{1/4}, \frac{1}{4}, \left(\frac{1}{128}\right)^{1/4}, \frac{1}{\sqrt{8}}, \left(\frac{1}{32}\right)^{1/4}, \frac{1}{2}, \left(\frac{1}{8}\right)^{1/4}, \frac{1}{\sqrt{2}}, \left(\frac{1}{2}\right)^{1/4}, 1\}$ or $\{(\frac{1}{32768})^{1/4}, \frac{1}{\sqrt{128}}, \left(\frac{1}{8192}\right)^{1/4}, \frac{1}{8}, \left(\frac{1}{2048}\right)^{1/4}, \frac{1}{2\sqrt{8}}, \left(\frac{1}{512}\right)^{1/4}, \frac{1}{4}, \left(\frac{1}{128}\right)^{1/4}, \frac{1}{\sqrt{8}}, \left(\frac{1}{32}\right)^{1/4}, \frac{1}{2}, \left(\frac{1}{8}\right)^{1/4}, \frac{1}{\sqrt{2}}, \left(\frac{1}{2}\right)^{1/4}, 1\}$ or $\{\frac{1}{\sqrt{128}}, \left(\frac{1}{8192}\right)^{1/4}, \frac{1}{8}, \left(\frac{1}{2048}\right)^{1/4}, \frac{1}{2\sqrt{8}}, \left(\frac{1}{512}\right)^{1/4}, \frac{1}{4}, \left(\frac{1}{128}\right)^{1/4}, \frac{1}{\sqrt{8}}, \left(\frac{1}{32}\right)^{1/4}, \frac{1}{2}, \left(\frac{1}{8}\right)^{1/4}, \frac{1}{\sqrt{2}}, \left(\frac{1}{2}\right)^{1/4}, 1\}$ or $\{\frac{1}{8\sqrt{2}}, \frac{1}{8}, \frac{1}{4\sqrt{2}}, \frac{1}{4}, \frac{1}{2\sqrt{2}}, \frac{1}{2}, \frac{1}{\sqrt{2}}, 1\}$ or $\{0, \frac{1}{8}, \frac{1}{4\sqrt{2}}, \frac{1}{4}, \frac{1}{2\sqrt{2}}, \frac{1}{2}, \frac{1}{\sqrt{2}}, 1\}$ or $\{\frac{1}{\sqrt{2}}, 1\}$ or $\{\frac{1}{2\sqrt{2}}, \frac{1}{2}, \frac{1}{\sqrt{2}}, 1\}$.

[143] In some embodiments, the amplitude coefficient in the measurement report may reuse amplitude coefficient in CSI report as below table.

$k_{l,p}^{(1)}$	0	1	2	3	4	5	6	7
$P_{l,p}^{(1)}$	Reserved or	$\frac{1}{\sqrt{128}}$	$(\frac{1}{8192})^{1/4}$	1, 8	$(\frac{1}{2048})^{1/4}$	$\frac{1}{2\sqrt{8}}$	$(\frac{1}{512})^{1/4}$	1,4

	$(\frac{1}{32768})^{1/4}$							
$k_{l,p}^{(1)}$	8	9	10	11	12	13	14	15
$P_{l,p}^{(1)}$	$(\frac{1}{128})^{1/4}$	$\frac{1}{\sqrt{8}}$	$(\frac{1}{32})^{1/4}$	1, 2	$(\frac{1}{8})^{1/4}$	$\frac{1}{\sqrt{2}}$	$(\frac{1}{2})^{1/4}$	1

[144] In some example embodiments, the first part of the measurement report may comprise at least one of: a first indication of the second plurality of CSI-RS resources (such as, a bitmap), a third indication of the reference CSI-RS resource, a (first) granularity of delay information, a size of subband, or a (second) granularity of phase offset.

[145] In some example embodiments, the second part of the measurement report may comprise the information except the first part in the measurement report, e.g., at least one of: at least one delay indication/information, at least one frequency offset, at least one phase offset in time domain, at least one phase offset in frequency domain, at least one amplitude coefficient, the reference CSI-RS resource and so on.

[146] In some embodiments, the at least one measurement report may be configured to be a periodic, semi-persistent, aperiodic or event-triggered reporting. In other words, the measurement report may be any of: a periodic report configured by network device 120, a semi-persistent report activated by network device 120, or an event triggered report (such as, an aperiodic report triggered by network device 120 or an aperiodic report triggered by terminal device 110).

[147] In some embodiments, the terminal device 110 may transmit the at least one measurement report to the network device 120 if at least one of the following:

➢ a computation requirement for the at least one measurement report may be met,

➢ a velocity of the terminal device 110 may be equal to or larger than a threshold velocity, or

➢ a probability line-of-sight (LOS) may be equal to or higher than a threshold probability.

[148] In some embodiments, the terminal device 110 may transmit the at least one measurement report to the network device 120 in response to measurement results of a

CSI-RS resource of the second plurality of CSI-RS resources being below a first criteria.

[149] In some embodiments, in case that the duration within which the at least one measurement value corresponding to one CSI-RS resource is unacceptable exceeds a threshold time length, the measurement report may be triggered to be transmitted to the network device 120, wherein the at least one measurement value may be at least one of: delay information, phase information, frequency offset, or amplitude coefficient and so on.

[150] In some embodiments, the threshold time length may be a predefined/preconfigured time duration (e.g., the cyclic prefix length). When this condition is met, the terminal device 110 may report the related CSI-RS resource to the network device 120 (such as, the second plurality of CSI-RS resources not including the reference CSI-RS resource).

[151] In some embodiments, the terminal device 110 may stop the transmission of the at least one measurement report in response to values of the delay information or the phase information to be reported being smaller than or equal to a threshold.

[152] In some embodiments, the measurement report may be updated until the difference of the measurement value(s) corresponding to different CSI-RS resources within a threshold, wherein the threshold may be 0 or a value corresponding to the first information (such as, report unit, time unit).

[153] In some embodiments, the at least one measurement report may comprise an initial measurement report and a subsequent measurement report, and wherein at least one of the following may be different between the initial measurement report and the subsequent measurement report: candidate values of a measurement result, candidate ranges of a measurement result, or bit size of a field indicating of a measurement result.

[154] In some embodiments, in addition to the at least one measurement report, the terminal device 110 may further transmit at least CSI report to the network device 120.

[155] Additionally, in some embodiments, prior to transmitting the at least CSI report, the terminal device 110 may receive 250 second configuration information of the at least CSI report from the network device 120, where the second configuration information is determined by the network device 120 based on the at least measurement report, as discussed below.

[156] In some embodiments, based on the measurement report, the network device 120

may determine 240 a third plurality of CSI-RS resources (e.g., N_{TRP} CSI-RS resources) for channel measurement (for example, a (CJT) CSI report). For example, the third plurality of CSI-RS resources may be configured to the terminal device 110 by the network device 120.

[157] In some embodiments, the network device may configure the third plurality of CSI-RS resources (e.g., N_{TRP} CSI-RS resources) for channel measurement (for example, a (CJT) CSI report). In some embodiments, N_{TRP} may be a positive integer. In some embodiments, the value of N_{TRP} may be no larger than the value of $N_{candidate}$. For example, $1 <= N_{TRP} <= 4$. For another example, $1 <= N_{TRP} <= 8$. For another example, $1 <= N_{TRP} <= N_{candidate}$. In some embodiments, the third plurality of CSI-RS resources may be same or a subset of the first plurality of CSI-RS resources. In some embodiments, the third plurality of CSI-RS resources may be same or a subset of the second plurality of CSI-RS resources.

[158] In some embodiments, the third plurality of CSI-RS resources may be configured with QCL parameters or TCI state associated with or including reference signal in the first or second plurality of CSI-RS resources except a delay parameter (either an average delay or a delay of the first path). For example, that is because the network device 120 has calibrated/adjusted the transmit timing of the CSI-RS based on the reported measurement report.

[159] In some embodiments, there may be a one-to-one mapping between the third plurality of CSI-RS resources and the first plurality of CSI-RS resources or the second plurality of CSI-RS resources. Alternatively, in some embodiments, the third plurality of CSI-RS resources may be the same or a subset of the first plurality or the second plurality of CSI-RS resources. For example, the first plurality of CSI-RS resources may be CSI-RS resources #1 to #4. The second plurality of CSI-RS resources (which may be determined by the terminal device 110) may be CSI-RS resources #1 to #3. For example, because the delay-related information of the CSI-RS resource #4 indicate that the CSI-RS resource #4 is not suitable for multi-TRP transmission or CJT or NCJT. Then, the third plurality of CSI-RS resources may be selected by the network device 120 from the CSI-RS resources #1 to #3.

[160] In some embodiments, the first configuration information may further indicate a first sub-configuration of the first plurality CSI-RS resources and a second sub-configuration of the first plurality CSI-RS resources. In this event, the at least one

measurement report may be generated by the terminal device 110 based on the first sub-configuration and the at least CSI report may be generated based on the second sub-configuration.

[161] In some embodiments, the measurement report and the CSI report may correspond to different sub-configurations of a same configuration of CSI-RS resources. Specifically, a first sub-configuration (e.g., corresponding to the first plurality of CSI-RS resources) may be periodic or semi-persistent or aperiodic, and after application or transmission of the measurement report, the terminal device may assume a second sub-configuration (e.g., corresponding to the third or the second plurality of CSI-RS resources) transmitted.

[162] In some embodiments, the periodicity of the CSI-RS resources corresponding to the second sub-configuration may be no larger than the periodicity of the CSI-RS resources corresponding to the first sub-configuration.

[163] In some embodiments, the number of ports of the CSI-RS resources corresponding to the first sub-configuration may be less than the number of ports of the CSI-RS resources corresponding to the second sub-configuration.

[164] In some embodiments, the number of resources of the CSI-RS resources corresponding to the first sub-configuration may be larger than the number of resources of the CSI-RS resources corresponding to the second sub-configuration.

[165] In some embodiments, after transmitting the at least one measurement report, the terminal device 110 may perform at least one of the following:

➢ assuming the at least one measurement report has been applied after a time duration from the last symbol of uplink resource carrying the at least one measurement report;

➢ determining a validation period for the at least one measurement report; or

➢ updating, based on the at least one measurement report, at least one of downlink reference timing parameters or quasi co-location (QCL) parameters.

[166] In some embodiments, the terminal device 110 may assume that the information comprised in the measurement report is applied after a second time duration from the last symbol of the first report. In addition, the terminal device 110 may assume the information comprised in the measurement report is valid or applied until a third time duration from the last symbol or the slot of the measurement report. In some embodiments,

the second time duration may be a number of symbols, the third time duration may be a number of mili-seconds or slots/frames.

[167] In some embodiments, in case that the information comprised in the measurement report is assumed to be applied, the downlink reference timing corresponding to one CSI-RS resource may be updated and/or the average delay in QCL parameters may be updated.

[168] Optionally, in some embodiments, prior to receiving the first configuration information, the terminal device 110 may transmit 205 capability-related information to the network device 120. Example capability-related information may include at least one of the following:

- the maximum number of the first plurality of CSI-RS resources supported by the terminal device 110, i.e., the maximum number of CSI-RS resources of the first plurality of CSI-RS resources,
- the maximum number of the second plurality of CSI-RS resources supported by the terminal device 110, i.e., support of reporting and/or maximum number (candidate value of $N_{selected}$) for second plurality of CSI-RS resources,
- the maximum number of the first set supported by the terminal device 110, i.e., support of reporting the number of delay information,
- the maximum number of the second set supported by the terminal device 110, i.e., Support of reporting the number of phase information,
- the maximum number of the third set supported by the terminal device 110,
- the maximum number of the at least one amplitude coefficient, i.e., the support of reporting and/or number of amplitude coefficients,
- the maximum number of the at least one frequency offset,
- values of the first granularity supported by the terminal device 110, i.e., support of reporting and/or candidate values for granularity of delay information,
- values of the second granularity supported by the terminal device 110,
- values of the third granularity supported by the terminal device 110, or
- values of the size of subband supported by the terminal device 110, i.e., support of reporting and/or candidate values for size of subband (value of frequency unit).

[169] With the above capability-related information, the following configuration information (such as, the first configuration information and the second configuration information) may be more proper.

Example methods

[170] FIG. 4 illustrates a flowchart of a communication method 400 implemented at a terminal device in accordance with some embodiments of the present disclosure. For the purpose of discussion, the method 400 will be described from the perspective of the terminal device 110 in FIG. 1A.

[171] At block 410, the terminal device receives, from a network device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources.

[172] At block 420, the terminal device transmits, to the network device, the at least one measurement report indicating at least one of the following: At block 430, a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is the same as or a part of the first CSI-RS resources.

[173] In some example embodiments, the at least one measurement report further indicates at least one of the following: a first granularity of the delay information corresponding to the first set, a second granularity of the phase information corresponding to the second set, a third set of doppler information in time domain, the third set corresponding to the second plurality of CSI-RS resources, the doppler information comprised in the third set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, a third granularity of the doppler information, a size of subband, a frequency unit, at least one frequency offset, at least one amplitude coefficient corresponding to the second plurality of CSI-RS resources, a first indication indicating the second plurality of CSI-RS resources,

a second indication indicating a transmission type of coherent joint transmission (CJT) or non-CJT (NCJT), or a third indication indicating the reference CSI-RS resource.

[174] In some example embodiments, the measurement report comprises a first part and a second part associated with the first part, wherein the first part indicates at least one of the following: the first granularity, the second granularity, the third granularity, the size of subband, the frequency unit, the first indication of the second plurality of CSI-RS resources, the second indication or the third indication, and wherein the second part indicates at least one of the following: the first set, the second set, the third set, the at least one frequency offset, the at least one amplitude coefficient or the third indication.

[175] In some example embodiments, the at least one measurement report is configured to be a periodic, semi-persistent, aperiodic or event-triggered reporting.

[176] In some example embodiments, the processor is configured to further cause the terminal device to: transmit the at least one measurement report to the network device in response to: measurement results of a CSI-RS resource of the second plurality of CSI-RS resources being below a first criteria.

[177] In some example embodiments, the processor is configured to further cause the terminal device to: stop the transmission of the at least one measurement report in response to: values of the delay information or the phase information to be reported being smaller than or equal to a threshold.

[178] In some example embodiments, the processor is configured to further cause the terminal device to: transmit the at least one measurement report to the network device if at least one of the following: a computation requirement for the at least one measurement report is met, a velocity of the terminal device is equal to or larger than a threshold velocity (such as, a low speed, a velocity under a threshold), or a probability line-of-sight (LOS) is equal to or higher than a threshold probability (i.e., a high probability with LOS). Else, in some example embodiments, the terminal device 110 may not update or drop the transmission of the measurement report.

[179] In some example embodiments, the processor is configured to further cause the terminal device to: after transmitting the at least one measurement report, perform at least one of the following: assuming the at least one measurement report has been applied after a time duration from the last symbol of uplink resource carrying the at least one

measurement report; determining a validation period for the at least one measurement report; or updating, based on the at least one measurement report, at least one of downlink reference timing parameters or quasi co-location (QCL) parameters.

[180] In some example embodiments, the first configuration information further indicates: a first sub-configuration of the first plurality CSI-RS resources and a second sub-configuration of the first plurality CSI-RS resources, and wherein the at least one measurement report is generated by the terminal device based on the first sub-configuration.

[181] In some example embodiments, the processor is configured to further cause the terminal device to: transmit at least CSI report to the network device, the at least CSI report being generated based on the second sub-configuration.

[182] In some example embodiments, the processor is configured to further cause the terminal device to: prior to transmitting the at least CSI report, receive second configuration information of the at least CSI report from the network device, the second configuration information being determined by the network device based on the at least measurement report.

[183] In some example embodiments, the at least one measurement report comprises an initial measurement report and a subsequent measurement report, and wherein at least one of the following is different between the initial measurement report and the subsequent measurement report: candidate values of a measurement result, candidate ranges of a measurement result, or bit size of a field indicating of a measurement result. That is because, the network device 120 may adjust the transmission of the CSI-RS, and the measurement value(s) of the subsequent measurement report should be smaller than the measurement value(s) of the initial measurement report.

[184] In some example embodiments, the second plurality of CSI-RS resources is indicated by a bitmap corresponding to the first plurality of CSI-RS resources, each bit value indicating whether a corresponding CSI-RS resource is selected by the terminal device, or wherein a measurement value of CSI-RS resource is a pre-defined abnormal value, the pre-defined abnormal value used for indicating the CSI-RS resource is not selected by the terminal device or the CSI-RS resource is not suitable of a joint transmission.

[185] In some example embodiments, the measurement value comprises at least one of the following: a value of the delay information, a value of the phase information, a value of the doppler information, a value of the amplitude information, or a value of the frequency offset.

[186] In some example embodiments, the delay information is reported based on the first granularity and at least one first parameter, the phase information is reported based on the second granularity and the at least one first parameter, the doppler information is reported based on the first granularity and the at least one first parameter, at least one of the first, second or third granularity is reported based on the at least one first parameter, and wherein the at least one first parameter comprises at least one of the following: a size of reporting band, a size of bandwidth part (BWP), a subcarrier spacing, whether the measurement report is an initial measurement report or a subsequent measurement report, a size of subband, a value of time unit, a value of frequency unit, or the number of precoding matrix indicators (PMIs) per subband.

[187] In some example embodiments, the at least one first parameter is configured by the network device or reported by the network device.

[188] In some example embodiments, the processor is configured to further cause the terminal device to: transmit, to the network device, capability-related information comprising at least one of the following: the maximum number of the first plurality of CSI-RS resources supported by the terminal device, the maximum number of the second plurality of CSI-RS resources supported by the terminal device, the maximum number of the first set supported by the terminal device, the maximum number of the second set supported by the terminal device, the maximum number of the third set supported by the terminal device, the maximum number of the at least one amplitude coefficient, the maximum number of the at least one frequency offset, values of the first granularity supported by the terminal device, values of the second granularity supported by the terminal device, values of the third granularity supported by the terminal device, or values of the size of subband supported by the terminal device.

[189] In some example embodiments, the reference CSI-RS resource is one of the following: a default CSI-RS resource, or a CSI-RS resource with the minimum value of the delay information or the phase information.

[190] In some example embodiments, the delay information is a multiple of a time unit,

and the phase information is a phase rotation or an index of frequency domain basis.

[191] In some example embodiments, the delay information of a CSI-RS resource is one of the following: an absolute value of a delay between the network device and the terminal device, or a delay different between the CSI-RS resource and the reference CSI-RS resource.

[192] FIG. 5 illustrates a flowchart of a communication method 500 implemented at a network device in accordance with some embodiments of the present disclosure. For the purpose of discussion, the method 500 will be described from the perspective of the network device in FIG. 1A.

[193] At block 510, the network device transmits, to a terminal device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources.

[194] At block 520, the network device receives, from the terminal device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is a same as or a part of the first CSI-RS resources.

[195] In some example embodiments, the at least one measurement report further indicates at least one of the following: a first granularity of the delay information corresponding to the first set, a second granularity of the phase information corresponding to the second set, a third set of doppler information in time domain, the third set corresponding to the second plurality of CSI-RS resources, the doppler information comprised in the third set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, a third granularity of the doppler information, a size of subband, a frequency unit, at least one frequency offset, at least one amplitude coefficient corresponding to the second plurality of CSI-RS resources, a first indication indicating the second plurality of CSI-RS resources,

a second indication indicating a transmission type of coherent joint transmission (CJT) or non-CJT (NCJT), or a third indication indicating the reference CSI-RS resource.

[196] In some example embodiments, the measurement report comprises a first part and a second part associated with the first part, wherein the first part indicates at least one of the following: the first granularity, the second granularity, the third granularity, the size of subband, the first indication indicating the second plurality of CSI-RS resources, the second indication or the third indication, and wherein the second part indicates at least one of the following: the first set, the second set, the third set, the at least one frequency offset, the at least one amplitude coefficient or the third indication.

[197] In some example embodiments, the at least one measurement report is configured to be a periodic, semi-persistent, aperiodic or event-triggered reporting.

[198] In some example embodiments, the processor is configured to further cause the network device to: update, based on the at least one measurement report, at least one of downlink reference timing parameters or quasi co-location (QCL) parameters within the validation period.

[199] In some example embodiments, the first configuration information further indicates: a first sub-configuration of the first plurality CSI-RS resources and a second sub-configuration of the first plurality CSI-RS resources, and wherein the at least one measurement report is generated by the terminal device based on the first sub-configuration.

[200] In some example embodiments, the processor is configured to further cause the network device to: receive at least CSI report to the network device, the at least CSI report being generated based on the second sub-configuration.

[201] In some example embodiments, the processor is configured to further cause the network device to: determine second configuration information of the at least CSI report based on the at least measurement report; and transmit the second configuration information to the terminal device.

[202] In some example embodiments, the at least one measurement report comprises an initial measurement report and a subsequent measurement report, and wherein at least one of the following is different between the initial measurement report and the subsequent measurement report: candidate values of a measurement result, candidate ranges of a

measurement result, or bit size of a field indicating of a measurement result.

[203] In some example embodiments, the second plurality of CSI-RS resources is indicated by a bitmap corresponding to the first plurality of CSI-RS resources, each bit value indicating whether a corresponding CSI-RS resource is selected by the terminal device, or wherein a measurement value of CSI-RS resource is a pre-defined abnormal value, the pre-defined abnormal value used for indicating the CSI-RS resource is not selected by the terminal device or the CSI-RS resource is not suitable of a joint transmission.

[204] In some example embodiments, the measurement value comprises at least one of the following: a value of the delay information, a value of the phase information, a value of the doppler information, a value of the amplitude information, or a value of the frequency offset.

[205] In some example embodiments, the delay information is reported based on the first granularity and at least one first parameter, the phase information is reported based on the second granularity and the at least one first parameter, the doppler information is reported based on the first granularity and the at least one first parameter, at least one of the first, second or third granularity is reported based on the at least one first parameter, and wherein the at least one first parameter comprises at least one of the following: a size of reporting band, a size of bandwidth part (BWP), a subcarrier spacing, whether the measurement report is an initial measurement report or a subsequent measurement report, a size of subband, a value of time unit, a value of frequency unit, or the number of precoding matrix indicators (PMIs) per subband.

[206] In some example embodiments, the at least one first parameter is configured by the network device or reported by the network device.

[207] In some example embodiments, the processor is configured to further cause the network device to: receive, from the terminal device, capability-related information comprising at least one of the following: the maximum number of the first plurality of CSI-RS resources supported by the terminal device, the maximum number of the second plurality of CSI-RS resources supported by the terminal device, the maximum number of the first set supported by the terminal device, the maximum number of the second set supported by the terminal device, the maximum number of the third set supported by the terminal device, the maximum number of the at least one amplitude coefficient, the

maximum number of the at least one frequency offset, values of the first granularity supported by the terminal device, values of the second granularity supported by the terminal device, values of the third granularity supported by the terminal device, or values of the size of subband supported by the terminal device.

[208] In some example embodiments, the reference CSI-RS resource is one of the following: a default CSI-RS resource, or a CSI-RS resource with the minimum value of the delay information or the phase information.

[209] In some example embodiments, the delay information is a multiple of a time unit, and the phase information is a phase rotation or an index of frequency domain basis.

[210] In some example embodiments, the delay information of a CSI-RS resource is one of the following: an absolute value of a delay between the network device and the terminal device, or a delay different between the CSI-RS resource and the reference CSI-RS resource.

Example devices and apparatuses

[211] FIG. 6 is a simplified block diagram of a device 600 that is suitable for implementing embodiments of the present disclosure. The device 600 can be considered as a further example implementation of any of the devices as shown in FIG. 1A. Accordingly, the device 600 can be implemented at or as at least a part of the terminal device 110 or the network device 120.

[212] As shown, the device 600 includes a processor 610, a memory 620 coupled to the processor 610, a suitable transceiver 640 coupled to the processor 610, and a communication interface coupled to the transceiver 640. The memory 620 stores at least a part of a program 630. The transceiver 640 may be for bidirectional communications or a unidirectional communication based on requirements. The transceiver 640 may include at least one of a transmitter 642 and a receiver 644. The transmitter 642 and the receiver 644 may be functional modules or physical entities. The transceiver 640 has at least one antenna to facilitate communication, though in practice an Access Node mentioned in this application may have several ones. The communication interface may represent any interface that is necessary for communication with other network elements, such as X2/Xn interface for bidirectional communications between eNBs/gNBs, S1/NG interface for

communication between a Mobility Management Entity (MME)/Access and Mobility Management Function (AMF)/SGW/UPF and the eNB/gNB, Un interface for communication between the eNB/gNB and a relay node (RN), or Uu interface for communication between the eNB/gNB and a terminal device.

[213] The program 630 is assumed to include program instructions that, when executed by the associated processor 610, enable the device 600 to operate in accordance with the embodiments of the present disclosure, as discussed herein with reference to FIGS. 1 to 6. The embodiments herein may be implemented by computer software executable by the processor 610 of the device 600, or by hardware, or by a combination of software and hardware. The processor 610 may be configured to implement various embodiments of the present disclosure. Furthermore, a combination of the processor 610 and memory 620 may form processing means 650 adapted to implement various embodiments of the present disclosure.

[214] The memory 620 may be of any type suitable to the local technical network and may be implemented using any suitable data storage technology, such as a non-transitory computer readable storage medium, semiconductor based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory, as non-limiting examples. While only one memory 620 is shown in the device 600, there may be several physically distinct memory modules in the device 600. The processor 610 may be of any type suitable to the local technical network, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs) and processors based on multicore processor architecture, as non-limiting examples. The device 600 may have multiple processors, such as an application specific integrated circuit chip that is slaved in time to a clock which synchronizes the main processor.

[215] According to embodiments of the present disclosure, a terminal device comprising a circuitry is provided. The circuitry is configured to: receive, from a network device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and transmit, to the network device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding

to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is the same as or a part of the first plurality of CSI-RS resources. According to embodiments of the present disclosure, the circuitry may be configured to perform any method implemented by the terminal device as discussed above.

[216] According to embodiments of the present disclosure, a network device comprising a circuitry is provided. The circuitry is configured to: transmit, to a terminal device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and receive , from the terminal device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is a same as or a part of the first CSI-RS resources. According to embodiments of the present disclosure, the circuitry may be configured to perform any method implemented by the network device as discussed above.

[217] The term "circuitry" used herein may refer to hardware circuits and/or combinations of hardware circuits and software. For example, the circuitry may be a combination of analog and/or digital hardware circuits with software/firmware. As a further example, the circuitry may be any portions of hardware processors with software including digital signal processor(s), software, and memory(ies) that work together to cause an apparatus, such as a terminal device or a network device, to perform various functions. In a still further example, the circuitry may be hardware circuits and or processors, such as a microprocessor or a portion of a microprocessor, that requires software/firmware for operation, but the software may not be present when it is not needed for operation. As used herein, the term circuitry also covers an implementation of merely a hardware circuit or processor(s) or a portion of a hardware circuit or processor(s) and its (or their)

accompanying software and/or firmware.

[218] According to embodiments of the present disclosure, a terminal apparatus is provided. The terminal apparatus comprises means for receiving, from a network device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and means for transmitting, to the network device, the at least one measurement report indicating at least one of the following: means for a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or means for a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, means for wherein the second plurality of CSI-RS resources is the same as or a part of the first plurality of CSI-RS resources. In some embodiments, the first apparatus may comprise means for performing the respective operations of the method 400. In some example embodiments, the first apparatus may further comprise means for performing other operations in some example embodiments of the method 400. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module.

[219] According to embodiments of the present disclosure, a network apparatus is provided. The network apparatus comprises means for transmitting, to a terminal device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and means for receiving , from the terminal device, the at least one measurement report indicating at least one of the following: means for a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or means for a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, means for wherein the second plurality of CSI-RS resources is a

same as or a part of the first CSI-RS resources. In some embodiments, the second apparatus may comprise means for performing the respective operations of the method 500. In some example embodiments, the second apparatus may further comprise means for performing other operations in some example embodiments of the method 500. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module.

[220] In summary, embodiments of the present disclosure provide the following aspects.

[221] In an aspect, it is proposed a terminal device comprising: a processor configured to cause the terminal device to: receive, from a network device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and transmit, to the network device, the at least one measurement report indicating at least one of the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is the same as or a part of the first plurality of CSI-RS resources.

[222] In some embodiments, the at least one measurement report further indicates at least one of the following: a first granularity of the delay information corresponding to the first set, a second granularity of the phase information corresponding to the second set, a third set of doppler information in time domain, the third set corresponding to the second plurality of CSI-RS resources, the doppler information comprised in the third set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, a third granularity of the doppler information, a size of subband, a frequency unit, at least one frequency offset, at least one amplitude coefficient corresponding to the second plurality of CSI-RS resources, a first indication indicating the second plurality of CSI-RS resources, a second indication indicating a transmission type of coherent joint transmission (CJT) or non-CJT (NCJT), or a third indication indicating the reference CSI-RS resource.

[223] In some embodiments, the measurement report comprises a first part and a second

part associated with the first part, wherein the first part indicates at least one of the following: the first granularity, the second granularity, the third granularity, the size of subband, the frequency unit, the first indication of the second plurality of CSI-RS resources, the second indication or the third indication, and wherein the second part indicates at least one of the following: the first set, the second set, the third set, the at least one frequency offset, the at least one amplitude coefficient or the third indication.

[224] In some embodiments, the at least one measurement report is configured to be a periodic, semi-persistent, aperiodic or event-triggered reporting.

[225] In some embodiments, the processor is configured to further cause the terminal device to: transmit the at least one measurement report to the network device in response to: measurement results of a CSI-RS resource of the second plurality of CSI-RS resources being below a first criteria.

[226] In some embodiments, the processor is configured to further cause the terminal device to: stop the transmission of the at least one measurement report in response to: values of the delay information or the phase information to be reported being smaller than or equal to a threshold.

[227] In some embodiments, the processor is configured to further cause the terminal device to: transmit the at least one measurement report to the network device if at least one of the following: a computation requirement for the at least one measurement report is met, a velocity of the terminal device is equal to or larger than a threshold velocity, or a probability line-of-sight (LOS) is equal to or higher than a threshold probability.

[228] In some embodiments, the processor is configured to further cause the terminal device to: after transmitting the at least one measurement report, perform at least one of the following: assuming the at least one measurement report has been applied after a time duration from the last symbol of uplink resource carrying the at least one measurement report; determining a validation period for the at least one measurement report; or updating, based on the at least one measurement report, at least one of downlink reference timing parameters or quasi co-location (QCL) parameters.

[229] In some embodiments, the first configuration information further indicates: a first sub-configuration of the first plurality CSI-RS resources and a second sub-configuration of the first plurality CSI-RS resources, and wherein the at least one measurement report

is generated by the terminal device based on the first sub-configuration.

[230] In some embodiments, the processor is configured to further cause the terminal device to: transmit at least CSI report to the network device, the at least CSI report being generated based on the second sub-configuration.

[231] In some embodiments, the processor is configured to further cause the terminal device to: prior to transmitting the at least CSI report, receive second configuration information of the at least CSI report from the network device, the second configuration information being determined by the network device based on the at least measurement report.

[232] In some embodiments, the at least one measurement report comprises an initial measurement report and a subsequent measurement report, and wherein at least one of the following is different between the initial measurement report and the subsequent measurement report: candidate values of a measurement result, candidate ranges of a measurement result, or bit size of a field indicating of a measurement result.

[233] In some embodiments, the second plurality of CSI-RS resources is indicated by a bitmap corresponding to the first plurality of CSI-RS resources, each bit value indicating whether a corresponding CSI-RS resource is selected by the terminal device, or wherein a measurement value of CSI-RS resource is a pre-defined abnormal value, the pre-defined abnormal value used for indicating the CSI-RS resource is not selected by the terminal device or the CSI-RS resource is not suitable of a joint transmission.

[234] In some embodiments, the measurement value comprises at least one of the following: a value of the delay information, a value of the phase information, a value of the doppler information, a value of the amplitude information, or a value of the frequency offset.

[235] In some embodiments, the delay information is reported based on the first granularity and at least one first parameter, the phase information is reported based on the second granularity and the at least one first parameter, the doppler information is reported based on the first granularity and the at least one first parameter, at least one of the first, second or third granularity is reported based on the at least one first parameter, and wherein the at least one first parameter comprises at least one of the following: a size of reporting band, a size of bandwidth part (BWP), a subcarrier spacing, whether the

measurement report is an initial measurement report or a subsequent measurement report, a size of subband, a value of time unit, a value of frequency unit, or the number of precoding matrix indicators (PMIs) per subband.

[236] In some embodiments, the at least one first parameter is configured by the network device or reported by the network device.

[237] In some embodiments, the processor is configured to further cause the terminal device to: transmit, to the network device, capability-related information comprising at least one of the following: the maximum number of the first plurality of CSI-RS resources supported by the terminal device, the maximum number of the second plurality of CSI-RS resources supported by the terminal device, the maximum number of the first set supported by the terminal device, the maximum number of the second set supported by the terminal device, the maximum number of the third set supported by the terminal device, the maximum number of the at least one amplitude coefficient, the maximum number of the at least one frequency offset, values of the first granularity supported by the terminal device, values of the second granularity supported by the terminal device, values of the third granularity supported by the terminal device, or values of the size of subband supported by the terminal device.

[238] In some embodiments, the reference CSI-RS resource is one of the following: a default CSI-RS resource, or a CSI-RS resource with the minimum value of the delay information or the phase information.

[239] In some embodiments, the delay information is a multiple of a time unit, and the phase information is a phase rotation or an index of frequency domain basis.

[240] In some embodiments, the delay information of a CSI-RS resource is one of the following: an absolute value of a delay between the network device and the terminal device, or a delay different between the CSI-RS resource and the reference CSI-RS resource.

[241] In an aspect, it is proposed a network device comprising: a processor configured to cause the network device to: transmit, to a terminal device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and receive , from the terminal device, the at least one measurement report indicating at least one of

the following: a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, wherein the second plurality of CSI-RS resources is a same as or a part of the first CSI-RS resources.

[242] In some embodiments, the at least one measurement report further indicates at least one of the following: a first granularity of the delay information corresponding to the first set, a second granularity of the phase information corresponding to the second set, a third set of doppler information in time domain, the third set corresponding to the second plurality of CSI-RS resources, the doppler information comprised in the third set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, a third granularity of the doppler information, a size of subband, a frequency unit, at least one frequency offset, at least one amplitude coefficient corresponding to the second plurality of CSI-RS resources, a first indication indicating the second plurality of CSI-RS resources, a second indication indicating a transmission type of coherent joint transmission (CJT) or non-CJT (NCJT), or a third indication indicating the reference CSI-RS resource.

[243] In some embodiments, the measurement report comprises a first part and a second part associated with the first part, wherein the first part indicates at least one of the following: the first granularity, the second granularity, the third granularity, the size of subband, the first indication indicating the second plurality of CSI-RS resources, the second indication or the third indication, and wherein the second part indicates at least one of the following: the first set, the second set, the third set, the at least one frequency offset, the at least one amplitude coefficient or the third indication.

[244] In some embodiments, the at least one measurement report is configured to be a periodic, semi-persistent, aperiodic or event-triggered reporting.

[245] In some embodiments, the processor is configured to further cause the network device to: update, based on the at least one measurement report, at least one of downlink reference timing parameters or quasi co-location (QCL) parameters within the validation period.

[246] In some embodiments, the first configuration information further indicates: a first sub-configuration of the first plurality CSI-RS resources and a second sub-configuration of the first plurality CSI-RS resources, and wherein the at least one measurement report is generated by the terminal device based on the first sub-configuration.

[247] In some embodiments, the processor is configured to further cause the network device to: receive at least CSI report to the network device, the at least CSI report being generated based on the second sub-configuration.

[248] In some embodiments, the processor is configured to further cause the network device to: determine second configuration information of the at least CSI report based on the at least measurement report; and transmit the second configuration information to the terminal device.

[249] In some embodiments, the at least one measurement report comprises an initial measurement report and a subsequent measurement report, and wherein at least one of the following is different between the initial measurement report and the subsequent measurement report: candidate values of a measurement result, candidate ranges of a measurement result, or bit size of a field indicating of a measurement result.

[250] In some embodiments, the second plurality of CSI-RS resources is indicated by a bitmap corresponding to the first plurality of CSI-RS resources, each bit value indicating whether a corresponding CSI-RS resource is selected by the terminal device, or wherein a measurement value of CSI-RS resource is a pre-defined abnormal value, the pre-defined abnormal value used for indicating the CSI-RS resource is not selected by the terminal device or the CSI-RS resource is not suitable of a joint transmission.

[251] In some embodiments, the measurement value comprises at least one of the following: a value of the delay information, a value of the phase information, a value of the doppler information, a value of the amplitude information, or a value of the frequency offset.

[252] In some embodiments, the delay information is reported based on the first granularity and at least one first parameter, the phase information is reported based on the second granularity and the at least one first parameter, the doppler information is reported based on the first granularity and the at least one first parameter, at least one of the first, second or third granularity is reported based on the at least one first parameter, and

wherein the at least one first parameter comprises at least one of the following: a size of reporting band, a size of bandwidth part (BWP), a subcarrier spacing, whether the measurement report is an initial measurement report or a subsequent measurement report, a size of subband, a value of time unit, a value of frequency unit, or the number of precoding matrix indicators (PMIs) per subband.

[253] In some embodiments, the at least one first parameter is configured by the network device or reported by the network device.

[254] In some embodiments, the processor is configured to further cause the network device to: receive, from the terminal device, capability-related information comprising at least one of the following: the maximum number of the first plurality of CSI-RS resources supported by the terminal device, the maximum number of the second plurality of CSI-RS resources supported by the terminal device, the maximum number of the first set supported by the terminal device, the maximum number of the second set supported by the terminal device, the maximum number of the third set supported by the terminal device, the maximum number of the at least one amplitude coefficient, the maximum number of the at least one frequency offset, values of the first granularity supported by the terminal device, values of the second granularity supported by the terminal device, values of the third granularity supported by the terminal device, or values of the size of subband supported by the terminal device.

[255] In some embodiments, the reference CSI-RS resource is one of the following: a default CSI-RS resource, or a CSI-RS resource with the minimum value of the delay information or the phase information.

[256] In some embodiments, the delay information is a multiple of a time unit, and the phase information is a phase rotation or an index of frequency domain basis.

[257] In some embodiments, the delay information of a CSI-RS resource is one of the following: an absolute value of a delay between the network device and the terminal device, or a delay different between the CSI-RS resource and the reference CSI-RS resource.

[258] In an aspect, a terminal device comprises: at least one processor; and at least one memory coupled to the at least one processor and storing instructions thereon, the instructions, when executed by the at least one processor, causing the device to perform

the method implemented by the terminal device discussed above.

[259] In an aspect, a network device comprises: at least one processor; and at least one memory coupled to the at least one processor and storing instructions thereon, the instructions, when executed by the at least one processor, causing the device to perform the method implemented by the network device discussed above.

[260] In an aspect, a computer readable medium having instructions stored thereon, the instructions, when executed on at least one processor, causing the at least one processor to perform the method implemented by the terminal device discussed above.

[261] In an aspect, a computer readable medium having instructions stored thereon, the instructions, when executed on at least one processor, causing the at least one processor to perform the method implemented by the network device discussed above.

[262] In an aspect, a computer program comprising instructions, the instructions, when executed on at least one processor, causing the at least one processor to perform the method implemented by the terminal device discussed above.

[263] In an aspect, a computer program comprising instructions, the instructions, when executed on at least one processor, causing the at least one processor to perform the method implemented by the network device discussed above.

[264] Generally, various embodiments of the present disclosure may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. Some aspects may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device. While various aspects of embodiments of the present disclosure are illustrated and described as block diagrams, flowcharts, or using some other pictorial representation, it will be appreciated that the blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

[265] The present disclosure also provides at least one computer program product tangibly stored on a non-transitory computer readable storage medium. The computer program product includes computer-executable instructions, such as those included in program modules, being executed in a device on a target real or virtual processor, to carry out the

process or method as described above with reference to FIGS. 1 to 6. Generally, program modules include routines, programs, libraries, objects, classes, components, data structures, or the like that perform particular tasks or implement particular abstract data types. The functionality of the program modules may be combined or split between program modules as desired in various embodiments. Machine-executable instructions for program modules may be executed within a local or distributed device. In a distributed device, program modules may be located in both local and remote storage media.

[266] Program code for carrying out methods of the present disclosure may be written in any combination of one or more programming languages. These program codes may be provided to a processor or controller of a general purpose computer, special purpose computer, or other programmable data processing apparatus, such that the program codes, when executed by the processor or controller, cause the functions/operations specified in the flowcharts and/or block diagrams to be implemented. The program code may execute entirely on a machine, partly on the machine, as a stand-alone software package, partly on the machine and partly on a remote machine or entirely on the remote machine or server.

[267] The above program code may be embodied on a machine readable medium, which may be any tangible medium that may contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device. The machine readable medium may be a machine readable signal medium or a machine readable storage medium. A machine readable medium may include but not limited to an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples of the machine readable storage medium would include an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing.

[268] Further, while operations are depicted in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Likewise, while several specific implementation details are contained in

the above discussions, these should not be construed as limitations on the scope of the present disclosure, but rather as descriptions of features that may be specific to particular embodiments. Certain features that are described in the context of separate embodiments may also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment may also be implemented in multiple embodiments separately or in any suitable sub-combination.

[269] Although the present disclosure has been described in language specific to structural features and/or methodological acts, it is to be understood that the present disclosure defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

CLAIMS

1. A terminal device comprising:

a processor configured to cause the terminal device to:

receive, from a network device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and

transmit, to the network device, the at least one measurement report indicating at least one of the following:

a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or

a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources,

wherein the second plurality of CSI-RS resources is the same as or a part of the first plurality of CSI-RS resources.

2. The terminal device of claim 1, wherein the at least one measurement report further indicates at least one of the following:

a first granularity of the delay information corresponding to the first set,

a second granularity of the phase information corresponding to the second set,

a third set of doppler information in time domain, the third set corresponding to the second plurality of CSI-RS resources, the doppler information comprised in the third set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources,

a third granularity of the doppler information,

a size of subband,

a frequency unit,

at least one frequency offset,

at least one amplitude coefficient corresponding to the second plurality of CSI-RS resources,

a first indication indicating the second plurality of CSI-RS resources,

a second indication indicating a transmission type of coherent joint transmission (CJT) or non-CJT (NCJT), or a third indication indicating the reference CSI-RS resource.

3. The terminal device of claim 2, wherein the measurement report comprises a first part and a second part associated with the first part,

wherein the first part indicates at least one of the following: the first granularity, the second granularity, the third granularity, the size of subband, the frequency unit, the first indication of the second plurality of CSI-RS resources, the second indication or the third indication, and

wherein the second part indicates at least one of the following: the first set, the second set, the third set, the at least one frequency offset, the at least one amplitude coefficient or the third indication.

4. The terminal device of claim 1, wherein the at least one measurement report is configured to be a periodic, semi-persistent, aperiodic or event-triggered reporting.

5. The terminal device of claim 1, wherein the processor is configured to further cause the terminal device to:

transmit the at least one measurement report to the network device in response to:

measurement results of a CSI-RS resource of the second plurality of CSI-RS resources being below a first criteria, or

stop the transmission of the at least one measurement report in response to:

values of the delay information or the phase information to be reported being smaller than or equal to a threshold.

6. The terminal device of claim 1, wherein the processor is configured to further cause the terminal device to:

transmit the at least one measurement report to the network device if at least one of the following:

a computation requirement for the at least one measurement report is met,

a velocity of the terminal device is equal to or larger than a threshold velocity, or

a probability line-of-sight (LOS) is equal to or higher than a threshold probability.

7. The terminal device of claim 1, wherein the processor is configured to further cause

the terminal device to:

after transmitting the at least one measurement report, perform at least one of the following:

assuming the at least one measurement report has been applied after a time duration from the last symbol of uplink resource carrying the at least one measurement report;

determining a validation period for the at least one measurement report; or

updating, based on the at least one measurement report, at least one of downlink reference timing parameters or quasi co-location (QCL) parameters.

8. The terminal device of claim 1, wherein the first configuration information further indicates: a first sub-configuration of the first plurality CSI-RS resources and a second sub-configuration of the first plurality CSI-RS resources, and

wherein the at least one measurement report is generated by the terminal device based on the first sub-configuration.

9. The terminal device of claim 8, the processor is configured to further cause the terminal device to:

transmit at least CSI report to the network device, the at least CSI report being generated based on the second sub-configuration.

10. The terminal device of claim 9, the processor is configured to further cause the terminal device to:

prior to transmitting the at least CSI report, receive second configuration information of the at least CSI report from the network device, the second configuration information being determined by the network device based on the at least measurement report.

11. The terminal device of claim 1, wherein the at least one measurement report comprises an initial measurement report and a subsequent measurement report,

and wherein at least one of the following is different between the initial measurement report and the subsequent measurement report:

candidate values of a measurement result,

candidate ranges of a measurement result, or

bit size of a field indicating of a measurement result.

12. The terminal device of claim 2, wherein the second plurality of CSI-RS resources is indicated by a bitmap corresponding to the first plurality of CSI-RS resources, each bit value indicating whether a corresponding CSI-RS resource is selected by the terminal device,

or wherein a measurement value of CSI-RS resource is a pre-defined abnormal value, the pre-defined abnormal value used for indicating the CSI-RS resource is not selected by the terminal device or the CSI-RS resource is not suitable of a joint transmission.

13. The terminal device of claim 11 or 13, wherein the measurement value comprises at least one of the following:

a value of the delay information,

a value of the phase information,

a value of the doppler information,

a value of the amplitude information, or

a value of the frequency offset.

14. The terminal device of claim 2, wherein,

the delay information is reported based on the first granularity and at least one first parameter,

the phase information is reported based on the second granularity and the at least one first parameter,

the doppler information is reported based on the first granularity and the at least one first parameter,

at least one of the first, second or third granularity is reported based on the at least one first parameter,

and wherein the at least one first parameter comprises at least one of the following:

a size of reporting band,

a size of bandwidth part (BWP),

a subcarrier spacing,

whether the measurement report is an initial measurement report or a subsequent measurement report,

a size of subband,

a value of time unit,

a value of frequency unit, or

the number of precoding matrix indicators (PMIs) per subband.

15. The terminal device of claim 14, wherein the at least one first parameter is configured by the network device or reported by the network device.

16. The terminal device of claim 1, wherein the processor is configured to further cause the terminal device to:

transmit, to the network device, capability-related information comprising at least one of the following:

the maximum number of the first plurality of CSI-RS resources supported by the terminal device,

the maximum number of the second plurality of CSI-RS resources supported by the terminal device,

the maximum number of the first set supported by the terminal device,

the maximum number of the second set supported by the terminal device,

the maximum number of the third set supported by the terminal device,

the maximum number of the at least one amplitude coefficient,

the maximum number of the at least one frequency offset,

values of the first granularity supported by the terminal device,

values of the second granularity supported by the terminal device,

values of the third granularity supported by the terminal device, or

values of the size of subband supported by the terminal device.

17. The terminal device of claim 1, wherein the reference CSI-RS resource is one of the following:

a default CSI-RS resource, or

a CSI-RS resource with the minimum value of the delay information or the phase information.

18. The terminal device of claim 1, wherein the delay information is a multiple of a time unit, and the phase information is a phase rotation or an index of frequency domain basis.

19. The terminal device of claim 1, wherein the delay information of a CSI-RS resource is one of the following:

an absolute value of a delay between the network device and the terminal device, or a delay different between the CSI-RS resource and the reference CSI-RS resource.

20. A network device comprising:

a processor configured to cause the network device to:

transmit, to a terminal device, first configuration information for at least one measurement report, the first configuration information indicating a first plurality of channel state information (CSI)-reference signal (RS) resources; and

receive , from the terminal device, the at least one measurement report indicating at least one of the following:

a first set of delay information in time domain, the first set corresponding to a second plurality of CSI-RS resources with a reference CSI-RS included or excluded, the delay information comprised in the first set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources, or

a second set of phase information in frequency domain, the second set corresponding to the second plurality of CSI-RS resources, the phase information comprised in the second set corresponding to a CSI-RS resource of the second plurality of CSI-RS resources,

wherein the second plurality of CSI-RS resources is a same as or a part of the first plurality of CSI-RS resources.

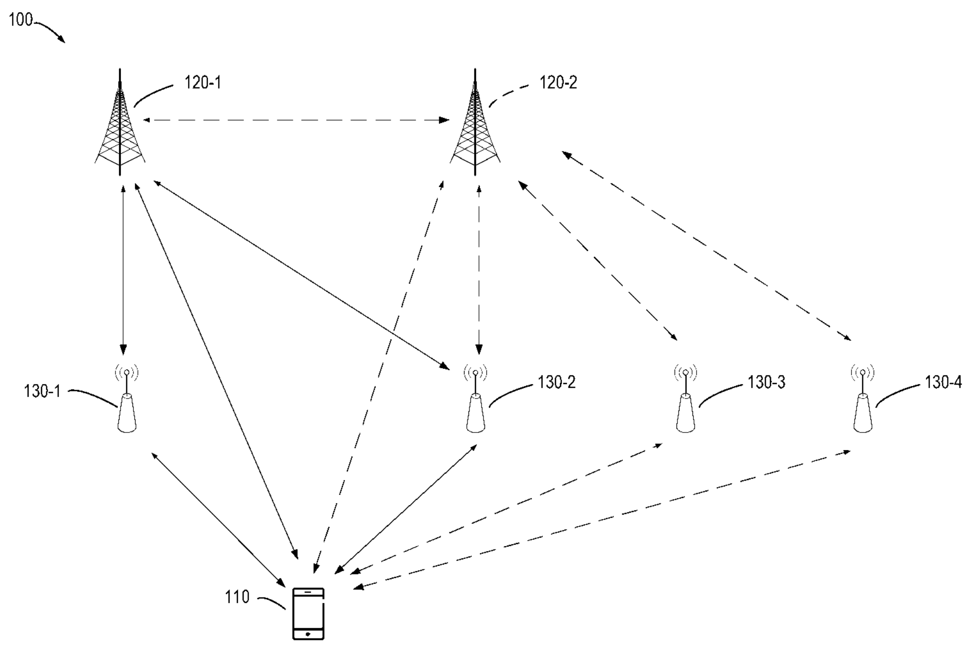

FIG. 1A

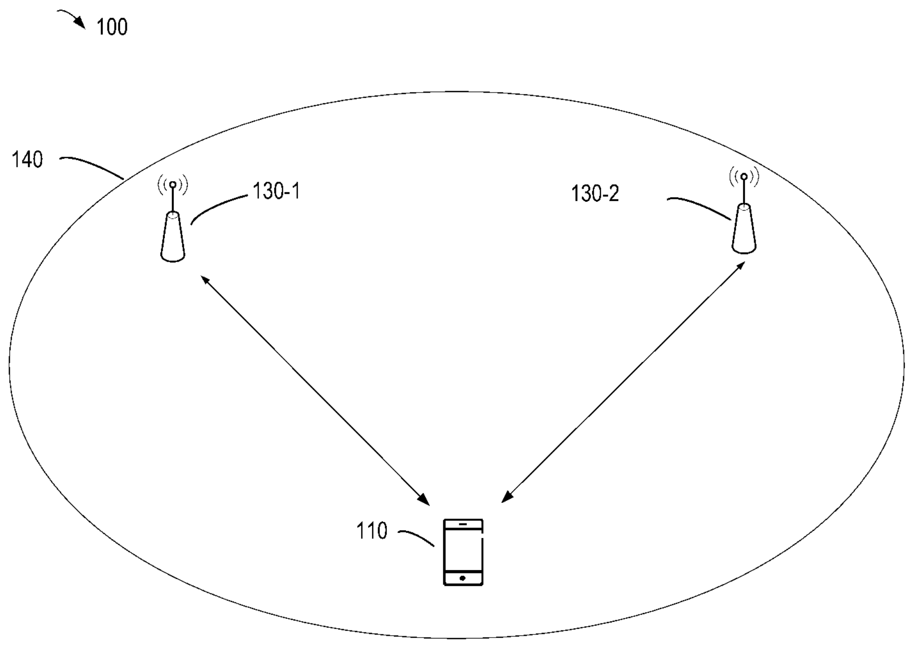

FIG. 1B

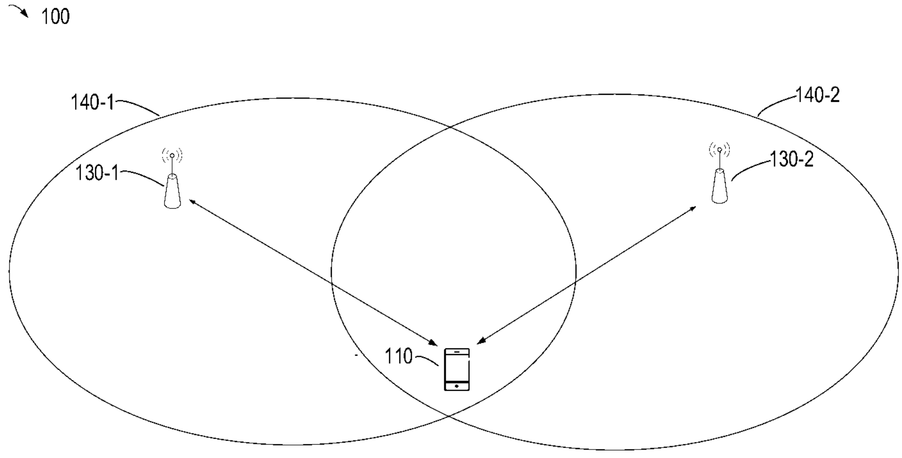
100
140-1
140-2
130-1
130-2
110

FIG. 1C

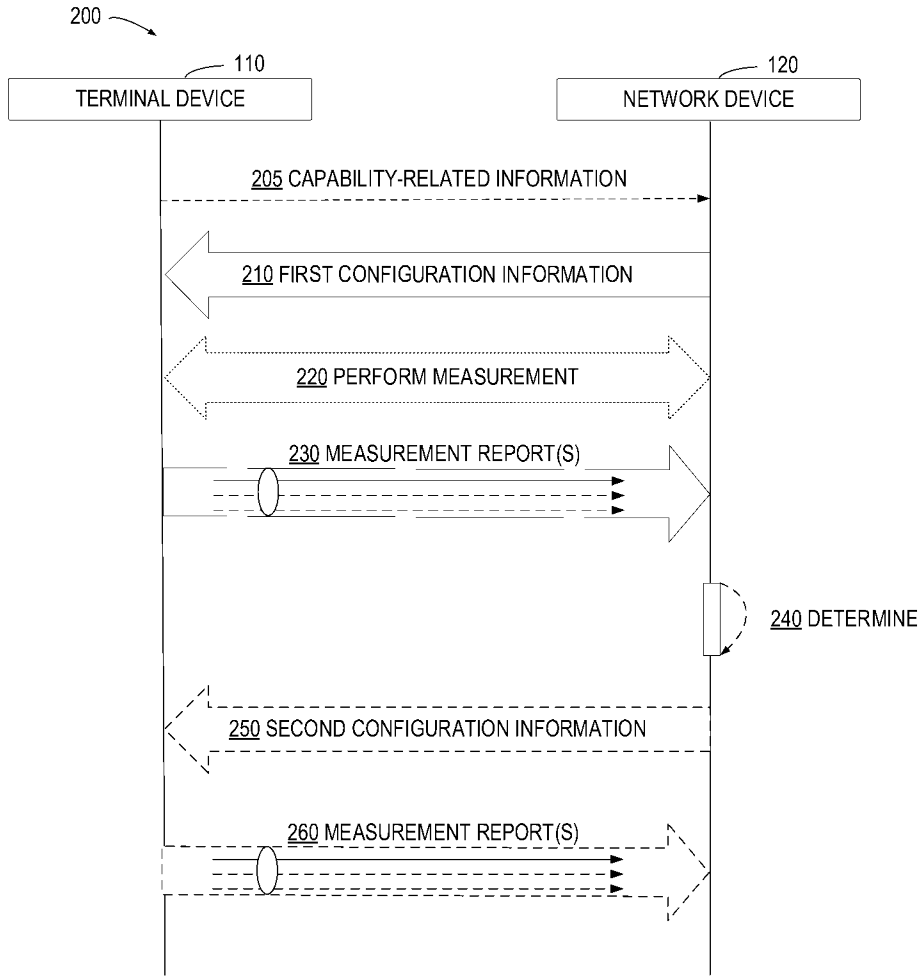
200
110
120
TERMINAL DEVICE
NETWORK DEVICE
205 CAPABILITY-RELATED INFORMATION
210 FIRST CONFIGURATION INFORMATION
220 PERFORM MEASUREMENT
230 MEASUREMENT REPORT(S)
240 DETERMINE
250 SECOND CONFIGURATION INFORMATION
260 MEASUREMENT REPORT(S)

FIG. 2

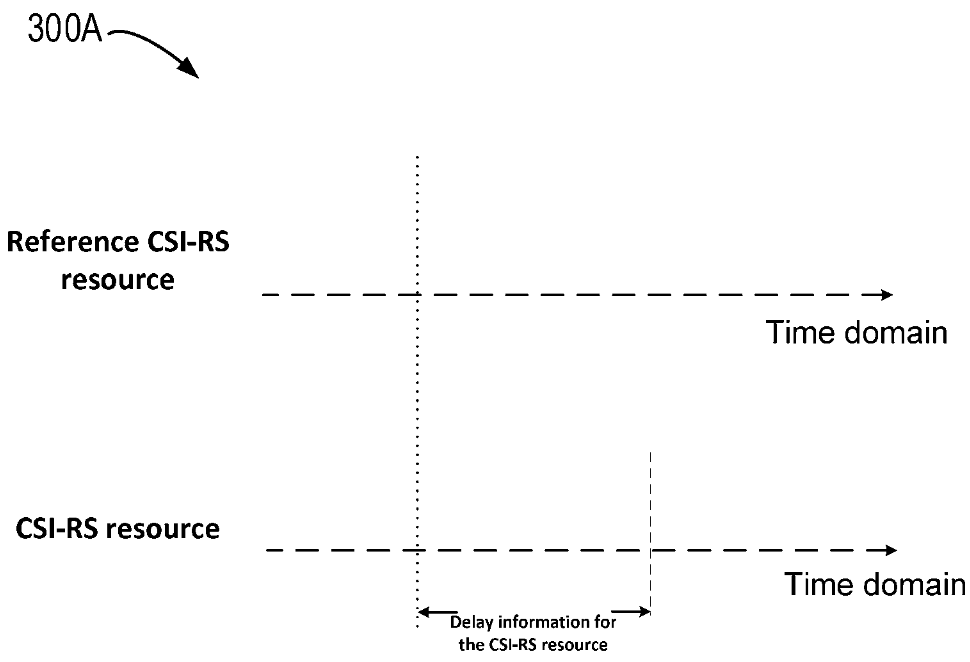
300A
Reference CSI-RS resource
Time domain
CSI-RS resource
Time domain
Delay information for the CSI-RS resource

FIG. 3A

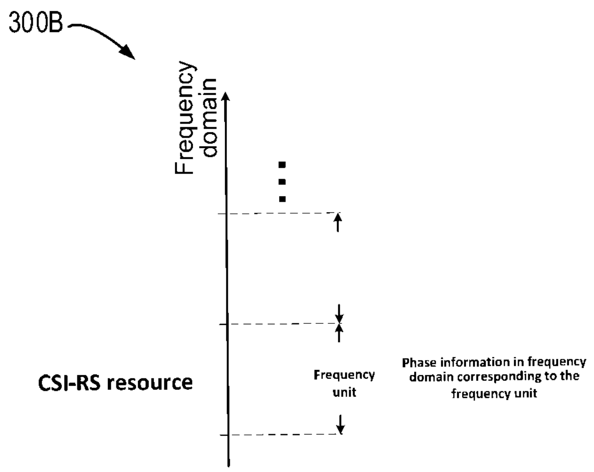
300B
Frequency domain
CSI-RS resource
Frequency unit
Phase information in frequency domain corresponding to the frequency unit

FIG. 3B

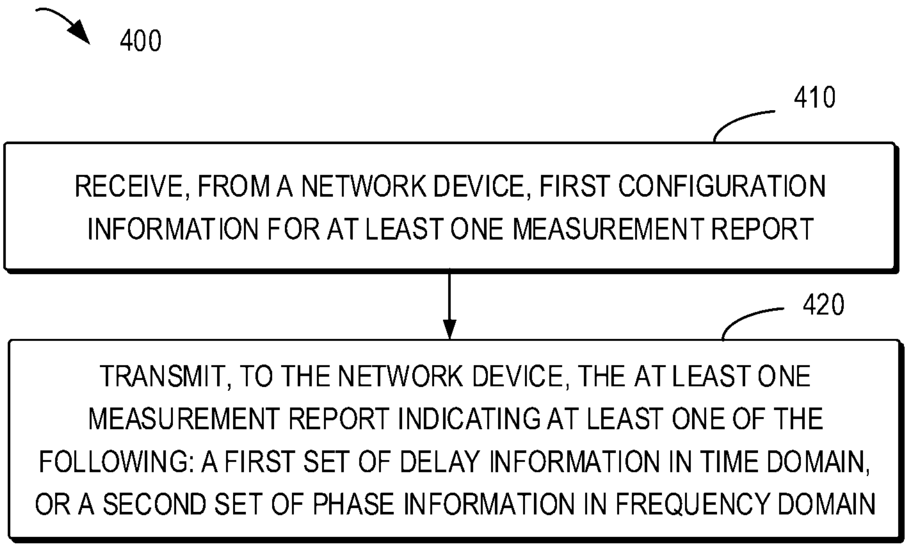
400
410
RECEIVE, FROM A NETWORK DEVICE, FIRST CONFIGURATION INFORMATION FOR AT LEAST ONE MEASUREMENT REPORT
420
TRANSMIT, TO THE NETWORK DEVICE, THE AT LEAST ONE MEASUREMENT REPORT INDICATING AT LEAST ONE OF THE FOLLOWING: A FIRST SET OF DELAY INFORMATION IN TIME DOMAIN, OR A SECOND SET OF PHASE INFORMATION IN FREQUENCY DOMAIN

FIG. 4

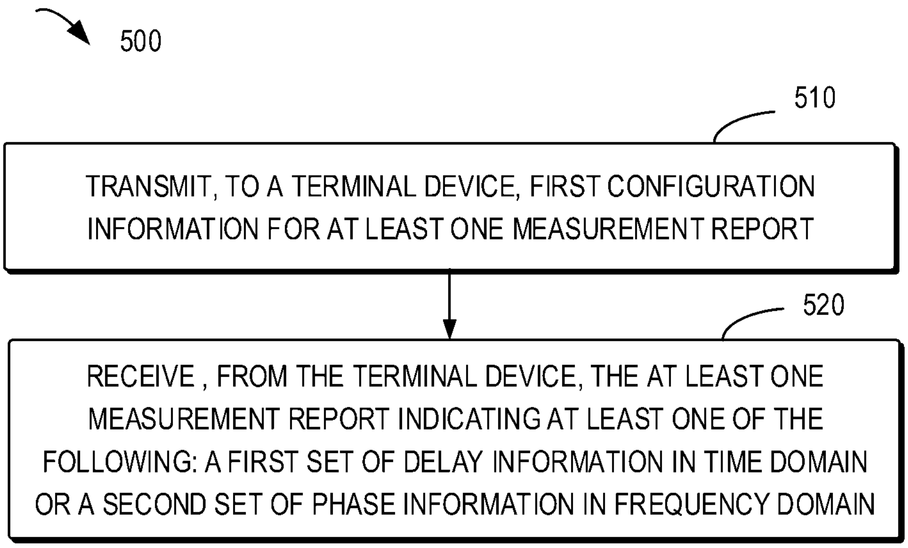
500
510
TRANSMIT, TO A TERMINAL DEVICE, FIRST CONFIGURATION INFORMATION FOR AT LEAST ONE MEASUREMENT REPORT
520
RECEIVE , FROM THE TERMINAL DEVICE, THE AT LEAST ONE MEASUREMENT REPORT INDICATING AT LEAST ONE OF THE FOLLOWING: A FIRST SET OF DELAY INFORMATION IN TIME DOMAIN OR A SECOND SET OF PHASE INFORMATION IN FREQUENCY DOMAIN

FIG. 5

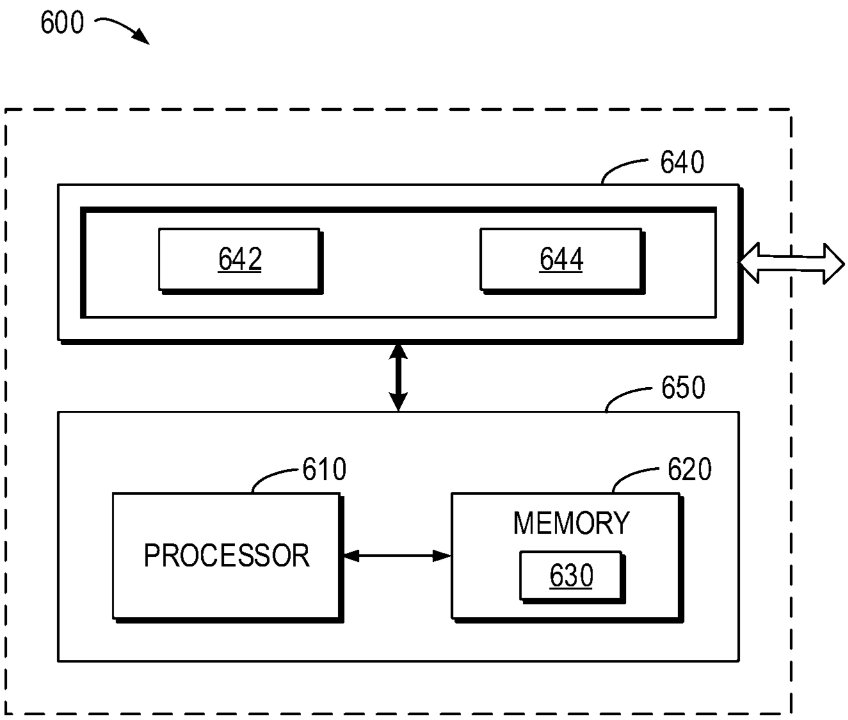

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/106172

A. CLASSIFICATION OF SUBJECT MATTER

H04L5/00(2006.01)i; H04W24/10(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04L H04W

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

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

CNTXT, ENTXT, WPABS, CNKI, 3GPP: CSI-RS, config, multi, trp, M-TRP, non-ideal, backhaul, synchronize, UE, assist, measure, report, delay, Doppler, shift, phase, reference, CJT, coherent joint transmissio n, calibration

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2021248431 A1 (QUALCOMM INCORPORATED) 16 December 2021 (2021-12-16) description, paragraphs [0063]-[0066], [0113]-[0153]	1-20
Y	US 2021028843 A1 (ZHOU, Hua et al.) 28 January 2021 (2021-01-28) description, paragraph [0337]	1-20
Y	WO 2022032567 A1 (QUALCOMM INCORPORATED) 17 February 2022 (2022-02-17) description, paragraphs [0040]-[0041], [0085]-[0113]	1-20
A	US 2021297116 A1 (SONY CORPORATION) 23 September 2021 (2021-09-23) the whole document	1-20
A	LENOVO. "R1-2204164, CSI enhancements for high mobility and coherent JT" *3GPP TSG RAN WG1 #109-e*, 20 May 2022 (2022-05-20), the whole document	1-20

☐ 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
- "D" document cited by the applicant in the international application
- "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
13 December 2023	**21 December 2023**

Name and mailing address of the ISA/CN	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/106172

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
WO	2021248431	A1	16 December 2021	US	2023141785	A1	11 May 2023
				WO	2021248907	A1	16 December 2021
				EP	4165838	A1	19 April 2023
US	2021028843	A1	28 January 2021	None			
WO	2022032567	A1	17 February 2022	EP	4197173	A1	21 June 2023
				US	2023291440	A1	14 September 2023
				CN	116325670	A	23 June 2023
US	2021297116	A1	23 September 2021	EP	3834291	A1	16 June 2021
				US	2023163811	A1	25 May 2023
				JP	2021533664	A	02 December 2021
				JP	7193616	B2	20 December 2022
				WO	2020030476	A1	13 February 2020
				US	11581920	B2	14 February 2023
				CN	112534733	A	19 March 2021