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Application Number	
Filing Date	
First Named Inventor	CHIEN-CHUN CHENG
Title	METHODS AND APPARATUSES FOR BEAM OPERATIONS
Art Unit	
Examiner Name	
Attorney Docket Number	US84280

SIGNATURE of Applicant or Patent Practitioner

Signature	/Amir Bahrami/	Date (Optional)	2021-05-06
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Applicant Name (if Applicant is a juristic entity)	FG Innovation Company Limited		

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Name	CHIE-MING CHOU		
Title	CEO		

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METHODS AND APPARATUSES FOR BEAM OPERATIONS

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] The present application is a continuation application of US Patent Application Serial No. 16/660726, which claims the benefit of and priority to a provisional U.S. Patent Application Serial No. 62/754,165 filed on November 1, 2018, entitled "Method and Apparatus for Spatial QCL assumptions with Overlapped CORESETs," with Attorney Docket No. US75368. The contents of all above-named applications are fully incorporated herein by reference for all purposes.

FIELD

[0002] The present disclosure generally relates to wireless communications, and more particularly, to methods and apparatuses for beam operations.

BACKGROUND

[0003] The next generation (e.g., Fifth Generation (5G) New Radio (NR)) wireless communication system may utilize beamforming technologies to provide directional communications. For example, a User Equipment (UE) may perform beam operations to switch its beam(s) to transmit or receive channels or resources. Each beam the UE applies may be considered as a spatial domain filter that is determined by a corresponding QCL assumption.

[0004] However, current specifications for the next generation wireless communication system may cause a UE to perform unfavorable beam switching when the UE is configured with multiple Control Resource Sets (CORESETs). In addition, although the next generation wireless communication system enables utilizing a flexible resource allocation scheme, a UE is likely unable to decide which QCL assumption to use due to the ambiguity of the current specifications for the next generation wireless communication system.

[0005] Therefore, there is a need in the art for methods and apparatuses of determining QCL assumptions for beam operations when multiple CORESETs are configured to a UE.

SUMMARY

[0006] The present disclosure is directed to methods and apparatuses for beam operations.

[0007] According to an aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, and apply a first QCL assumption of a first CORESET of a set of one or more monitored CORESETs to receive a Downlink (DL) Reference Signal (RS). The first CORESET may be associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

[0008] According to another aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, receive Downlink Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH) from a Physical Downlink Control Channel (PDCCH), and apply a QCL assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between a last symbol of the PDCCH carrying the DCI and a first symbol of the PDSCH is less than a threshold. The PDCCH may be transmitted in one of a set of one or more monitored CORESETs, and the one of the set of one or more monitored CORESETs may be associated with a monitored search space configured with a lowest CORESET ID among the set of one or more monitored CORESETs.

[0009] According to another aspect of the present disclosure, a method of wireless communications is provided. The method includes monitoring, by a UE, at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first QCL assumption of a first CORESET of the set of one or more monitored CORESETs to receive a DL RS. The first CORESET may be associated with a monitored search space configured with a lowest CORESET ID among the set of one or more monitored CORESETs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Aspects of the present disclosure are best understood from the following detailed description when read with the accompanying figures. Various features are not drawn to scale. Dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

[0011] Fig. 1 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0012] Fig. 2 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0013] Fig. 3 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0014] Fig. 4 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0015] Fig. 5 is a schematic diagram illustrating a PDSCH overlapping a CORESET in the time domain, in accordance with an example implementation of the present disclosure.

[0016] Fig. 6 is a schematic diagram illustrating that an aperiodic CSI-RS, a PDSCH, and a CORESET are overlapped in the time domain, in accordance with an example implementation of the present disclosure.

[0017] Fig. 7 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0018] Fig. 8 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0019] Fig. 9 is a flowchart for a method of determining QCL assumptions in a wireless communication system, in accordance with an example implementation of the present disclosure.

[0020] Fig. 10 is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure.

DETAILED DESCRIPTION

[0021] The following description contains specific information pertaining to example implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely example implementations. However, the present disclosure is not limited to merely these example implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted

otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale and are not intended to correspond to actual relative dimensions.

[0022] For the purpose of consistency and ease of understanding, like features may be identified (although, in some examples, not shown) by the same numerals in the example figures. However, the features in different implementations may be differed in other respects, and thus shall not be narrowly confined to what is shown in the figures.

[0023] The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent. The expression "at least one of A, B and C" or "at least one of the following: A, B and C" means "only A, or only B, or only C, or any combination of A, B and C."

[0024] Additionally, for the purposes of explanation and non-limitation, specific details, such as functional entities, techniques, protocols, standard, and the like are set forth for providing an understanding of the described technology. In other examples, detailed description of well-known methods, technologies, systems, architectures, and the like are omitted so as not to obscure the description with unnecessary details.

[0025] Persons skilled in the art will immediately recognize that any network function(s) or algorithm(s) described in the present disclosure may be implemented by hardware, software or a combination of software and hardware. Described functions may correspond to modules which may be software, hardware, firmware, or any combination thereof. The software implementation may comprise computer executable instructions stored on computer readable medium such as memory or other type of storage devices. For example, one or more microprocessors or general-purpose computers with communication processing capability may be programmed with corresponding executable instructions and carry out the described network function(s) or algorithm(s). The microprocessors or general-purpose computers may be formed of Applications Specific Integrated Circuitry (ASIC), programmable logic arrays, and/or using one or more Digital

Signal Processor (DSPs). Although some of the example implementations described in this specification are oriented to software installed and executing on computer hardware, nevertheless, alternative example implementations implemented as firmware or as hardware or combination of hardware and software are well within the scope of the present disclosure.

[0026] The computer readable medium includes but is not limited to Random Access Memory (RAM), Read Only Memory (ROM), Erasable Programmable Read-Only Memory (EPROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), flash memory, Compact Disc Read-Only Memory (CD-ROM), magnetic cassettes, magnetic tape, magnetic disk storage, or any other equivalent medium capable of storing computer-readable instructions.

[0027] A radio communication network architecture (e.g., a Long Term Evolution (LTE) system, an LTE-Advanced (LTE-A) system, an LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network (RAN)) typically includes at least one Base Station (BS), at least one User Equipment (UE), and one or more optional network elements that provide connection towards a network. The UE communicates with the network (e.g., a Core Network (CN), an Evolved Packet Core (EPC) network, an Evolved Universal Terrestrial Radio Access Network (E-UTRAN), a 5G Core (5GC), or an internet), through a RAN established by one or more BSs.

[0028] It should be noted that, in the present application, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, a vehicle, or a Personal Digital Assistant (PDA) with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

[0029] A BS may be configured to provide communication services according to at least one of the following Radio Access Technologies (RATs): Worldwide Interoperability for Microwave Access (WiMAX), Global System for Mobile communications (GSM, often referred to as 2G), GSM Enhanced Data rates for GSM Evolution (EDGE) Radio Access Network (GERAN), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS, often referred to as 3G) based on basic Wideband-Code Division Multiple Access (W-CDMA), High-Speed Packet Access (HSPA), LTE, LTE-A, eLTE (evolved LTE, e.g., LTE connected to 5GC), NR (often referred to as 5G), and/or LTE-A Pro. However, the scope of the present application should not be limited to the above-mentioned protocols.

[0030] A BS may include, but is not limited to, a node B (NB) as in the UMTS, an evolved Node B (eNB) as in the LTE or LTE-A, a Radio Network Controller (RNC) as in the UMTS, a Base Station Controller (BSC) as in the GSM/GERAN, a ng-eNB as in an Evolved Universal Terrestrial Radio Access (E-UTRA) BS in connection with the 5GC, a next generation Node B (gNB) as in the 5G-RAN, and any other apparatus capable of controlling radio communication and managing radio resources within a cell. The BS may serve one or more UEs through a radio interface.

[0031] The BS is operable to provide radio coverage to a specific geographical area using a plurality of cells forming the radio access network. The BS supports the operations of the cells. Each cell is operable to provide services to at least one UE within its radio coverage. More specifically, each cell (often referred to as a serving cell) provides services to serve one or more UEs within its radio coverage (e.g., each cell schedules the Downlink (DL) and optionally uplink resources to at least one UE within its radio coverage for DL and optionally uplink packet transmissions). The BS can communicate with one or more UEs in the radio communication system through the plurality of cells. A cell may allocate Sidelink (SL) resources for supporting Proximity Service (ProSe) or Vehicle to Everything (V2X) service. Each cell may have overlapped coverage areas with other cells.

[0032] As discussed above, the frame structure for NR is to support flexible configurations for accommodating various next generation (e.g., 5G) communication requirements, such as Enhanced Mobile Broadband (eMBB), Massive Machine Type Communication (mMTC), Ultra-Reliable and Low-Latency Communication (URLLC), while fulfilling high reliability, high data rate and low latency requirements. The Orthogonal Frequency-Division Multiplexing (OFDM) technology as agreed in the 3rd Generation Partnership Project (3GPP) may serve as a baseline for NR waveform. The scalable OFDM numerology, such as the adaptive sub-carrier spacing, the channel bandwidth, and the Cyclic Prefix (CP) may also be used. Additionally, two coding schemes are considered for NR: (1) Low-Density Parity-Check (LDPC) code and (2) Polar Code. The coding scheme adaption may be configured based on the channel conditions and/or the service applications.

[0033] Moreover, it is also considered that in a transmission time interval TX of a single NR frame, a DL transmission data, a guard period, and an Uplink (UL) transmission data should at least be included, where the respective portions of the DL transmission data, the guard period, the

UL transmission data should also be configurable, for example, based on the network dynamics of NR. In addition, SL resources may also be provided in an NR frame to support ProSe services or V2X services.

[0034] In addition, the terms "system" and "network" herein may be used interchangeably. The term "and/or" herein is only an association relationship for describing associated objects, and represents that three relationships may exist. For example, A and/or B may indicate that: A exists alone, A and B exist at the same time, or B exists alone. In addition, the character "/" herein generally represents that the former and latter associated objects are in an "or" relationship.

[0035] In some implementations, a UE may perform the following processes to determine a default PDSCH beam when multiple search spaces are overlapped in the time domain:

> for a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with Carrier Aggregation (CA) in the same frequency band,
>
> > if the monitoring occasions of the search space are overlapped in the time domain and the search spaces are associated with different CORESETs having different Quasi Co-Location (QCL)-TypeD properties, the UE may monitor the search spaces associated with a given CORESET containing a Common Search Space (CSS) in the active DL BWP in the serving cell with the lowest serving cell index and any other CORESET associated with the same QCL-TypeD properties as the given CORESET,
> >
> > > if two or more CORESETs contain the CSS, the UE may select the CORESET containing the search space having the lowest search space ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index, and
> > >
> > > if none of the CORESETs contains the CSS, the UE may select the CORESET containing the search space having the lowest search space ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index.

[0036] For this purpose, the QCL assumption with respect to the Synchronization Signal Block (SSB) and the QCL assumption with respect to the Channel Status Information-Reference Signal (CSI-RS) (or Tracking Reference Signal (TRS)) may be considered as two different QCL

assumptions, even if the CSI-RS is sourced from the same SSB. The QCL assumption may be based on different parameters, such as the spatial-domain QCL parameters (e.g., QCL TypeD parameter), or the QCL parameters obtained based on at least one of the average delay, the delay spread, the Doppler shift, and the Doppler spread.

[0037] In addition, the UE may perform the process described below:

> if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH (e.g., which means a time interval between the last symbol of the PDCCH carrying the DCI and the first symbol of the PDSCH) is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the Demodulation-Reference Signal (DM-RS) ports of the PDSCH of a serving cell are quasi co-located with the RS(s) in the Transmission Configuration Indication (TCI) state with respect to the QCL assumption(s) used for the PDCCH QCL indication of the lowest CORESET ID in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE.

[0038] In this manner, if the QCL assumption of the DM-RSs of a PDSCH is different from that of the DM-RSs of a PDCCH overlapping the PDSCH in at least one symbol in the time domain, the UE may be expected to prioritize the reception of the PDCCH associated with that CORESET. This may also apply to the intra-band CA case (e.g., the PDSCH and the CORESET are in different Component Carriers (CCs)).

[0039] In some of the present implementations, a UE may be configured with multiple CORESETs, but not all of them may be monitored by the UE. For example, if a UE is configured with two CORESETs that overlap each other in at least one symbol (e.g., an OFDM symbol) in the time domain, the UE may select one of the CORESETs to monitor based on certain priority rule(s) or pre-configuration(s).

[0040] In some of the present implementations, the UE may prioritize and monitor a CORESET if the monitored CORESET is associated with a CSS and the lowest search space ID. By contrast, a non-monitored CORESET may be a CORESET that is associated with a non-monitored search space configuration, for example, due to QCL-TypeD conflicts. The non-monitored CORESET may be configured on a deactivated BWP, on a deactivated Secondary Cell (SCell), or on the same active BWP of a serving cell as other monitored CORESET(s). In some

other implementations, the non-monitored CORESET may contain a PDCCH that overlaps with at least one Resource Element (RE) corresponding to a Synchronization Signal (SS)/Physical Broadcast Channel (PBCH) block. In some other implementations, the non-monitored CORESET may be a CORESET configured for a UE that operates under a Discontinuous Reception (DRX) mode.

[0041] **NON-MONITORED CORESET FOR A DEFAULT PDSCH BEAM**

[0042] In some implementations, a non-monitored CORESET may be used for a beam indication for receiving a PDSCH when the non-monitored CORESET has the lowest CORESET ID among the configured CORESETs.

[0043] For example, if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the DM-RS ports of the PDSCH may be quasi co-located with the RS(s) in the TCI state with respect to the QCL assumption(s). The QCL assumption(s) may be used for a PDCCH QCL indication (e.g., CORESET) with the lowest CORESET ID in the latest slot, where one or more CORESETs, in the latest slot, within the active BWP of the serving cell are configured for the UE.

[0044] Fig. 1 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 1, the UE is configured with two CORESETs, CORESET#1 102 and CORESET#2 104, overlapping in at least one symbol in the time domain. The UE may receive DCI from CORESET#2 104 to schedule PDSCH 106. CORESET#1 102 may not be monitored by the UE due to, for example, priority rules (e.g., CORESET#1 102 is not configured with a CSS, and/or is associated with a non-monitored search space having the lowest search space ID). The non-monitored search space may have the lowest search space ID among those search spaces overlapping this non-monitored search space. For example, if CORESET#1 102 is associated with a non-monitored search space that is configured with a first search space ID, and CORESET#2 104 is associated with a monitored search space that is configured with a second search space ID, the first search space ID may be lower than the second search space ID.

[0045] Currently, assuming that CORESET#1 102 has the lowest CORESET ID, if the scheduling offset 11 between CORESET#2 104 and the corresponding PDSCH 106 is less than a threshold (e.g., Threshold-Sched-Offset), an RX beam which is determined by the TCI state of CORESET#1 102 may be required to be used to receive PDSCH 106. In this case, the UE is forced

to use different RX beams for CORESET#2 104 and PDSCH 106 in order to follow the 3GPP specification. This type of beam switching, however, is undesirable and needs to be prevented.

[0046] **Case 1.1**

[0047] In some of the present implementations, the CORESET having the lowest CORESET ID may not be taken as a non-monitored CORESET. In such a case, if the monitoring occasions of the search space are overlapped in the time domain and the search spaces are associated with different CORESETs having different QCL-TypeD properties, the UE may select the CORESET having the lowest CORESET ID in the monitoring occasions in the active DL BWP of a serving cell with the lowest serving cell index. Any overlapped search space(s) associated with the CORESET(s) having the same QCL-TypeD parameter may be monitored.

[0048] In some other implementations, the UE may select the following CORESETs to monitor according to a predefined priority order (from high priority to low priority):

1) CORESET associated with a CSS;
2) CORESET associated with a search space having the lowest search space ID; and
3) CORESET containing the lowest CORESET ID.

[0049] This priority rule may be used for determining the QCL assumptions of the RX beams when two or more CORESETs are overlapped in the time domain.

[0050] **Case 1.2**

[0051] In some of the present implementations, to avoid unfavorable beam switching, the non-monitored CORESETs may be transparent to the UE. For example, if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the DM-RS ports of the PDSCH are quasi co-located with the RS(s) in the TCI state with respect to the QCL assumption(s). The QCL assumption(s) may be used for a monitored PDCCH QCL indication with the lowest CORESET ID in the latest slot, where one or more CORESETs, in the latest slot, within the active BWP of the serving cell are configured for the UE.

[0052] In this case, the non-monitored PDCCH/CORESET may not be used for the QCL assumption for reception of the scheduled PDSCH.

[0053] In some of the present implementations, a PDCCH is a monitored PDCCH when a UE prioritizes to monitor the search space(s) associated with a given CORESET (containing the monitored PDCCH) in an active DL BWP of a serving cell having the lowest serving cell index.

This UE may be configured to monitor multiple search spaces associated with different CORESETs (e.g., for a single cell operation or for an operation with CA in the same frequency band).

[0054] **Case 1.3**

[0055] In some of the present implementations, a non-monitored CORESET may be treated as a non-configured CORESET by a UE. For example, an RRC configuration for a CORESET may not be used for other purposes when the UE does not monitor the CORESET, but the RRC configuration may still be stored by the UE and become valid again when there is no collision between two or more CORESETs in the subsequent time slots. An example of the UE's operation is described below:

> for a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and the search spaces are associated with different CORESETs having different QCL-TypeD properties, and the search spaces are not monitored by the UE,
> >
> > > the CORESETs that UE does not monitor are transparent to the UE, and treated as blank REs in the corresponding slots; or
> > >
> > > at least, the CORESETs that the UE does not monitor may not be used for beam-indication or QCL-indication purposes.

[0056] In some of the present implementations, the UE may maintain and store the RRC configuration of the non-monitored CORESET(s). This RRC configuration may be updated via MAC-CE(s) and/or DCI.

[0057] In some other implementations, the UE may release the RRC configuration for the non-monitored CORESET(s). The released RRC configuration may not be updated or stored by the UE.

[0058] **Case 1.4**

[0059] Currently, there is no clear wording on a non-monitored CORESET whether its QCL assumption should be maintained, be invalidated, or be overridden by the overlapped monitored CORESET. Example solutions for this issue are described below as different cases.

[0060] **Case 1.4.1**

[0061] In Case 1.4.1, the UE may store and maintain the QCL assumption of the non-monitored CORESET. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search spaces are not monitored by the UE,
> >
> > > the UE may store and maintain the QCL assumption for the non-monitored CORESET(s).

[0062] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be updated via a MAC-CE and/or the DCI.

[0063] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used if the UE supports multiple RX beams.

[0064] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used for the non-overlapped symbols of this CORESET in the time domain.

[0065] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used as a beam indication, a QCL indication, or being part of a QCL chain.

[0066] **Case 1.4.2**

[0067] In Case 1.4.2, the UE may release or suspend the QCL assumption of the non-monitored CORESET. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,

> if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search space(s) are not monitored by the UE,

> the UE may release the QCL assumption for the non-monitored CORESET(s) and for the non-overlapped CORESET(s) related to this search space, or

> the UE may suspend the QCL assumption for the slots in which the CORESETs are overlapped and non-monitored by the UE, but keep the QCL assumption for the non-overlapped CORESETs in the same search space, or

> the UE may release or suspend the QCL assumption for the overlapped parts of the non-monitored CORESET(s), but keep using the configured QCL assumptions for the non-overlapped parts of the CORESETs (e.g., within one or two OFDM symbols).

[0068] **Option #3**

[0069] In this option, the UE may override the QCL assumption of the non-monitored CORESET by another QCL assumption. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,

> if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search spaces are not monitored by the UE,

> the UE may override the QCL assumption for the non-monitored CORESET(s) by the monitored CORESET.

[0070] In some of the present implementations, the QCL assumption of the non-monitored CORESET may only be overridden in the overlapped symbols of the non-monitored CORESET.

[0071] In some other implementations, the QCL assumption of the non-monitored CORESET(s) may be overridden in the whole-time interval of the non-monitored CORESET.

[0072] **NON-SELECTED CORESET FOR RADIO LINK MONITOR (RLM) RS**

SELECTION

[0073] In some implementations, an RLM RS selection process for a UE is described as follows:

> the UE is not required to use an aperiodic or semi-persistent RS for radio link monitoring, and
>
> the UE selects N_{RLM} RS(s) provided for the active TCI states for a PDCCH reception in the CORESET(s) associated with the search space(s) with the shortest monitoring periodicity, and
>
> if multiple CORESETs are associated with the search space(s) with the same periodicity, the UE may select the CORESET(s) with the highest CORESET ID.

[0074] Fig. 2 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 2, the UE is configured with CORESET#1 202, CORESET#2 204, and CORESET#3 206, where CORESET#1 202 overlaps CORESET#2 204 in at least one symbol in the time domain.

[0075] Assuming that CORESET#1 202 has a higher CORESET ID than the overlapped CORESET#2 204, the above-described RLM RS selection process may be ambiguous in a case that CORESET#2 204 is not monitored by the UE.

[0076] In view of this issue, some of the present implementations provide methods to improve the UE's behavior for the RLM RS selection process.

[0077] **Case 2.1**

[0078] In this case, the UE may select the CORESET(s) with the lowest CORESET ID to monitor when there are multiple CORESETs configured to the UE. An example RLM RS selection process is described below:

> the UE is not required to use an aperiodic or semi-persistent RS for radio link monitoring, and

> the UE selects N_{RLM} RS provided for the active TCI states for a PDCCH reception in the CORESET(s) associated with the search space(s) with the shortest monitoring periodicity, and

> if multiple CORESETs are associated with the search space(s) with the same periodicity, the UE may select the CORESET(s) with the lowest CORESET ID containing an active TCI-state to monitor.

[0079] **Case 2.2**

[0080] In this case, to avoid a case that there are no TCI states (or TCI states are not valid) for selection, the selected CORESET(s) may be monitored by the UE and be configured with TCI state(s) during the RLM RS selection process.

[0081] **NON-MONITORED CORESET FOR A DEFAULT APERIODIC CSI-RS BEAM**

[0082] In some implementations, if there is no PDSCH transmitted in the same symbols as the aperiodic CSI-RS, the default QCL assumption of the aperiodic CSI-RS may be derived from the CORESET with the lowest CORESET ID. An example process applied by a UE for determining a default QCL assumption is described below:

> after the UE successfully decodes the DCI scheduling a PDSCH, if there is only PDSCH(s) transmitted in the same symbols as the CSI-RS, the default QCL assumption of the aperiodic CSI-RS may follow the QCL assumption of the PDSCH (assuming that the scheduling offset between the reception of DCI and the PDSCH is larger than, or equal to, a threshold), and

> if there is no PDSCH transmitted in the same symbols as the CSI-RS, the default QCL assumption of the aperiodic CSI-RS may be derived from the CORESET with the lowest CORESET ID.

[0083] As described above, the CORESET with the lowest CORESET ID may be a non-monitored CORESET. If the non-monitored CORESET is used for a beam indication, an unfavorable beam switching may happen, as shown in Fig. 3.

[0084] Fig. 3 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As show in Fig. 3, the UE is configured with two CORESETs, CORESET#1 302 and CORESET#2 304, overlapping in at least one symbol in the time domain. In addition, the UE may receive DCI from CORESET#2 304 to transmit the aperiodic CSI-RS in resource 306.

[0085] Assuming that CORESET#1 302 has the lowest CORESET ID and is not monitored by the UE, based on the above-described process, CORESET#1 302 may be used for the beam indication (or QCL assumption) for receiving resource 306 carrying the aperiodic CSI-RS when the scheduling offset 31 between the reception of the DCI in CORESET#2 304 and the resource 306 is less than a threshold (e.g., Threshold-Sched-Offset), but this may result in an unfavorable beam switching.

[0086] In view of this issue, in some of the present implementations, the CORESET with the lowest CORESET ID may be expected to be monitored by the UE and contain at least one activated TCI state.

[0087] Fig. 4 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 4, the UE is configured with CORESET#1 402, CORESET#2 404 and CORESET#3 406. CORESET#1 402 may overlap CORESET#2 404 in at least one symbol in the time domain, and CORESET#2 404 may further overlap CORESET#3 406 in at least one symbol in the time domain.

[0088] In this example implementation, the UE may monitor CORESET#1 402 only, or monitor both of CORESET#1 402 and CORESET#3 406 simultaneously. If the UE monitors CORESET#1 402 and CORESET#3 406, then CORESET#2 404 may be the only non-monitored CORESET, and its QCL assumption for the beam indication may follow the processes described in the present disclosure. By contrast, if the UE only monitors CORESET#1 402, then both CORESET#2 404 and CORESET#3 406 may become overlapped non-monitored CORESETs, and their QCL assumptions for the beam indication may either remain the same spatial QCLs, or be overridden by the non-monitored CORESET with the lowest CORESET ID.

[0089] **DEPRIORITIZED PDSCH**

[0090] In some implementations, the reception of a PDSCH may be deprioritized when the PDSCH overlaps one or more CORESETs in the time domain. This PDSCH may be referred to as a deprioritized PDSCH, which means that the level of priority for receiving this PDSCH may be

reduced.

[0091] Fig. 5 is a schematic diagram illustrating a PDSCH overlapping a CORESET in the time domain, in accordance with example implementations of the present disclosure. As shown in Fig. 5, the UE may receive DCI in CORESET#1 502 to schedule PDSCH 504 that overlaps CORESET#2 508 in the time domain. In this example implementation, PDSCH 504 may contain resource 506 carrying an aperiodic CSI-RS that does not overlap CORESET#2 508 in the time domain. The location of resource 506 may be scheduled or determined by the DCI obtained from CORESET#1 502. The scheduling offset 51 may be a time interval between the end of the last symbol of the PDCCH carrying the DCI (in CORESET#1 502) and the beginning of the first symbol of PDSCH 504. In this example implementation, the scheduling offset 51 may be less than a threshold (e.g., Threshold-Sched-Offset).

[0092] In some of the present implementations, all CORESETs configured to the UE (e.g., CORESET#1 502 and CORESET#2 508) and the resource carrying the aperiodic CSI-RS (e.g., resource 506 in Fig. 5) may be provided in a time slot in an active BWP of a serving cell.

[0093] In some implementations of the present implementation, CORESET#2 508 may be a non-monitored CORESET associated with a non-monitored search space configured to the UE.

[0094] Techniques for determining the QCL assumption for PDSCH 504 or resource 506 carrying the aperiodic CSI-RS are described below.

[0095] **Case 3.1**

[0096] In this case, the QCL assumption of PDSCH 504 may follow the QCL assumption of CORESET#2 508 that overlaps PDSCH 504 in at least one symbol in the time domain. For example, the UE may assume that the DM-RS ports of PDSCH 504 are quasi co-located with the RS(s) indicated in the TCI state with respect to the QCL assumption(s) used for the PDCCH QCL indication (e.g., corresponding to CORESET#2 508) with the lowest CORESET ID in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE.

[0097] This case may also be applied to the intra-band CA case (in which the PDSCH and the CORESET are in different CCs).

[0098] **Case 3.2**

[0099] In this case, after a successful decoding of the DCI scheduling PDSCH 504, if only PDSCH 504 is transmitted in the same symbols as resource 506 having the aperiodic CSI-RS, the

default QCL assumption for the aperiodic CSI-RS resource 506 may follow the QCL assumption of PDSCH 504, even if the reception of PDSCH 504 is deprioritized because of being overlapped with CORESET#2 508 in at least one OFDM symbol in the time domain.

[00100] In some of such implementations, if there are multiple QCL assumptions for a single PDSCH in the time domain over at least one OFDM symbol, the aperiodic CSI RS may follow the same QCL assumption(s) as the aligned PDSCH symbols.

[00101] **Case 3.3**

[00102] Currently, there is no clear wording on a deprioritized PDSCH whether its QCL assumption should be maintained, invalidated, or overridden by the overlapped CORESET. Example solutions for this issue are described below.

[00103] **Case 3.3.1**

[00104] In Case 3.3.1, the UE may store and maintain the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508 shown in Fig. 5) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET (e.g., CORESET#2 508). In some of the present implementations, the QCL assumption of the deprioritized PDSCH may still be used for this PDSCH if the UE supports multiple RX beams. In some other implementations, the QCL assumption of the deprioritized PDSCH may be used for the non-overlapped portion with CORESET#2 508. In some other implementations, the QCL assumption may be used for beam indication purposes or for building a QCL chain.

[00105] **Case 3.3.2**

[00106] In Case 3.3.2, the UE may release, or partially release, the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET (e.g., CORESET#2 508). For example, the UE may release the QCL assumption of PDSCH 504 only for the overlapped portion with CORESET#2 508 in the time domain, while maintaining this QCL assumption for the non-overlapped portion.

[00107] **Case 3.3.3**

[00108] In Case 3.3.3, the UE may override the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504) by an overlapped monitored CORESET (e.g., CORESET#1 502), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET.

[00109] In some of the present implementations, if two or more CORESETs are chosen, the UE may select the CORESET with the lowest CORESET ID to override the QCL assumption of the deprioritized PDSCH. In some of the present implementations, the UE may overwrite the QCL assumption of the deprioritized PDSCH only for the overlapped portion with the CORESET(s) in the time domain while maintaining this QCL assumption for the non-overlapped portion.

[00110] **DEPRIORITIZED PDSCH FOR OVERLAPPED APERIODIC CSI-RS AND CORESET**

[00111] Fig. 6 is a schematic diagram illustrating that an aperiodic CSI-RS, a PDSCH, and a CORESET are overlapped in the time domain, in accordance with example implementations of the present disclosure. As shown in Fig. 6, the UE may receive DCI in CORESET#1 602 to schedule PDSCH 604 that overlaps CORESET#2 608 in the time domain. Similar to Fig. 5, PDSCH 604 may also contain resource 606 carrying an aperiodic CSI-RS, but resource 606 overlaps CORESET#2 608 in the time domain. In addition, the scheduling offset 61 may be a time interval between the end of last symbol of the PDCCH carrying the DCI (in CORESET#1 602) and the beginning of the first symbol of PDSCH 604. In this example implementation, the scheduling offset 61 may be less than a threshold (e.g., Threshold-Sched-Offset).

[00112] In some of the present implementations, the UE may apply the QCL assumption of the monitored and prioritized CORESET (e.g., CORESET#2 608) as a default beam for the reception of the aperiodic CSI-RS resource (e.g., resource 606). In some implementations, both the overlapped and non-overlapped portions of the symbols of the aperiodic CSI-RS in resource 606 may use the same QCL assumption. In some other implementations, only the overlapped portions of the aperiodic CSI-RS in resource 606 may use the same QCL assumption as the overlapped CORESET#2 608, and the non-overlapped portions of the aperiodic CSI-RS in resource 606 may keep using the original QCL configuration.

[00113] **DEPRIORITIZED PDSCH FOR NON-MONITORED CORESET(s)**

[00114] As described above, if the QCL assumption (e.g., QCL-TypeD) of the PDSCH DMRSs is different from that of the PDCCH DMRSs with which they overlap in at least one symbol in the time domain, the UE may be expected to prioritize the reception of the PDCCH associated with that CORESET over the PDSCH.

[00115] However, if that CORESET is not monitored by the UE (e.g., due to accidentally overlapping with other CORESETs), the UE's behavior may be unclear because the UE may not know whether to prioritize the QCL assumption for the non-monitored CORESET, as illustrated in Fig. 7.

[00116] Fig. 7 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. In the example implementation, the UE may receive DCI from CORESET#1 702 to schedule PDSCH 704 that overlaps CORESET#2 706 in the time domain, where CORESET#2 706 and CORESEST#3 708 are overlapped in at least one symbol in the time domain with different QCL assumptions. In addition, CORESET#3 is monitored by the UE, and while CORESET#2 is not monitored. As described above, it may be unclear whether the reception of PDSCH 704 should change its QCL assumption for the non-monitored and overlapped CORESET#2 706.

[00117] In view of this issue, techniques for determining the QCL assumption for the PDSCH that overlaps CORESET(s) are described below.

[00118] **Case 4.1**

[00119] In this case, the PDSCH may have the same QCL assumption as the overlapped non-monitored CORESET. For example, in Fig. 7, the QCL assumption of PDSCH 704 may follow the QCL assumption of the overlapped non-monitored CORESET#2 706, if the scheduling offset 71 between the reception of the DCI and the corresponding PDSCH 704 is less than a threshold (e.g., Threshold-Sched-Offset). This case may also apply to the intra-band CA case (e.g., the PDSCH and the overlapped CORESET are in different CCs).

[00120] **Case 4.2**

[00121] Fig. 8 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. In the example implementation, the UE may receive DCI from CORESET#1 802 to schedule PDSCH 804 that overlaps CORESET#2 806 in the time domain. In addition, CORESET#2 806 is monitored by the UE.

[00122] In this case, if the scheduling offset 81 between the reception of the DCI and the corresponding PDSCH 804 is less than a threshold (e.g., Threshold-Sched-Offset), and the QCL assumption of the DMRSs of PDSCH 804 is different from the overlapped monitored PDCCH (in CORESET#2 806), the UE may be expected to prioritize the reception of monitored PDCCH associated with that CORESET (e.g., CORESET#2 806). This case may also apply to the intra-band CA case (e.g., the PDSCH and the CORESET are in different CCs).

[00123] Fig. 9 is a flowchart for a method of determining QCL assumptions in a wireless communication system, in accordance with an example implementation of the present disclosure. In action 902, a UE may monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot. In action 904, the UE may apply a QCL assumption of a CORESET to receive an aperiodic CSI-RS. The CORESET may be associated with a monitored search space configured with the lowest CORESET ID among the monitored CORESET(s).

[00124] In some of the present implementations, the UE may monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot. In addition, the UE may receive DCI scheduling a PDSCH from a PDCCH and apply a QCL assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between an end of a last symbol of the PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold. The above-described PDCCH may be transmitted in one of a set of one or more monitored CORESETs, where this monitored CORESET (in which the PDCCH is transmitted) may be associated with a monitored search space configured with a lowest CORESET ID among the monitored CORESET(s).

[00125] Fig. 10 is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure. As shown in Fig. 10, a node 1000 may include a transceiver 1020, a processor 1028, a memory 1034, one or more presentation components 1038, and at least one antenna 1036. The node 1000 may also include an RF spectrum band module, a BS communications module, a network communications module, and a system communications management module, Input/Output (I/O) ports, I/O components, and power supply (not explicitly shown in Fig. 10). Each of these components may be in communication with each other, directly or indirectly, over one or more buses 1040. In one implementation, the node 1000 may be a UE or a BS that performs various functions described herein, for example, with

reference to Figs. 1 through 9.

[00126] The transceiver 1020 having a transmitter 1022 (e.g., transmitting/transmission circuitry) and a receiver 1024 (e.g., receiving/reception circuitry) may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, the transceiver 1020 may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. The transceiver 1020 may be configured to receive data and control channels.

[00127] The node 1000 may include a variety of computer-readable media. Computer-readable media may be any available media that may be accessed by the node 1000 and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or data.

[00128] Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, Digital Versatile Disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

[00129] The memory 1034 may include computer-storage media in the form of volatile and/or non-volatile memory. The memory 1034 may be removable, non-removable, or a combination thereof. Example memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in Fig. 10, The memory 1034 may store computer-readable, computer-executable instructions 1032 (e.g., software codes) that are configured to, when executed, cause the processor

1028 to perform various functions described herein, for example, with reference to Figs. 1 through 9. Alternatively, the instructions 1032 may not be directly executable by the processor 1028 but be configured to cause the node 1000 (e.g., when compiled and executed) to perform various functions described herein.

[00130] The processor 1028 (e.g., having processing circuitry) may include an intelligent hardware device, e.g., a Central Processing Unit (CPU), a microcontroller, an ASIC, and etc. The processor 1028 may include memory. The processor 1028 may process the data 1030 and the instructions 1032 received from the memory 1034, and information through the transceiver 1020, the base band communications module, and/or the network communications module. The processor 1028 may also process information to be sent to the transceiver 1020 for transmission through the antenna 1036, to the network communications module for transmission to a core network.

[00131] One or more presentation components 1038 presents data indications to a person or other device. Examples of presentation components 1038 may include a display device, speaker, printing component, vibrating component, etc.

[00132] From the above description, it is manifested that various techniques may be used for implementing the concepts described in the present application without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art may recognize that changes may be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present application is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

CLAIMS

WHAT IS CLAIMED IS:

1. A user equipment (UE) for performing beam operations, the UE comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and

apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more of the monitored at least one of the plurality of CORESETs to receive a Downlink (DL) Reference Signal (RS),

wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more of the monitored at least one of the plurality of CORESETs.

2. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

obtain, from the first CORESET, Downlink Control Information (DCI) scheduling the DL RS, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the DL RS is less than a threshold.

3. The UE of claim 1, wherein the first CORESET overlaps a non-monitored second CORESET of the plurality of CORESETs in a time domain, the non-monitored second CORESET associated with a non-monitored search space configured to the UE.

4. The UE of claim 3, wherein:

the monitored search space is configured with a first search space ID,

the non-monitored search space is configured with a second search space ID, and

a value of the first search space ID is smaller than a value of the second search space ID.

5. The UE of claim 3, wherein the second CORESET is configured on one of a deactivated BWP and a deactivated Secondary Cell (SCell).

6. The UE of claim 3, wherein the second CORESET overlaps a third CORESET of the set of one or more of the monitored at least one of the plurality of CORESETs in the time domain.

7. The UE of claim 1, wherein the plurality of CORESETs and a resource carrying the DL RS are provided in the time slot and the active BWP of the serving cell.

8. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

obtain, from the first CORESET, DL Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH); and

apply a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold,

wherein the second CORESET overlaps the PDSCH in a time domain.

9. The UE of claim 8, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, the non-monitored CORESET associated with a non-monitored search space configured to the UE.

10. A user equipment (UE) for performing beam operations, the UE comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot;

receive, from a Physical Downlink Control Channel (PDCCH), Downlink Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH); and

apply a Quasi Co-Location (QCL) assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between an end of a last symbol of the PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold.

11. A method performed by a user equipment (UE) for beam operations, the method comprising:

monitoring at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and

applying a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more of the monitored at least one of the plurality of CORESETs to receive a Downlink (DL) Reference Signal (RS),

wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more of the monitored at least one of the plurality of CORESETs.

12. The method of claim 11, further comprising:

obtaining Downlink Control Information (DCI) scheduling the DL RS from the first CORESET, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the DL RS is less than a threshold.

13. The method of claim 11, wherein the first CORESET overlaps a non-monitored second CORESET of the plurality of CORESETs in a time domain, the non-monitored second CORESET associated with a non-monitored search space configured to the UE.

14. The method of claim 13, wherein:

the monitored search space is configured with a first search space ID,

the non-monitored search space is configured with a second search space ID, and

a value of the first search space ID is smaller than a value of the second search space ID.

15. The method of claim 13, wherein the second CORESET is configured on one of a deactivated BWP and a deactivated Secondary Cell (SCell).

16. The method of claim 13, wherein the second CORESET overlaps a third CORESET of the set of CORESETs in the time domain.

17. The method of claim 11, wherein the plurality of CORESETs and a resource carrying the DL RS are provided in the time slot and the active BWP of the serving cell

18. The method of claim 11, further comprising:

obtaining DL Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH) from the first CORESET; and

applying a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold,

wherein the second CORESET overlaps the PDSCH in time domain.

19. The method of claim 18, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, the non-monitored CORESET associated with a non-monitored search space configured to the UE.

ABSTRACT

A method and a User Equipment (UE) for beam operations are provided. The method includes monitoring at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and applying a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more of the monitored at least one of the plurality of CORESETs to receive a Downlink (DL) Reference Signal (RS), wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more of the monitored at least one of the plurality of CORESETs.

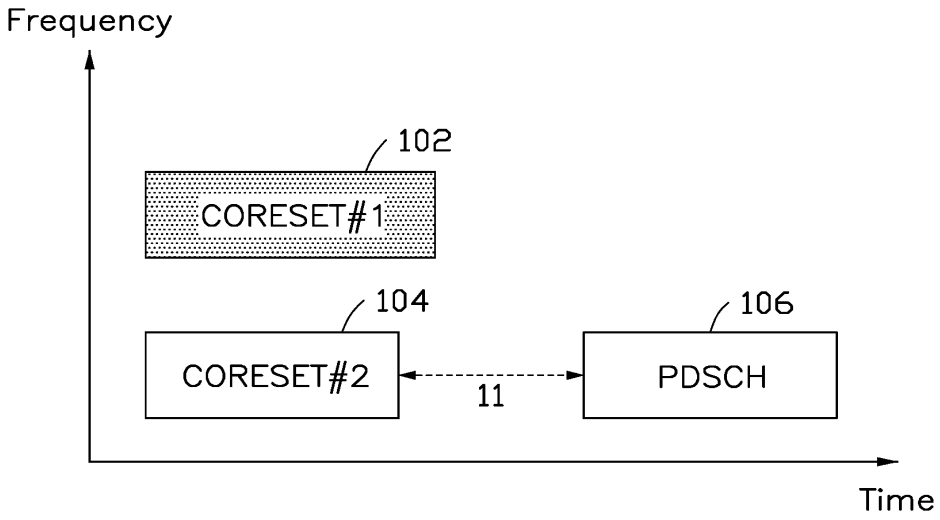

Frequency
102
CORESET#1
104
CORESET#2
11
106
PDSCH
Time

FIG. 1

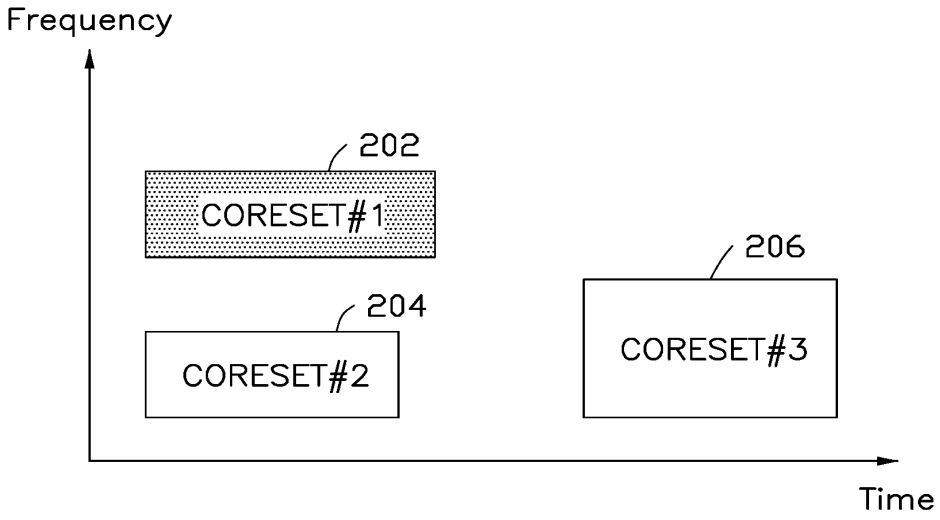

Frequency
202
CORESET#1
204
CORESET#2
206
CORESET#3
Time

FIG. 2

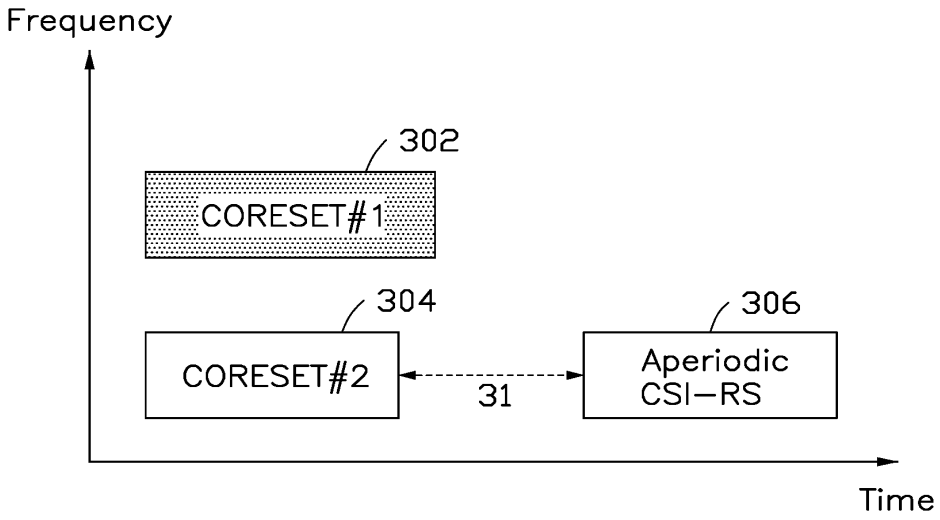

Frequency
302
CORESET#1
304
CORESET#2
306
Aperiodic
CSI–RS
31
Time

FIG. 3

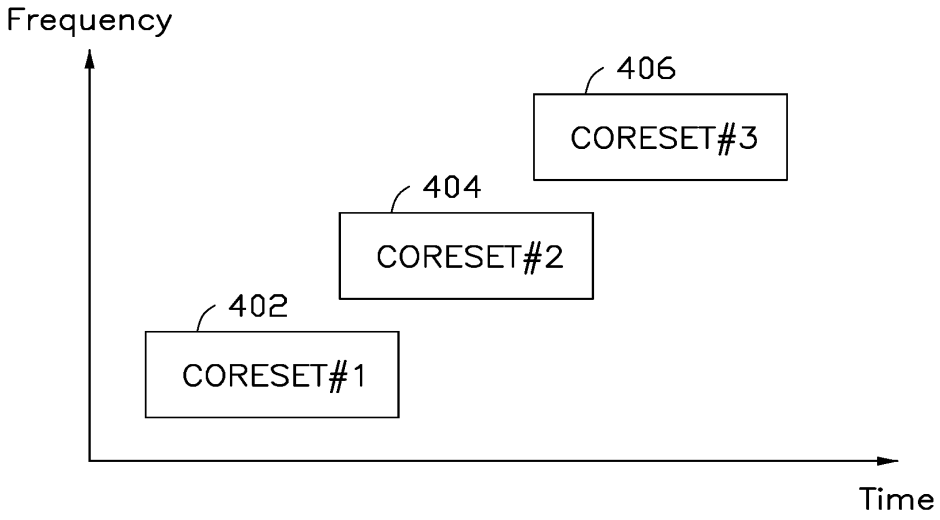

Frequency
406
CORESET#3
404
CORESET#2
402
CORESET#1
Time

FIG. 4

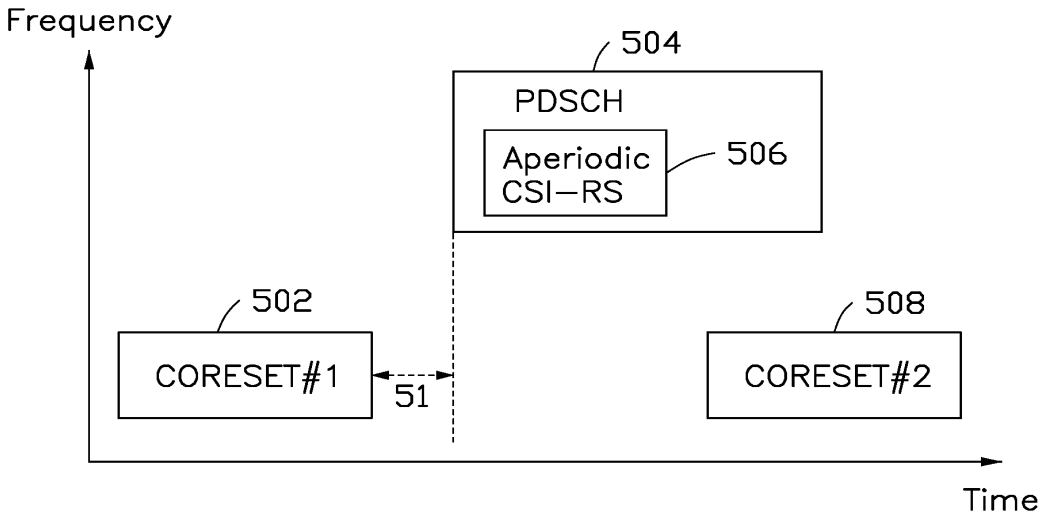

Frequency
504
PDSCH
Aperiodic CSI–RS
506
502
CORESET#1
51
508
CORESET#2
Time

FIG. 5

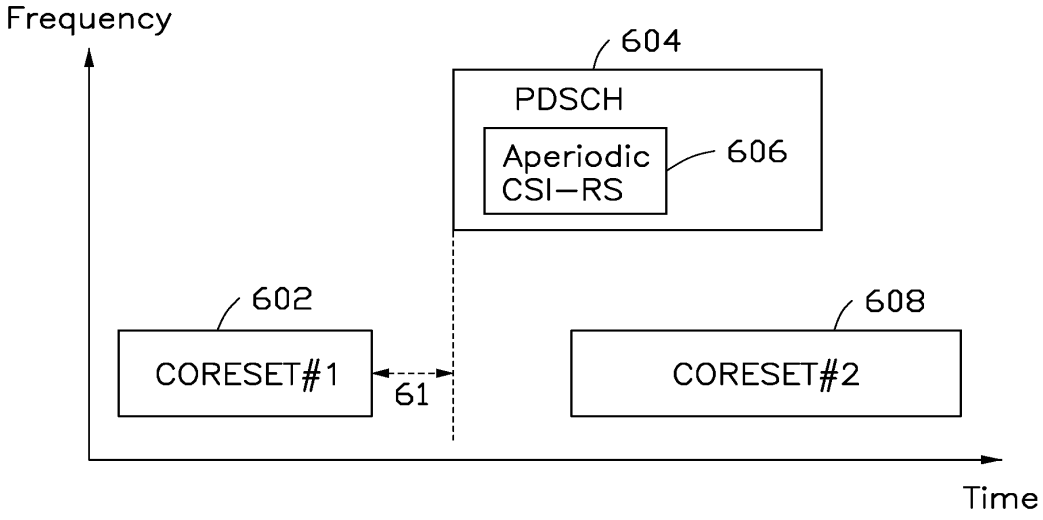

Frequency
604
PDSCH
Aperiodic CSI–RS
606
602
CORESET#1
61
608
CORESET#2
Time

FIG. 6

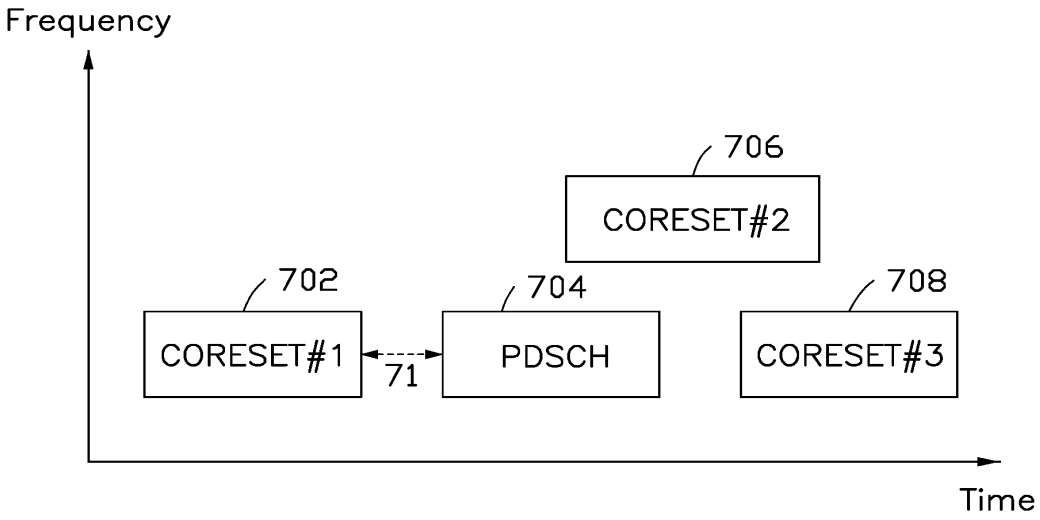

Frequency
706
CORESET#2
702
704
708
CORESET#1
71
PDSCH
CORESET#3
Time

FIG. 7

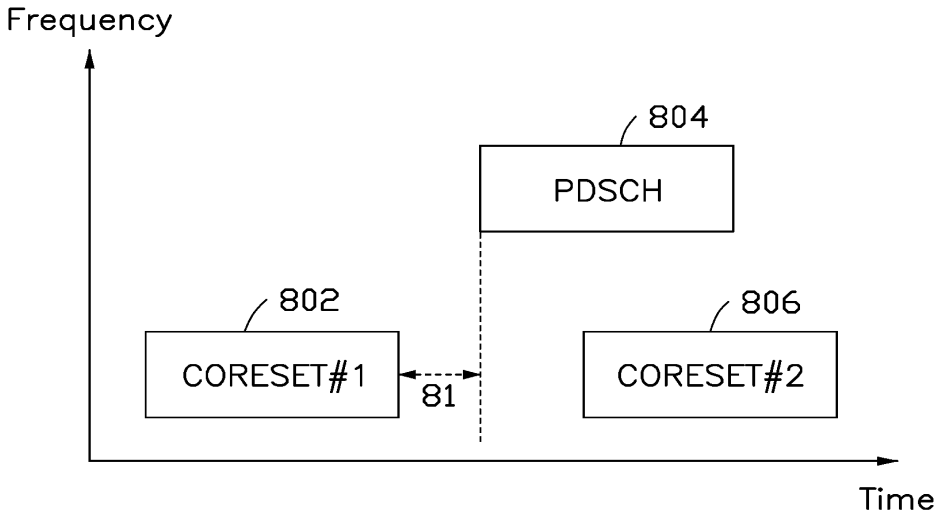

Frequency
804
PDSCH
802
806
CORESET#1
81
CORESET#2
Time

FIG. 8

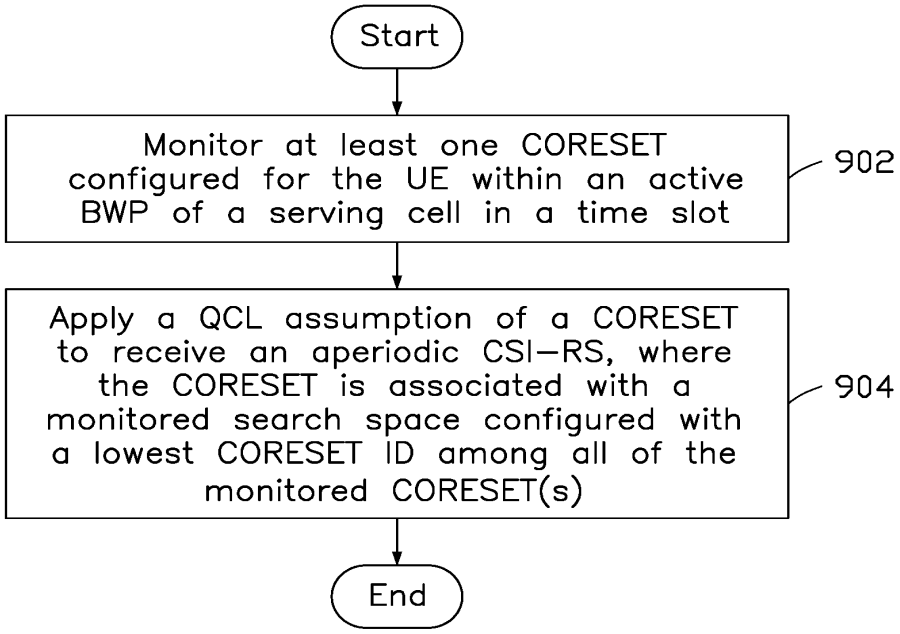

Start
Monitor at least one CORESET configured for the UE within an active BWP of a serving cell in a time slot
902
Apply a QCL assumption of a CORESET to receive an aperiodic CSI-RS, where the CORESET is associated with a monitored search space configured with a lowest CORESET ID among all of the monitored CORESET(s)
904
End

FIG. 9

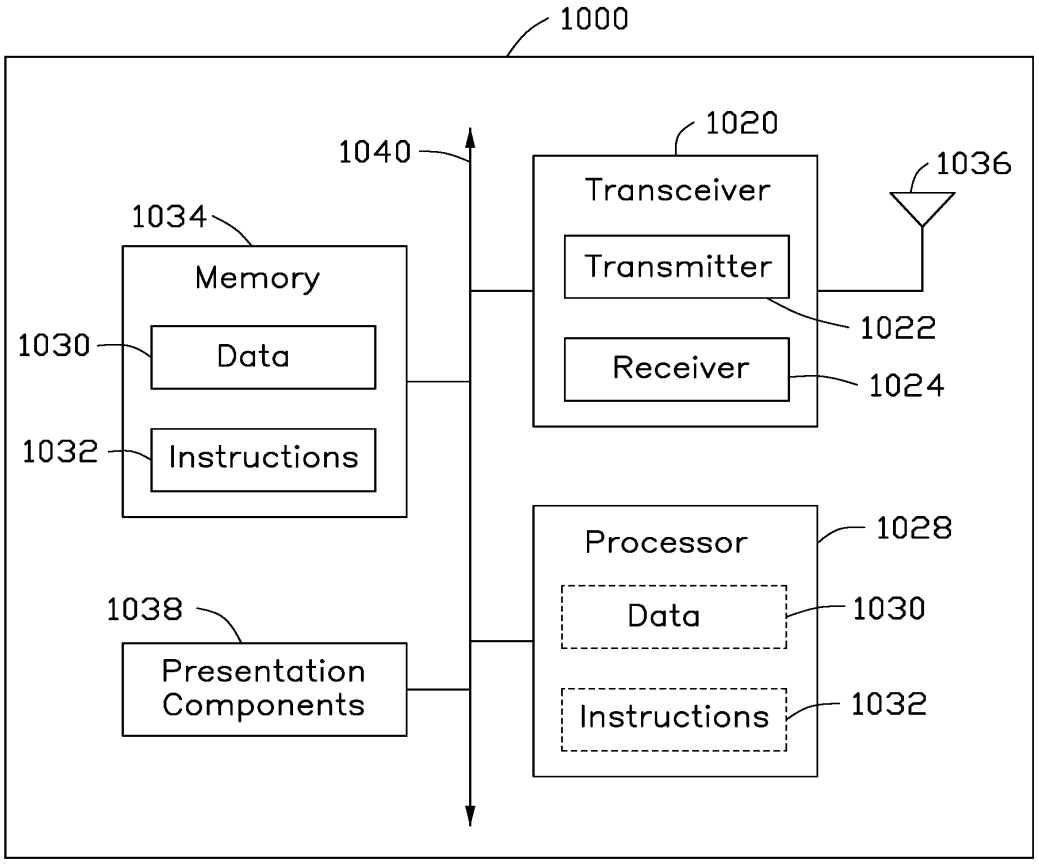

1000
1040
1020
Transceiver
1036
1034
Memory
Transmitter
1030
Data
1022
Receiver
1024
1032
Instructions
Processor
1028
1038
Data
1030
Presentation Components
Instructions
1032

FIG. 10

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: CHIEN-CHUN CHENG Date (Optional): 16-OCT-2019

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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LEGAL NAME OF INVENTOR

Inventor: TSUNG-HUA TSAI Date (Optional): 16-OCT-2019

Signature: TSAI, Tsung-Hua

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This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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LEGAL NAME OF INVENTOR

Inventor: YU-HSIN CHENG Date (Optional) : _____

Signature: Yu-Hsin CHENG

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This declaration is directed to:

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- [ ] United States application or PCT international application number _____ filed on _____.

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LEGAL NAME OF INVENTOR

Inventor: WAN-CHEN LIN Date (Optional): 2019.10.16

Signature: Wan-Chen Lin

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	CHIEN-CHUN		CHENG	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,
Address 2	
City	Taipei
State/Province	
Postal Code	114
Country [i]	TW

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	TSUNG-HUA		TSAI	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,
Address 2	
City	Taipei
State/Province	
Postal Code	114
Country [i]	TW

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Prefix	Given Name	Middle Name	Family Name	Suffix
	YU-HSIN		CHENG	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,		
Address 2			
City	Taipei	State/Province	
Postal Code	114	Country [i]	TW

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	WAN-CHEN		LIN	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,		
Address 2			
City	Taipei	State/Province	
Postal Code	114	Country [i]	TW

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	64000		
Email Address	eoa-proce@scienbizip.com	Add Email	Remove Email
Email Address	eoa-cbd@scienbizip.com	Add Email	Remove Email
Email Address	eoa-procc@scienbizippc.com		Remove Email

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Application Information:

Title of the Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS		
Attorney Docket Number	US84280	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	6	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	54000		

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16/660726	2019-10-22
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/660726	Claims benefit of provisional	62/754165	2018-11-01

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Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (11-15)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	FG Innovation Company Limited		
Mailing Address Information For Applicant:			
Address 1	Flat 2623, 26/F Tuen Mun Central Square		
Address 2	22 Hoi Wing Road, Tuen Mun, New Territories		
City	Tuen Mun	**State/Province**	
Country	HK	Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Amir Bahrami/			Date (YYYY-MM-DD)	2021-05-06
First Name	Amir	Last Name	Bahrami	Registration Number	70460

Additional Signature may be generated within this form by selecting the Add button. Add

PTO/AIA/14 (11-15)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US84280
	Application Number	
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	METHODS AND APPARATUSES FOR BEAM OPERATIONS
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Filer:	Amir Bahrami
Attorney Docket Number:	US84280
Filed as Large Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1820**

Electronic Acknowledgement Receipt	
EFS ID:	42654237
Application Number:	17313283
International Application Number:	
Confirmation Number:	3737
Title of Invention:	METHODS AND APPARATUSES FOR BEAM OPERATIONS
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Customer Number:	54000
Filer:	Amir Bahrami
Filer Authorized By:	
Attorney Docket Number:	US84280
Receipt Date:	06-MAY-2021
Filing Date:	
Time Stamp:	13:35:07
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1820
RAM confirmation Number	E202156D35382145
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	US84280210506POA.pdf	1170938 26eafc86596c50b49b7b37a5a6a3b6022a826442	no	2
Warnings:					
Information:					
2	Specification	US84280210506_Spec.pdf	141538 a13dbd9ae1b244462daefea106010162c6c2da63	no	23
Warnings:					
Information:					
3	Claims	US84280210506_Clms.pdf	35325 519d82533288ab489611c7fc68b88923155be970	no	4
Warnings:					
Information:					
4	Abstract	US84280210506_Abst.pdf	22009 f6aaa239ccf58e5c5588a5f60ed4e16b390efaa2	no	1
Warnings:					
Information:					
5	Drawings-only black and white line drawings	US84280210506_draw.pdf	559699 beeff456583a78363d382d62f17fc6ad1fd18757	no	6
Warnings:					
Information:					
6	Oath or Declaration filed	US84280210506DEC.pdf	1089751 39d10b262ef3476858d7589b92617e22cb7624f9	no	4
Warnings:					
Information:					

7	Application Data Sheet	US84280__ADS.pdf	1792962 89f1f8f8792a98a433f1fb122bcdcf0201527078	no	9
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	34619 c1658c28a097da6e6ffab6e3acd20eb3f046247d	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	4846841		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/313,283

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	19 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 480 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/313,283	05/06/2021		1820	US84280	19	3

CONFIRMATION NO. 3737

FILING RECEIPT

54000
ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

OC000000125589440

Date Mailed: 05/14/2021

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

CHIEN-CHUN CHENG, Taipei, TAIWAN;
TSUNG-HUA TSAI, Taipei, TAIWAN;
YU-HSIN CHENG, Taipei, TAIWAN;
WAN-CHEN LIN, Taipei, TAIWAN;

Applicant(s)

FG Innovation Company Limited, Tuen Mun, HONG KONG;

Power of Attorney: The patent practitioners associated with Customer Number 54000

Domestic Priority data as claimed by applicant

This application is a CON of 16/660,726 10/22/2019
which claims benefit of 62/754,165 11/01/2018

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/13/2021
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/313,283**
Projected Publication Date: 08/19/2021
Non-Publication Request: No
Early Publication Request: No
Title

METHODS AND APPARATUSES FOR BEAM OPERATIONS

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/313,283	05/06/2021	CHIEN-CHUN CHENG	US84280

CONFIRMATION NO. 3737

54000
ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

PUBLICATION NOTICE



Title:METHODS AND APPARATUSES FOR BEAM OPERATIONS

Publication No.US-2021-0258946-A1
Publication Date:08/19/2021

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/AIA/80 (07-17)
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 116201

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 116201

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address:

Hannibal IP LLC, 5204 Bluewater Dr., Frisco, Texas 75036 U.S.A.

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature Khalid Fekih-Romdhane	Date Sept 3, 2021
Name Khalad Fekih-Romdhane	Telephone
Title Manager	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	CHENG, Chien-Chun
Serial No.:	17/313,283
Filing Date:	May 6, 2021
Group Art Unit:	TBD
Examiner:	TBD
Confirmation No.:	3737
Title:	METHODS AND APPARATUSES FOR BEAM OPERATIONS

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

SUBMISSION OF NEW APPLICATION DATA SHEET

Applicant submits a new Application Data Sheet in order to update the name of the Applicant from FG Innovation Company Limited to Hannibal IP LLC. The Applicant also requests an updated filing receipt listing Hannibal IP LLC as the Applicant.

No fee is believed due. However, the Commissioner is hereby authorized to charge any fees and credit any over payments to Deposit Account No. 602766.

Respectfully submitted,

/Do Hyung Kim/

Dated: September 27, 2021

Do Hyung Kim
Attorney of Applicant
Reg. No. 66487

SUL LEE Law Firm PLLC
3030 LBJ Fwy, Ste 1130
Dallas, Texas 75234
Tel.: 214-206-4064
Fax.: 214-206-4068
E-mail: dkim@sulleelaw.com

Electronic Acknowledgement Receipt	
EFS ID:	43873382
Application Number:	17313283
International Application Number:	
Confirmation Number:	3737
Title of Invention:	METHODS AND APPARATUSES FOR BEAM OPERATIONS
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Customer Number:	54000
Filer:	Do Hyung Kim/Julie Mcleod
Filer Authorized By:	Do Hyung Kim
Attorney Docket Number:	US84280
Receipt Date:	27-SEP-2021
Filing Date:	06-MAY-2021
Time Stamp:	14:16:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	2021_09_27_Amended_ADS.pdf	387979 cac05fdbd9d6d2c58bd98ee8a69ff1ab9919cc20	no	9
Warnings:					

Information:					
This is not an USPTO supplied ADS fillable form					
2	Assignee showing of ownership per 37 CFR 3.73	2021_09_27_373C.pdf	269421 805f622bf3786a0db9651d335601afc80186dcf3	no	3
Warnings:					
Information:					
3	Power of Attorney	Executed_POA_signed.pdf	424726 1bb8c625420d9f9359a1aee50de638db722fca81	no	2
Warnings:					
Information:					
4	Transmittal Letter	Transmittal_Ltr.pdf	22762 60299d3bc3e7a4c7d2dec6257480e6da173a7149	no	1
Warnings:					
Information:					
		Total Files Size (in bytes):	1104888		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	CHIEN-CHUN		CHENG	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,
Address 2	
City	Taipei
State/Province	
Postal Code	114
Country [i]	TW

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	TSUNG-HUA		TSAI	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,
Address 2	
City	Taipei
State/Province	
Postal Code	114
Country [i]	TW

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Prefix	Given Name	Middle Name	Family Name	Suffix
	YU-HSIN		CHENG	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,		
Address 2			
City	Taipei	State/Province	
Postal Code	114	Country [i]	TW

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	WAN-CHEN		LIN	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Taipei	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	11F., No. 32, Jihu Rd., Neihu Dist.,		
Address 2			
City	Taipei	State/Province	
Postal Code	114	Country [i]	TW

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ An Address is being provided for the correspondence Information of this application.

Customer Number	~~64000~~ 116201		
Email Address	~~eoa-proce@scienbizip.com~~ ip@sulleelaw.com	Add Email	Remove Email
Email Address	~~eoa-cbd@scienbizip.com~~	Add Email	Remove Email
Email Address	~~eoa-procc@scienbizippc.com~~		Remove Email

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Application Information:

Title of the Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS		
Attorney Docket Number	~~US84280~~ HANN002-US-CON	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	6	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	~~54000~~ 116201		

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16/660726	2019-10-22
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/660726	Claims benefit of provisional	62/754165	2018-11-01

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	~~FG Innovation Company Limited~~ Hannibal IP LLC		
Mailing Address Information For Applicant:			
Address 1	~~Flat 2623, 26/F Tuen Mun Central Square~~ 5204 Bluewater Dr.		
Address 2	~~22 Hoi Wing Road, Tuen Mun, New Territories~~		
City	~~Tuen Mun~~ Frisco	**State/Province**	TX
Country	~~HK~~ U.S.A.	Postal Code	75036
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	~~/Amir Bahrami/~~ /Do Hyung Kim/			Date (YYYY-MM-DD)	2021-09-27 ~~2021-05-06~~
First Name	~~Amir~~ Do Hyung	Last Name	~~Bahrami~~ Kim	Registration Number	~~70460~~ 66487

Additional Signature may be generated within this form by selecting the Add button. Add

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Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~US84280~~ HANN002-US-CON
	Application Number	17/313,283
Title of Invention	METHODS AND APPARATUSES FOR BEAM OPERATIONS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Hannibal IP LLC

Application No./Patent No.: 17/313,283 Filed/Issue Date: May 6, 2021

Titled: METHODS AND APPARATUSES FOR BEAM OPERATIONS

Hannibal IP LLC, a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: CHENG, Chien-Chun; TSAI, Tsung-Hua; CHENG, Yu-Hsin; LIN, Wan-Chen To: FG Innovation Company Limited

   The document was recorded in the United States Patent and Trademark Office at Reel 056157, Frame 0084, or for which a copy thereof is attached.

2. From: FG Innovation Company Limited To: Hannibal IP LLC

   The document was recorded in the United States Patent and Trademark Office at Reel 057487, Frame 0504, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Do Hyung Kim/	September 27, 2021
Signature	Date
Do Hyung Kim	66487
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/313,283	05/06/2021	CHIEN-CHUN CHENG	HANN002-US-CON

CONFIRMATION NO. 3737

116201
Sul Lee
3030 Lyndon B Johnson Fwy
Suite 1130
Dallas, TX 75234

POA ACCEPTANCE LETTER

OC000000128746985

Date Mailed: 09/30/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/27/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sstephanos/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/313,283	05/06/2021	CHIEN-CHUN CHENG	US84280

CONFIRMATION NO. 3737

POWER OF ATTORNEY NOTICE

54000
ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

OC000000128746965

Date Mailed: 09/30/2021

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/27/2021.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sstephanos/

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/313,283	05/06/2021	OPAP	1820	HANN002-US-CON	19	3

CONFIRMATION NO. 3737

CORRECTED FILING RECEIPT

116201
Sul Lee
3030 Lyndon B Johnson Fwy
Suite 1130
Dallas, TX 75234

OC000000128747065

Date Mailed: 09/30/2021

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

CHIEN-CHUN CHENG, Taipei, TAIWAN;
TSUNG-HUA TSAI, Taipei, TAIWAN;
YU-HSIN CHENG, Taipei, TAIWAN;
WAN-CHEN LIN, Taipei, TAIWAN;

Applicant(s)

Hannibal IP LLC, Frisco, TX;

Power of Attorney: The patent practitioners associated with Customer Number 116201

Domestic Priority data as claimed by applicant

This application is a CON of 16/660,726 10/22/2019 PAT 11057896
which claims benefit of 62/754,165 11/01/2018

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/13/2021

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/313,283**

Projected Publication Date: Not Applicable

Non-Publication Request: No

Early Publication Request: No

Title

METHODS AND APPARATUSES FOR BEAM OPERATIONS

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
17/313,283	05/06/2021	CHIEN-CHUN CHENG	HANN002-US-CON	153716

Acknowledgement of Change to Small Entity Status

The entity status change request below filed through Private PAIR on 12/06/2021 has been accepted.

CERTIFICATIONS:

Change of Entity Status:

☒ Applicant asserting small entity status. See 37 CFR 1.27.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

This portion must be completed by the signatory or signatories making the entity status change in accordance with 37 CFR 1.4(d)(4).

Signature:	/Do Hyung Kim/
Name:	Do Hyung Kim
Registration Number:	66487

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	17/313,283
Filing Date	05/06/2021
First Named Inventor	Chien-Chun Cheng
Title	METHODS AND APPARATUSES FOR BEAM OPERATIONS
Art Unit	
Examiner Name	
Attorney Docket Number	63456-0001-0013

SIGNATURE of Applicant or Patent Practitioner

Signature	/Marcella M. Bodner/	Date (Optional)	
Name	Marcella M. Bodner	Registration Number	46,561
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date
17/313,283	05/06/2021

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 155240

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Hannibal IP LLC

☐ Inventor or Joint Inventor (title not required below)
☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	Khaled Fekih Romdhane	Date (Optional)	4/28/22
Name	Khaled Fekih-Romdhane		
Title	Manager		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Acknowledgement Receipt	
EFS ID:	45603229
Application Number:	17313283
International Application Number:	
Confirmation Number:	3737
Title of Invention:	METHODS AND APPARATUSES FOR BEAM OPERATIONS
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Customer Number:	116201
Filer:	Marcella M. Bodner/James Dade
Filer Authorized By:	Marcella M. Bodner
Attorney Docket Number:	HANN002-US-CON
Receipt Date:	29-APR-2022
Filing Date:	06-MAY-2021
Time Stamp:	18:08:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	64365-0001_POA_04292022_p.pdf	258755 60b35056c7dcd9404c75a2724b9d872368dbcb64	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	258755

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/313,283	05/06/2021	CHIEN-CHUN CHENG	63456-0001-0013

CONFIRMATION NO. 3737

155240
Cole Schotz, P.C.
Court Plaza North 25 Main Street
Hackensack, NJ 07601

POA ACCEPTANCE LETTER

OC00000013358777

Date Mailed: 05/03/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/29/2022.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ngfissha/

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/313,283	05/06/2021	CHIEN-CHUN CHENG	HANN002-US-CON

CONFIRMATION NO. 3737

116201
Sul Lee
3030 Lyndon B Johnson Fwy
Suite 1130
Dallas, TX 75234

POWER OF ATTORNEY NOTICE

OC000000133558749

Date Mailed: 05/03/2022

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/29/2022.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ngfissha/

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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/313,283	05/06/2021	CHIEN-CHUN CHENG	63456-0001-0013	3737

155240 7590 06/03/2022

Cole Schotz, P.C.
Court Plaza North 25 Main Street
Hackensack, NJ 07601

EXAMINER	
TOWFIGHI, AFSHAWN M	

ART UNIT	PAPER NUMBER
2469	

MAIL DATE	DELIVERY MODE
06/03/2022	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	**Application No.** 17/313,283	**Applicant(s)** CHENG et al.	
	Examiner AFSHAWN M TOWFIGHI	**Art Unit** 2469	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 5/6/21.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-19 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-19 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☑ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 5/6/21 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Specification

1. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS.

Double Patenting

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the

reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

3. Claims 1-19 rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-19 of U.S. Patent No. 11,057,896. Although the claims at issue are not identical, they are not patentably distinct from each other because of the mapping below:

1. A user equipment (UE) for performing beam operations, the UE comprising: one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to: monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more of the monitored at least one of the plurality of CORESETs to receive a Downlink (DL)

Reference Signal (RS), wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more of the monitored at least one of the plurality of CORESETs *(Claim 1)*.

2. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: obtain, from the first CORESET, Downlink Control Information (DCI) scheduling the DL RS, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the DL RS is less than a threshold *(Claim 2)*.

3. The UE of claim 1, wherein the first CORESET overlaps a non-monitored second CORESET of the plurality of CORESETs in a time domain, the non-monitored second CORESET associated with a non-monitored search space configured to the UE *(Claim 3)*.

4. The UE of claim 3, wherein: the monitored search space is configured with a first search space ID, the non-monitored search space is configured with a second search space ID, and a value of the first search space ID is smaller than a value of the second search space ID *(Claim 4)*.

5. The UE of claim 3, wherein the second CORESET is configured on one of a deactivated BWP and a deactivated Secondary Cell (SCell) *(Claim 5)*.

6. The UE of claim 3, wherein the second CORESET overlaps a third CORESET of the set of one or more of the monitored at least one of the plurality of CORESETs in the time domain *(Claim 6)*.

7. The UE of claim 1, wherein the plurality of CORESETs and a resource carrying the DL RS are provided in the time slot and the active BWP of the serving cell *(Claim 7)*.

8. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: obtain, from the first CORESET, DL Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH); and apply a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold, wherein the second CORESET overlaps the PDSCH in a time domain *(Claim 8)*.

9. The UE of claim 8, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, the non-monitored CORESET associated with a non-monitored search space configured to the UE *(Claim 9)*.

10. A user equipment (UE) for performing beam operations, the UE comprising: one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to: monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; receive, from a Physical Downlink Control Channel (PDCCH), Downlink Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH); and apply a Quasi Co-Location (QCL) assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between an end of a last symbol of the PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold *(Claim 10)*.

11. A method performed by a user equipment (UE) for beam operations, the method comprising: monitoring at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and applying a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more of the monitored at least one of the plurality of CORESETs to receive a Downlink (DL) Reference Signal (RS), wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more of the monitored at least one of the plurality of CORESETs *(Claim 11)*.

12. The method of claim I 1, further comprising: obtaining Downlink Control Information (DCI) scheduling the DL RS from the first CORESET, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the DL RS is less than a threshold *(Claim 12)*.

13. The method of claim I1, wherein the first CORESET overlaps a non-monitored second CORESET of the plurality of CORESETs in a time domain, the non-monitored second CORESET associated with a non-monitored search space configured to the UE *(Claim 13)*.

14. The method of claim 13, wherein: the monitored search space is configured with a first search space ID, the non-monitored search space is configured with a second search space ID, and a value of the first search space ID is smaller than a value of the second search space ID *(Claim 14)*.

15. The method of claim 13, wherein the second CORESET is configured on one of a deactivated BWP and a deactivated Secondary Cell (SCell) *(Claim 15)*.

16. The method of claim 13, wherein the second CORESET overlaps a third CORESET of the set of CORESETs in the time domain *(Claim 16)*.

17. The method of claim 11, wherein the plurality of CORESETs and a resource carrying the DL RS are provided in the time slot and the active BWP of the serving cell *(Claim 17)*

18. The method of claim 11, further comprising: obtaining DL Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH) from the first CORESET; and applying a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold, wherein the second CORESET overlaps the PDSCH in time domain *(Claim 18)*.

19. The method of claim 18, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, the non-monitored CORESET associated with a non- monitored search space configured to the UE *(Claim 19)*.

Allowable Subject Matter

2. Claims 1-19 contain allowable subject matter.

Claims 1-19 are allowable over prior art since the prior art taken individually or in combination fails to particularly disclose, fairly suggests, or render obvious the following limitations:

In claim 1, … *monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS); wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs*…in combination with other limitations recited as specified in Claim 1.

The first closest prior art of record is ZTE (*ZTE* Simultaneous transmission and reception of different channels and reference signals; RI-1805830 3GPP TSG RAN WGI Meeting #93, 25 May 2018(25.05.2018), section 2), as disclosed in the IDS. ZTE teaches a method for ap-CSI-RS assumption as the same QCL assumption as the CORESET with the lowest CORESET ID in the latest slot. ZTE does not teach *monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS); wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.*

The second closest prior art of record is ZTE 2 (ZTE Maintenance for beam management; RI-1808196 3GPP TSG RAN WGI Meeting #94,24 Aug.2018(24.08.2018), sections 2-4), as disclosed in the IDS. ZTE 2 teaches a method for triggering aperiodic CSI-RS in a DCI field. ZTE 2 does not teach *monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active*

Bandwidth Part (BWP) of a serving cell in a time slot; and apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS): wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

The third closest prior art of record is Zhang et al (Pub No: 2019/0174466). Zhang teaches a method for triggering aperiodic CSI-RS in a DCI field. Zhang does not teach *monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot; and apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS): wherein the first CORESET is associated with a monitored search space configured*

For these reasons, in conjunction with the other limitations of the independent claims, puts this case in condition for allowance once the double patenting rejections are overcome.

Conclusion

1. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

   a. Liou et al (Pub No: 2019/0349964) [0322][0349].

   b. Guo et al (Pub No: 2019/0190582) [0249]

2. Any inquiry concerning this communication or earlier communications from the examiner should be directed to AFSHAWN M TOWFIGHI whose telephone number is (571)270-7296. The examiner can normally be reached M-F 8:00 AM -5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ian N Moore can be reached on 571-272-3085. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/AFSHAWN M TOWFIGHI/
Primary Examiner, Art Unit 2469

Notice of References Cited	Application/Control No. 17/313,283	Applicant(s)/Patent Under Reexamination CHENG et al.	
	Examiner AFSHAWN M TOWFIGHI	Art Unit 2469	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20190174466-A1	06-2019	ZHANG; Yushu	H04L5/0057	1/1
*	B	US-20190190582-A1	06-2019	Guo; Li	H04W72/046	1/1
*	C	US-20190349964-A1	11-2019	Liou; Jia-Hong	H04L5/001	1/1
	D					
	E					
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	L					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	ZTE Maintenance for beam management; RI-1808196 3GPP TSG RAN WGI Meeting #94,24 Aug.2018(24.08.2018), sections 2-4 (Year: 2018)
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/313,283	CHENG et al.
	Examiner	**Art Unit**
	AFSHAWN M TOWFIGHI	2469

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/02/2022								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/313,283	CHENG et al.
	Examiner	Art Unit
	AFSHAWN M TOWFIGHI	2469

CPC - Searched*		
Symbol	Date	Examiner
H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053	06/02/2022	AT

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053(Text Search Only) - see search history printout	06/02/2022	AT
SEARCH (USPAT, USPGPUB, EPO, JPO) - see search history printout	06/02/2022	AT
Inventor and Assignee SEARCH - see search history printout	06/02/2022	AT
101/112 compliance check	06/02/2022	AT
Google Patent Search - see screenshot	06/02/2022	AT
IP.com search - see screenshot	06/02/2022	AT
Consulted with expert n/a self	06/02/2022	AT
Title/spec/abstract/drawing compliance check	06/02/2022	AT
Considered and Reviewed Parent application history	06/02/2022	AT

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/313,283	CHENG et al.
	Examiner	Art Unit
	AFSHAWN M TOWFIGHI	2469

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Discover Help monitor CORESET bandwidth part serving c... TIC

1 - 50

Method for default qcl assumption and user equipment thereof

A method of default quasi-collocation (QCL) assumption for physical downlink shared channel (PDSCH) reception in NR networks is proposed. When the PDSCH scheduling offset is scheduled by the DCI on the PDCCH, the spatial receive filter for PDSCH reception can be determined according to the QCL...

MEDIATEK INC

TW202014031A | Taiwan Applications | 2020-04-01 | 4

Method for default qcl assumption and user equipment thereof

A method of default Quasi-Co-Location (QCL) assumption for Physical Downlink Shared Channel (PDSCH) reception in NR network is proposed. When PDSCH is scheduled by a DCI over PDCCH after a Scheduling Offset, the spatial RX filter for the PDSCH reception can be determined according to a QCL...

MEDIATEK INC

TWI723488B | Taiwan Patents | 2021-04-01 | 4

Default qcl assumption for pdsch reception

A method of default Quasi-Co-Location (QCL) assumption for Physical Downlink Shared Channel (PDSCH) reception in NR network is proposed. When PDSCH is scheduled by a DCI over PDCCH after a Scheduling Offset, the spatial RX filter for the PDSCH reception can be determined according to a QCL...

MEDIATEK INC

WO2020030189A1 | WIPO Applications | 2020-02-13 | 4

Default qcl assumption for pdsch reception

A method of default Quasi-Co-Location (QCL) assumption for Physical Downlink Shared Channel (PDSCH) reception in NR network is proposed. When PDSCH is scheduled by a DCI over PDCCH after a Scheduling Offset, the spatial RX filter for the PDSCH reception can be determined according to a QCL...

MEDIATEK INC

EP3834583A1 | EPO Applications | 2021-06-16 | 4

Default qcl assumption for pdsch reception

A method of default Quasi-Co-Location (QCL) assumption for Physical Downlink Shared Channel (PDSCH) reception in NR network is proposed. When PDSCH is scheduled by a DCI over PDCCH after a Scheduling Offset, the spatial RX filter for the PDSCH reception can be determined according to a QCL...

MEDIATEK INC

IN202127009890A | India Applications | 2021-09-17 | 4

Default QCL Assumption for PDSCH Reception

A method of default Quasi-Co-Location (QCL) assumption for Physical Downlink Shared Channel (PDSCH) reception in NR

Relevance

Publication Date

2018

First Our Assignees by Relevanc

MEDIATEK INC (18)
HANNIBAL IP LLC (7)
FG INNOV CO LTD (35)
QUALCOMM INC (152)
GUANGDONG OPPO MO... (12)
ASUSTEK COMPUTER INC (78)
ACER INC (15)
NTT DOCOMO INC (455)

Charts based on top 1500 results

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Result 1

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8 results (0.45 seconds)

Did you mean: monitor ***CORSET*** bandwidth part serving cell QCL assumption

www.google.com/patents/US9565667

Method and device for receiving downlink signal in wireless ...

Grant · Filed Sep 2, 2013 · Issued Feb 7, 2017 · Inkwon Seo · Lg Electronics Inc.
... terminal assumes that a cell-specific reference signal of a serving cell is QCL ... of REs included in a DL slot depends on a DL transmission bandwidth.
Overview · Related · Discuss

www.google.com/patents/WO2014119888A1?cl=en

Method and apparatus for performing synchronization in ...

App. · Filed Jan 27, 2014 · Published Aug 7, 2014 · Yun Jung Yi · Lg Electronics Inc.
The UE can camp on the PCC as a Primary serving cell (Pcell) at first in ... a TP can be assumed to be QCL relationship or CRS from a serving TP and CSI-RS ...
Overview · Related · Discuss

www.google.com/patents/US20160112099

Reference signals extension for massive mimo system

App. · Filed Feb 21, 2014 · Published Apr 21, 2016 · Kilbom LEE · Lg Electronicsinc.
The cell is set to one of bandwidths including 1.25 MHz, 2.5 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz and the like and then provides an uplink or downlink ...
Overview · Related · Discuss

www.google.com/patents/US9521664

EPDCCH resource and quasi-co-location management in LTE

Grant · Filed Sep 9, 2013 · Issued Dec 13, 2016 · Wanshi Chen · Qualcomm Incorporated
A method, an apparatus, and a computer program product for wireless communication are provided. In an aspect, the apparatus may receive a set of ...
Overview · Related · Discuss

www.google.com/patents/EP3050232A1?cl=en

Methods and apparatus for discovery signals for lte advanced

App. · Filed Sep 29, 2014 · Published Aug 3, 2016 · Boon Loong Ng · Samsung Electronics Co., Ltd.
A system and method for enhanced cell detection by a User Equipment (UE) is provided. The UE includes a transceiver configured to receive a discovery ...
Overview · Related · Discuss

www.google.com/patents/CN104350695A?cl=en

Method and apparatus for receiving control information in ...

App. · Filed Jun 5, 2013 · Published Feb 11, 2015 · 徐人权 · Lg 电子株式会社
The parameter set includes a Cell-specific Reference Signal (CRS)-related parameter, a Channel State Information-Reference Signal (CSI-RS)-related parameter ...
Overview · Related · Discuss

www.google.com/patents/US9756627

EPDCCH resource and quasi-co-location management in LTE

Grant · Filed May 21, 2015 · Issued Sep 5, 2017 · Wanshi Chen · Qualcomm Incorporated
It is designed to better support mobile broadband Internet access by ... ports may be assumed to be quasi co-located with CRS for the serving cell with ...
Overview · Related · Discuss

www.google.com/patents/EP2745454A1?cl=en

Method and apparatus for control channel transmission and ...

App. · Filed Aug 14, 2012 · Published Jun 25, 2014 · Ravikiran Nory · Motorola Mobility LLC

To perform channel estimation, the UE receives Reference Signals (RSs), for example, pilot symbols, that are Cell-specific reference signals (CRS) and ...

Overview · Related · Discuss

Tysons, Virginia - Based on your past activity - Update location

Help Send feedback Privacy Terms

Bibliographic Data

Application No: 17/313,283

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /AFSHAWN M TOWFIGHI/ Examiner's Signature | Initials

Title: METHODS AND APPARATUSES FOR BEAM OPERATIONS

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/06/2021	370	2469	63456-0001-0013
RULE			

APPLICANTS

Hannibal IP LLC, Frisco, TX,

INVENTORS

CHIEN-CHUN CHENG, Taipei, TAIWAN

TSUNG-HUA TSAI, Taipei, TAIWAN

YU-HSIN CHENG, Taipei, TAIWAN

WAN-CHEN LIN, Taipei, TAIWAN

CONTINUING DATA

This application is a CON of 16660726 10/22/2019 PAT 11057896

16660726 has PRO of 62754165 11/01/2018

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

05/13/2021

**** SMALL ENTITY ****

STATE OR COUNTRY

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Hackensack, NJ 07601

UNITED STATES

FILING FEE RECEIVED

$1,820

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	128	((("FG") near3 ("INNOVATION") near3 ("COMPANY") near3 ("LIMITED"))).AS,AANM.	(USPAT)	OR	OFF	OFF	2021/02/18 08:19 AM
L2	102	((("CHENG") near3 ("CHIEN-CHUN")) OR (("TSAI") near3 ("TSUNG-HUA")) OR (("CHENG") near3 ("YU-HSIN")) OR (("LIN") near3 ("WAN-CHEN"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	OFF	OFF	2021/02/18 08:19 AM
L3	65921	(H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053).cpc.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 08:25 AM
L4	65921	(H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053).cpc.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 02:05 PM
L5	9	L4 and (coreset with "csi-rs" with assumption with qcl)	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 02:05 PM
L6	2	"l3" and (bwp and coreset and qcl and CSI and monitor$3 and search and reference).clm.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 02:06 PM
L7	1	L5 and (bwp and coreset and qcl and CSI and monitor$3 and search and reference).clm.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 02:06 PM
L8	128	((("FG") near3 ("INNOVATION") near3 ("COMPANY") near3 ("LIMITED"))).AS,AANM.	(USPAT)	OR	OFF	OFF	2021/02/18 02:06 PM
L9	102	((("CHENG") near3 ("CHIEN-CHUN")) OR (("TSAI") near3	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	OFF	OFF	2021/02/18 02:06 PM

		("TSUNG-HUA")) OR (("CHENG") near3 ("YU-HSIN")) OR (("LIN") near3 ("WAN-CHEN"))).INV.					
L10	1	(L8 or L9) and (bwp and coreset and qcl and CSI and monitor$3 and search and reference).clm.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 02:06 PM
L11	3689	(aperiod$4 period$3) near5 ("channel status information" "CSI-RS")	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 03:10 PM
L12	218	QCL with (aperiod$4 period$3) near5 ("channel status information" "CSI-RS")	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 03:10 PM
L13	23	QCL near5 assumption with (aperiod$4 period$3) near5 ("channel status information" "CSI-RS")	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 03:11 PM
L14	3	QCL near5 assumption with (aperiod$4 period$3) near5 ("channel status information" "CSI-RS") with lowest	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 03:13 PM
L15	65921	(H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053).cpc.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 05:34 PM
L16	4	L15 and QCL near5 assumption with ("channel status information" "CSI-RS") with lowest	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2021/02/18 05:34 PM
L17	2	("20200145982").PN.	(US-PGPUB; USPAT; USOCR; DERWENT)	OR	OFF	OFF	2021/02/18 07:18 PM
L18	400	((("FG") near3 ("INNOVATION") near3 ("COMPANY") near3 ("LIMITED"))).AS,AANM.	(USPAT)	OR	OFF	OFF	2022/06/02 09:53 AM
L19	156	((("CHENG") near3 ("CHIEN-CHUN")) OR (("TSAI") near3 ("TSUNG-HUA")) OR (("CHENG") near3 ("YU-HSIN")) OR (("LIN") near3 ("WAN-	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	OFF	OFF	2022/06/02 09:53 AM

		CHEN"))).INV.					
L20	80095	(H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053).cpc.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L21	80095	(H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053).cpc.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L22	25	L4 and (coreset with "csi-rs" with assumption with qcl)	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L23	5	"l3" and (bwp and coreset and qcl and CSI and monitor$3 and search and reference).clm.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L24	2	L5 and (bwp and coreset and qcl and CSI and monitor$3 and search and reference).clm.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L25	400	((("FG") near3 ("INNOVATION") near3 ("COMPANY") near3 ("LIMITED"))).AS,AANM.	(USPAT)	OR	OFF	OFF	2022/06/02 09:53 AM
L26	156	((("CHENG") near3 ("CHIEN-CHUN")) OR (("TSAI") near3 ("TSUNG-HUA")) OR (("CHENG") near3 ("YU-HSIN")) OR (("LIN") near3 ("WAN-CHEN"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	OFF	OFF	2022/06/02 09:53 AM
L27	2	(L8 or L9) and (bwp and coreset and qcl and CSI and monitor$3 and search and reference).clm.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L28	5356	(aperiod$4 period$3) near5 ("channel status information" "CSI-RS")	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L29	466	QCL with (aperiod$4 period$3) near5 ("channel status information" "CSI-RS")	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM

L30	74	QCL near5 assumption with (aperiod$4 period$3) near5 ("channel status information" "CSI-RS")	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L31	9	QCL near5 assumption with (aperiod$4 period$3) near5 ("channel status information" "CSI-RS") with lowest	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L32	80095	(H04W72/048 or H04L5/005 or H04W72/044 or H04L5/0032 or H04W72/042 or H04L5/0098 or H04L5/0007 or H04L5/0053).cpc.	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L33	16	L15 and QCL near5 assumption with ("channel status information" "CSI-RS") with lowest	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 09:53 AM
L34	2	("20200145982").PN.	(US-PGPUB; USPAT; USOCR; DERWENT)	OR	OFF	OFF	2022/06/02 09:53 AM
L35	373	lowest ADJ coreset	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 10:01 AM
L36	201	lowest ADJ coreset WITH qcl	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 10:02 AM
L37	79	lowest ADJ coreset WITH qcl SAME assumption	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 10:03 AM
L38	799	coreset near5 ("csi-rs" "channel state information")	(US-PGPUB; USPAT; EPO; JPO)	OR	OFF	OFF	2022/06/02 12:51 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N18	0	(QCL and CORESET and "CSI-RS" and assumption and aperiodic and monitored and search and space).clm.	(USPAT)	OR	OFF	OFF	2021/02/18 08:10 PM
N19	1	(QCL and CORESET and "CSI-RS" and assumption and aperiodic and monitored and search and space).clm.	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/02/18 08:10 PM

PTO/SB/08a (01-22)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17313283
Filing Date	2021-05-06
First Named Inventor	Chien-Chun Cheng
Art Unit	2469
Examiner Name	Afshwan M. Towfighi
Attorney Docket Number	64365-0017

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	11057896		2021-07-06	Cheng, et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20190174466		2019-06-06	Zhang	
	2	20200145982		2020-05-07	Cheng, et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	108111286	CN		2018-06-01	ZTE Corporation		
	2	113039740	CN		2021-06-25	FG Innovation Co. Ltd.		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17313283
	Filing Date	2021-05-06
	First Named Inventor	Chien-Chun Cheng
	Art Unit	2469
	Examiner Name	Afshwan M. Towfighi
	Attorney Docket Number	64365-0017

	3	3874668	EP		2021-09-08	FG Innovation Co. Ltd.		
	4	202147019446	IN		2021-04-30	FG Innovation Co. Ltd.		
	5	2022506048	JP		2022-01-17	FG Innovation Co. Ltd.		
	6	20210076989	KR		2021-06-24	FG Innovation Co. Ltd.		
	7	2018016907	WO		2018-01-25	LG Electronics Inc.		
	8	2020088295	WO		2020-05-07	FG Innovation Co. Ltd.		

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	ZTE Simultaneous transmission and reception of different channels and reference signals; RI-1805830 3GPP TSG RAN WGI Meeting #93, 25 May 2018 (25.05.2018), section 2	
	2	VIVO Maintenance for beam management; RI-1810366 3 GPP TSG RAN WGI#94b, 12 Oct. 2018 (12.10.2018), section 2-3	
	3	ZTE Maintenance for beam management; RI-1808196 3GPP TSG RAN WGI Meeting#94, 24 Aug. 2021(24.08.201*	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17313283
	Filing Date	2021-05-06
	First Named Inventor	Chien-Chun Cheng
	Art Unit	2469
	Examiner Name	Afshwan M. Towfighi
	Attorney Docket Number	64365-0017

	4	International Search Report for International Patent Application No.: PCT/CN2019/112403, issued on January 23, 2020
	5	Written Opinionfor International Patent Application No.: PCT/CN2019/112403, issued on January 23, 2020
	6	International Preliminary Report on Patentability for International Patent Application No.: PCT/CN2019/112403, issued on April 27, 2021.
	7	Notice of Allowance for U.S. Patent Application No.: 16/660,726, issued on February 24, 2021.
	8	Issue Notification for U.S. Patent Application No.: 16/660,726, issued on June 16, 2021.
	9	INTEL CORPORATION: "Remaining Issues on Beam Management", 3GPP DRAFT; R1-1810751 REMAINING ISSUES ON BM, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , 29 September 2018 (2018-09-29), pages 1-15, XP051518155, Retrieved from the Internet:
	10	ZTE: "Maintenance for Reference signals and QCL", 3GPP DRAFT; R1-1808197 MAINTENANCE FOR REFERENCE SIGNALS AND QCL, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Gothenburg, Sweden; 20180820 - 20180824 11 August 2018 (2018-08-11), XP051515582,
	11	LG ELECTRONICS: "Remaining issues on downlink control channel", 3GPP DRAFT; R1-1808490 REMAINING ISSUES ON DOWNLINK CONTROL CHANNEL FINAL, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDE, vol. RAN WG1, no. Gothenburg, Sweden; 20180820 - 20180824 11 August 2018 (2018-08-11), pages 1-9,
	12	NOKIA ET AL: "Feature lead summary on QCL", 3GPP DRAFT; R1-1809758, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Gothenburg, Sweden; 20180820 - 20180824 22 August 2018 (2018-08-22), XP051517119, Retrieved from the Internet:
	13	Communication pursuant to Rules 70(2) and 70a(2) EPC issued on July 7, 2022 for European Application No.: 19880818.0
	14	Extended European Search Report issued on June 20, 2022 for corresponding European Patent Application No.: 19880818.0

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17313283
	Filing Date	2021-05-06
	First Named Inventor	Chien-Chun Cheng
	Art Unit	2469
	Examiner Name	Afshwan M. Towfighi
	Attorney Docket Number	64365-0017

	15	ERICSSON, "Feature lead summary for beam management", 3GPP TSG-RAN WG1 Meeting #94, 2018, Tdoce R1-1809864, pages 1-26, Gothenburg, Sweden	
	16	Notice of Reasons for Refusal issued by Japanese Patent Office for corresponding Japanese Patent Application on May 31, 2022	
	17	Examination Report issued by Indian Patent Office for corresponding Indian Patent Application No.: 202147019446, on February 14, 2022	

If you wish to add additional non-patent literature document citation information please click the Add button Add

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Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17313283
	Filing Date	2021-05-06
	First Named Inventor	Chien-Chun Cheng
	Art Unit	2469
	Examiner Name	Afshwan M. Towfighi
	Attorney Docket Number	64365-0017

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Marcella M. Bodner/	Date (YYYY-MM-DD)	2022-07-18
Name/Print	Marcella M. Bodner	Registration Number	46561

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal	
Application Number:	17313283
Filing Date:	06-May-2021
Title of Invention:	METHODS AND APPARATUSES FOR BEAM OPERATIONS
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Filer:	Marcella M. Bodner/James Dade
Attorney Docket Number:	64365-0017
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	130	130
		Total in USD ($)		**130**

Electronic Acknowledgement Receipt	
EFS ID:	46211180
Application Number:	17313283
International Application Number:	
Confirmation Number:	3737
Title of Invention:	METHODS AND APPARATUSES FOR BEAM OPERATIONS
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Customer Number:	155240
Filer:	Marcella M. Bodner/James Dade
Filer Authorized By:	Marcella M. Bodner
Attorney Docket Number:	64365-0017
Receipt Date:	18-JUL-2022
Filing Date:	06-MAY-2021
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Payment was successfully received in RAM	$130
RAM confirmation Number	E20227HF27022038
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	1-CN_108111286.pdf	7944094 a6082a3c7d274d6e7d075d77ac7a891a6109fbe2	no	51
Warnings:					
Information:					
2	Foreign Reference	2-CN113039740_p.pdf	2037113 ce178357a7d4e0593665e3da720c724e6463db3b	no	28
Warnings:					
Information:					
3	Foreign Reference	3-EP3874668_p.pdf	1816631 41c3768afd086dd60f76da390ab7cf508aa23084	no	39
Warnings:					
Information:					
4	Foreign Reference	4-IN202147019446_p.pdf	2810594 a28bc75704784adc99471830111b6fc81df264c6	no	51
Warnings:					
Information:					
5	Foreign Reference	5-JP2022506048_p.pdf	2281758 f34f1b963dc64aa91c9247aba5dba387a88bf1b0	no	36
Warnings:					
Information:					
6	Foreign Reference	6-KR20210076989_p.pdf	1383801 fd34918e83d2ffa007dc6569bb684a102f84aecf	no	24
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Information:					

7	Foreign Reference	7-WO2018016907.pdf	5787491 48e57e1667da38758309ce68a48addf03cbf5448	no	58
Warnings:					
Information:					
8	Foreign Reference	8-WO2020088295.pdf	1514517 4be2225ea59e3f0836cb99264c6d8fbd49da113d	no	37
Warnings:					
Information:					
9	Non Patent Literature	9-ZTE_Simultaneous.pdf	198451 a017b80cb93ae6c9f2a508efdefcf9b36a49b1f4	no	4
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Information:					
10	Non Patent Literature	10_VIVO_Maintenance_for_beam_management_p.pdf	4669500 c9b12d2e4ce953c34d8f0592a6a8063ac30f0950	no	6
Warnings:					
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11	Non Patent Literature	11-ZTE_Maintenance.pdf	565540 aaa2c926267d5c5ed51724eadd3608c0f4553a7d	no	10
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12	Non Patent Literature	12-WO2020088295-ISR.pdf	115056 855bb5922d5c542b91bc93269393bcec885675c8	no	3
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Information:					
13	Non Patent Literature	13-WO2020088295-WOSA.pdf	146961 1775805d312d81d2090d6842ee86a2d80dccbf7e	no	3
Warnings:					
Information:					

14	Non Patent Literature	14-WO2020088295-IPRP.pdf	187216 4646655b79250f1bdf2414e782699a02539242a1	no	4
Warnings:					
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15	Non Patent Literature	15-US_16660726_NOA.pdf	501000 2d0a9eb0130a769850dd39b0beb4ac59b90e7177	no	10
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Information:					
17	Non Patent Literature	17_Intel_Corporation_Remaining_Issues_on_Beam_Management_p.pdf	9240676 d77fe299ccc8a932789dc79e9edcc80e63934e0a	no	15
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Information:					
18	Non Patent Literature	18_ZTE_Maintenance_for_Reference_signals_and_OCL_p.pdf	7853308 f15e61858e65dd1a597d65c1999453b581d5e99e	no	14
Warnings:					
Information:					
19	Non Patent Literature	19_LG_Electronics_Remaining_issues_on_downlink_control_channel_p.pdf	6954338 1db0c505c29746c707db27e8ec3e9209508095f2	no	9
Warnings:					
Information:					
20	Non Patent Literature	21_EP_3874668_Form_1224_7July2022_p.pdf	392187 0b5ce88c33bfd5ec4401c9bbc76a8316384064ef	no	1
Warnings:					
Information:					

21	Non Patent Literature	20_Nokia_Feature_lead_summary_on_QCL_p.pdf	6462920 b41a8e97cad36d4d6b14c72a972be61575f1be48	no	12
Warnings:					
Information:					
22	Non Patent Literature	22_EP3874668_EESR_20Jun2022_p.pdf	4512797 051240f4f25314608e9ba9c637f5d407ddbeb2a4	no	13
Warnings:					
Information:					
23	Non Patent Literature	23_Ericsson_Feature_Lead.pdf	2921600 41b4df4da010fe91ad05476d396639907707d6dc	no	32
Warnings:					
Information:					
24	Non Patent Literature	24_JP_OA_2021523200_31May2022.pdf	5312012 9f460c8ce02a274f7ae350632e49f6c2c6ccb074	no	63
Warnings:					
Information:					
25	Non Patent Literature	25_IN_OA_202147019446_14February2022.pdf	8020801 6120f0de1267f71588791c6d94afae10829b7ea3	no	53
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Information:					
26	Information Disclosure Statement (IDS) Form (SB08)	64365-0017_IDS_07182022.pdf	1341114 84ff27bcb2fa5a07702f90c5812896cb7034b0a2	no	6
Warnings:					
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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Espacenet

Bibliographic data: CN108111286 (A) — 2018-06-01

Information sending and receiving method and apparatus, storage medium and processor

Inventor(s): GAO BO; LI RUYUE; ZHANG SHUJUAN; CHEN YIJIAN; LU ZHAOHUA ± (高波, ; 李儒岳, ; 张淑娟, ; 陈艺戬, ; 鲁照华)

Applicant(s): ZTE CORP ± (中兴通讯股份有限公司)

Classification: - international: ***H04B7/06; H04L5/00***
- cooperative: **H04B17/318 (KR, US)**; **H04B7/0632 (EP, CN, KR)**; **H04B7/0695 (EP)**; **H04B7/088 (EP)**; **H04J11/0069 (KR)**; **H04L1/0003 (KR)**; **H04L1/0026 (KR)**; **H04L43/16 (US)**; **H04L5/0005 (KR)**; **H04L5/0023 (EP)**; **H04L5/0048 (EP, CN, US)**; **H04L5/005 (KR)**; **H04L5/0055 (CN, KR)**; **H04L5/0057 (CN, KR)**; **H04L5/0092 (KR)**; **H04W72/0453 (KR)**; **H04W72/1284 (KR)**; **H04W74/04 (KR)**; **H04W74/0833 (KR)**; H04L5/0057 (EP)

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Also published as: CN108111286 (B) CN114710247 (A) EP3713131 (A1) EP3713131 (A4) JP2021503824 (A) more

Abstract of CN108111286 (A)

The invention provides an information sending and receiving method and apparatus, a storage medium and a processor. The information sending method comprises the following steps: when K elements in a beam related parameter set exceed a first type of thresholds corresponding to the K elements, generating a first type of signaling; sending the first type of signaling to a second communications node,wherein the first type of signaling carries information related to a reference signal, and K is an integer greater than or equal to 1. By adoption of the information sending and receiving method and apparatus provided by the invention, the problem of how to report the information related to the reference signal is solved.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

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代理人 江舟 董文倩

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H04L 5/00(2006.01)
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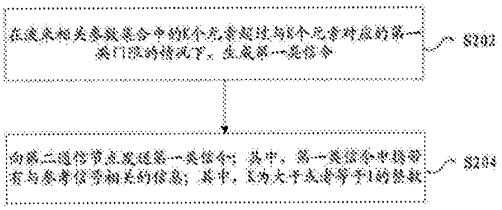
权利要求书9页 说明书34页 附图6页

(54)发明名称

信息发送、接收方法及装置、存储介质、处理器

(57)摘要

本发明提供了一种信息发送、接收方法及装置、存储介质、处理器；其中，信息发送方法包括：在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下，生成第一类信令；向第二通信节点发送第一类信令；其中，第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。通过本发明，解决了如何上报参考信号相关的信息的问题。



CN 108111286 A

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1.一种信息发送方法，应用于第一通信节点，其特征在于，包括：

在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下，生成第一类信令；

向第二通信节点发送所述第一类信令；其中，所述第一类信令中携带有与参考信号相关的信息；

其中，K为大于或者等于1的整数。

2.根据权利要求1所述的方法，其特征在于，向第二通信节点发送所述第一类信令包括：

通过以下至少之一信道向所述第二通信节点发送所述第一类信令：物理上行控制信道PUCCH，物理随机接入信道PRACH；

其中，所述PRACH包括：基于竞争的PRACH或免竞争PRACH。

3.根据权利要求1所述的方法，其特征在于，与所述参考信号相关的信息包括以下至少之一：

参考信号索引；

信道状态信息；

参考信号接收功率。

4.根据权利要求1所述的方法，其特征在于，所述第一类信令中直接携带所述与参考信号相关的信息或者所述第一类信令所使用的时频码资源位置指示与所述参考信号相关的信息。

5.根据权利要求1所述的方法，其特征在于，在向第二通信节点发送所述第一类信令之前，所述方法还包括：

接收第二通信节点为所述第一通信节点配置的以下至少之一门限信息：

第一类信令次数门限，其中，在所述第一类信令的发送次数超过所述第一类信令次数门限的情况下，停止发送所述第一类信令；

累计时间门限，其中，在计时单元的计时起点与发送所述第一类信令的时刻之间的时长超过所述累计时间门限的情况下，停止发送所述第一类信令。

6.根据权利要求5所述的方法，其特征在于，所述方法还包括一下至少之一：

在所述第一类信令的发送次数超过所述第一类信令次数门限和/或在计时单元的计时时长超过所述累计时间门限的情况下，向高层发送指定信息；

在发送达到所述第一类信令次数门限的第一类信令之后的第一预定时间内未收到所述第二通信节点发送的所述第一类信令的响应消息的情况下，向高层发送指定信息；

在计时单元的计时时长超过所述累计时间门限之后的第二预定时间内高层发送指定信息；

其中，所述指定信息包括以下至少之一信息：用于指示波束恢复失败的信息；无线链路失效的触发条件。

7.根据权利要求5所述的方法，其特征在于，所述计时起点为以下之一：

检测到链路或者波束失效的时刻；

检测到链路或者波束失效的时刻所在的时间窗的标记时刻；

波束失效检测结果达到预设门限的时刻；

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与波束失效检测结果达到所述预设门限的时刻所在的时间窗的标记时刻；

第一次发送所述第一类信令的时刻；

第一次发送所述第一类信令的时刻所在的时间窗的标记时刻；

配置用于承载所述第一类信令的上行资源的时刻；

配置用于承载所述第一类信令的上行资源的时刻所在的时间窗的标记时刻；

所述第一类信令承载的参考信号索引的发送时刻；

所述第一类信令承载的参考信号索引的发送时刻所在的时间窗的标记时刻；

第一次使用PUCCH发送所述第一类信令的时刻；

第一次使用PUCCH发送所述第一类信令的时刻所在的时间窗的标记时刻；

第一次使用PRACH发送所述第一类信令的时刻；

第一次使用PRACH发送所述第一类信令的时刻所在的时间窗的标记时刻。

8.根据权利要求7所述的方法，其特征在于，所述时间窗的标记时刻包括以下之一：

所述时间窗的开始时刻，所述时间窗的中间时刻，所述时间窗的结束时刻。

9.根据权利要求5所述的方法，其特征在于，所述第一类信令的发送次数包括以下至少之一：

使用PUCCH资源发送所述第一类信令的次数；

使用PRACH资源发送所述第一类信令的次数；

使用PRACH发送所述第一类信令的次数和使用PUCCH资源发送所述第一类信令的次数的总和。

10.根据权利要求1所述的方法，其特征在于，

在N个PRACH所关联的所述参考信号满足信道特性条件的情况下，所述N个PRACH资源分配在相同的时域单元中或者所述N个PRACH支持频分复用FDM；

其中，所述时域单元包括以下至少之一：时隙、子帧、符号，符号集合。

11.根据权利要求10所述的方法，其特征在于，所述参考信号包括以下至少之一：

信道状态信息参考信号CSI-RS；

同步信号块SS block。

12.根据权利要求11所述的方法，其特征在于，通过以下至少之一方式确定所述第一类信令的PRACH资源：

通过与所述第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时域位置，确定所述第一类信令所占用的PRACH资源的时域位置；

通过与所述第一类信令的PRACH所关联的SS block对应的初始接入的PRACH资源，确定所述第一类信令所占用的PRACH资源；

通过满足相同信道特征条件的SS block对应的初始接入的PRACH的时域位置，确定所述第一类信令所占用的PRACH资源的时域位置；

通过满足相同信道特征条件的SS block对应的初始接入的PRACH资源，确定所述第一类信令所占用的PRACH资源；

与所述第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时域偏置，与所述第一类信令所占用的PRACH资源的时域偏置相同；

与所述第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时频偏置，与

所述第一类信令所占用的PRACH资源的时频偏置相同；

与满足相同信道特征条件的SS block对应的初始接入的PRACH的时域偏置，与所述第一类信令所占用的PRACH资源的时域位置相同；

与满足相同信道特征假设的SS block对应的初始接入的PRACH的时频偏置，与所述第一类信令所占用的PRACH资源的时频位置相同；

其中，满足相同信道特征条件的SS block为与所述第一类信令所占用的PRACH所关联的CSI-RS的SS block。

13.根据权利要求11所述的方法，其特征在于，在向第二通信节点发送所述第一类信令之前，所述方法还包括以下至少之一：

接收所述第二通信节点发送的第二类信令，其中，所述第二类信令中携带预定的PRACH资源，其中，所述预定的PRACH资源为从已配置或者预定义的PRACH资源集合中选择的PRACH资源；所述预定的PRACH资源用于指示所述第一类信令所占用的PRACH资源的时域和/或频域位置；

接收所述第二通信节点发送的第三类信令，其中，所述第三类信令中携带与所述第一类信令的PRACH资源所关联的预定的CSI-RS资源和/或SS block；其中，所述预定的CSI-RS资源和/或SS block为从已配置或者预定义的CSI-RS资源集合和/或SS block集合中选择的，所述预定的CSI-RS资源和/或SS block与所述第一类信令所占用的PRACH资源关联。

14.根据权利要求1或11所述的方法，其特征在于，

所述第一类信令所占用的PRACH资源，为所述第一类信令所占用的PRACH关联的SS block的对应的初始接入的PRACH资源；

所述第一类信令所占用的PRACH资源，为所述第一类信令所占用的PRACH关联的CSI-RS的满足相同信道特征条件的SS block对应的初始接入的PRACH资源。

15.根据权利要求13所述的方法，其特征在于，

所述第二类信令中包括第一比特地图，其中，所述第一比特地图中的比特位取值为第一指定值时，所述PRACH资源集合中与所述比特位对应的PRACH资源被选择；

所述第三类信令中包括第二比特地图，其中，所述第二比特地图中的比特位取值为第二指定值时，所述CSI-RS资源集合和/或SS block集合中与所述比特位对应的CSI-RS资源和/或SS block被选择。

16.根据权利要求1所述的方法，其特征在于，所述方法还包括：

接收所述第二通信节点配置的频域步进量，其中，所述频域步进量用于指示位于相同时域单元下的PRACH之间的频域间隔。

17.根据权利要求2所述的方法，其特征在于，在通过所述PUCCH所述第一类信令和通过所述PRACH发送所述第一类信令使用相同的配置信息，其中，所述配置信息包括以下至少之一：

所述第二通信节点响应窗口持续时间；

所述第二通信节点响应窗口与向所述第二通信节点发送所述第一类信令的时间之间的时间偏置；

控制信道资源集CORESET资源；

搜索空间。

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18.一种信息发送方法，应用于第一通信节点，其特征在于，包括：

接收第二通信节点发送的参考信号；

确定与所述参考信号相关的信息，其中，所述信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息；

将确定的所述信息反馈给所述第二通信节点。

19.根据权利要求18所述的方法，其特征在于，

所述信息中包括的所述参考信号相关索引的数目小于或等于所述第二通信节点为所述第一通信节点配置的参考信号相关索引的反馈数目。

20.根据权利要求18所述的方法，其特征在于，在满足以下至少之一条件时，所述信息中包括所述参考信号相关索引：

所述参考信号的参考信号接收功率相对于最大的参考信号接收功率的差值，小于或者等于第一门限；

所述参考信号的参考信号接收功率相对于所述参考信号所在分组内的最大参考信号接收功率的差值，小于或者等于第二门限；

所述参考信号的参考信号接收功率相对于指定参考信号下的参考信号接收功率的差值，小于或者等于第三门限；

所述参考信号的参考信号接收功率，相对于用于计算差分参考信号接收功率的参考功率的差值，小于或者等于第四门限；

所述参考信号的参考信号接收功率，大于或者等于第五门限。

21.根据权利要求20所述的方法，其特征在于，

所述第一门限，所述第二门限，所述第三门限，所述第五门限通过以下之一方式确定：由所述第二通信节点配置的值，预定义的值；所述第四门限通过以下之一方式确定：所述第二通信节点配置的值，由所述差分参考信号接收功率的变化范围确定的值，预定义的值。

22.根据权利要求18所述的方法，其特征在于，所述信息包括：第一信息和第二信息；

其中，所述第一信息包括以下至少之一：所述参考信号相关索引的数目；参考信号分组的数目；参考信号分组的组索引；每个所述参考信号分组中最大的参考信号的接收功率值；所有参考信号的参考信号接收功率中最大的参考信号接收功率；用于计算差分参考信号接收功率的参考功率；与用于计算差分参考信号接收功率的参考功率所关联的参考信号相关索引；所述第二通信节点指定的参考信号相关索引；所述第二通信节点指定的参考信号的参考信号接收功率值；所述第二信息包括以下至少之一：参考信号相关索引，参考信号接收功率。

23.根据权利要求22所述的方法，其特征在于，所述第二信息中包括的参考信号接收功率为差分参考信号接收功率。

24.根据权利要求22所述的方法，其特征在于，所述第二信息中包括的所述参考信号相关索引用比特地图指示。

25.根据权利要求22所述的方法，其特征在于，通过以下之一方式反馈所述第一信息和所述第二信息：

均使用PUCCH资源反馈所述第一信息和所述第二信息；

均使用PUSCH资源反馈所述第一信息和所述第二信息；

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使用PUCCH资源反馈所述第一信息，而使用PUSCH反馈所述第二信息。

26.根据权利要求25所述的方法，其特征在于，在使用PUCCH资源反馈所述第一信息，使用PUSCH反馈所述第二信息的情况下，所述方法还包括以下之一：

所述第二通信节点不具备配置第一信息的能力，其中，所述第一信息用于指示所述第一通信节点以差分参考信号接收功率的方式反馈参考信号接收功率；

所述第二通信节点具有配置所述第一信息的能力；

所述第二通信节点不对所述第一通信节点配置所述第一信息；

所述第二通信节点对所述第一通信节点配置所述第一信息。

27.根据权利要求22所述的方法，其特征在于，所述第一信息的调制编码方式，与所述第二信息的调制编码方式不同。

28.根据权利要求18所述的方法，其特征在于，所述方法还包括以下至少之一：

在所述参考信号为参考信号分组内的X个参考信号的情况下，以差分参考信号接收功率的形式反馈所述X个参考信号对应的参考信号接收功率；

在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且所述参考信号为选择的参考信号的情况下，以差分参考信号接收功率的形式反馈与所述选择的参考信号对应的参考信号接收功率；

在所述参考信号为J个参考信号的情况下，以差分参考信号接收功率的形式反馈与所述J个参考信号对应的参考信号接收功率；

其中，X，Y，D，J为大于或等于1的正整数。

29.根据权利要求28所述的方法，其特征在于，在所述参考信号为参考信号分组内的X个参考信号的情况下，用于计算所述X个参考信号的所述差分参考信号接收功率的参考功率包括以下至少之一：

所述参考信号分组内的指定参考信号的参考信号接收功率；

在所述参考信号分组外的指定参考信号的参考信号接收功率；

所述第二通信节点配置的用于计算差分参考信号接收功率的参考值；

所述X个参考信号中的指定参考信号的参考信号接收功率。

30.根据权利要求28所述的方法，其特征在于，在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且所述参考信号为选择的参考信号的情况下，用于计算所述选择的参考信号的所述差分参考信号接收功率的参考功率包括以下至少之一：

所述D个参考信号分组内的指定参考信号的参考信号接收功率；

所述D个参考信号分组外的指定参考信号的参考信号接收功率；

所述第二通信节点配置的用于计算差分参考信号接收功率的参考值；

所述D个参考信号分组内的Y个参考信号中指定参考信号的参考信号接收功率。

31.根据权利要求28所述的方法，其特征在于，在所述参考信号为J个参考信号的情况下，用于计算所述J个参考信号的所述差分参考信号接收功率的参考功率包括以下至少之一：

所述J个参考信号中指定参考信号的参考信号接收功率；

所述第二通信节点配置的用于计算差分参考信号接收功率的参考值；

所述J个参考信号外的指定参考信号的参考信号接收功率。

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32.根据权利要求29所述的方法，其特征在于，在所述指定参考信号位于一个或多个指定参考信号分组内的情况下，所述指定参考信号为一个或多个所述指定参考信号分组内具有最大或者最小参考信号接收功率的参考信号；或者，所述指定参考信号为所有参考信号中具有最大或者最小参考信号接收功率的参考信号。

33.根据权利要求28所述的方法，其特征在于，差分参考信号接收功率的步进量通过以下至少之一方式确定：

根据预定义的步进量确定；

根据用于计算所述差分参考信号接收功率的参考功率确定；

根据用于计算所述差分参考信号接收功率的参考功率和所述第二通信节点配置的门限值确定；

其中，通过多个标识反馈多个所述差分参考信号接收功率的情况下，所述差分参考信号接收功率的步进量为所述多个标识中第一标识所指示的第一差分参考信号接收功率与所述多个标识中第二标识所指示的第二差分参考信号接收功率之差，其中，所述第一标识与所述第二标识相邻。

34.根据权利要求28所述的方法，其特征在于，通过以下至少之一方式反馈所述差分参考信号接收功率：

对于不同类型的参考信号，以差分参考信号接收功率的形式分别反馈与所述不同类型的参考信号的参考信号接收功率；

对于不同类型的参考信号，以差分参考信号接收功率的形式同时反馈不同类型的参考信号的参考信号接收功率；

以差分参考信号接收功率的形式反馈第一类型的参考信号的参考信号接收功率，直接反馈第二类型的参考信号的参考信号接收功率；

对于所述第二通信节点配置的不同参考信号集合，以差分参考信号接收功率的形式分别反馈不同参考信号集合的参考信号接收功率；

对于所述第一通信节点反馈的不同参考信号分组，以差分参考信号接收功率的形式分别反馈不同所述参考信号分组的参考信号接收功率。

35.根据权利要求1所述的方法，其特征在于，在以下至少之一条件下，以差分参考信号接收功率的形式反馈参考信号接收功率：

参考信号的参考信号类型为指定参考信号类型；

参考信号的数目大于或等于预定门限。

36.根据权利要求1所述的方法，其特征在于，在确定与所述参考信号相关的信息之前，所述方法还包括：

获取所述第二通信节点的配置的用于反馈所述参考信号相关的信息的报告模式，其中，所述报告模式包括以下至少之一：第一报告模式和第二报告模式；

其中，所述第一报告模式和所述第二报告模式之间的关系包括以下至少之一：

所述第一报告模式比所述第二报告模式有更高的配置优先级；

在所述第一报告模式下用于限定反馈所述参考信号相关的信息的门限值小于在所述第二报告模式下用于限定反馈所述参考信号相关的信息的门限值；

在所述第一报告模式下，向所述第二通信节点反馈所述第二通信节点为所述第一通信

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节点配置的所有的参考信号相关的信息；

在所述第二报告模式下，向所述第二通信节点的参考信号相关的信息的数目小于或等于所述第二通信节点为所述第一通信节点配置的参考信号相关的信息的反馈数目。

37.根据权利要求36所述的方法，其特征在于，

在所述报告模式为所述第一报告模式的情况下，所述参考信号的参考信号接收功率的顺序位置用于指示所述参考信号的参考信号相关索引。

38.根据权利要求36所述的方法，其特征在于，所述方法还包括以下至少之一：

在所述第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式反馈参考信号接收功率；

在所述第一报告模式下，直接反馈参考信号接收功率，在第二报告模式下，以差分参考信号接收功率的形式反馈参考信号接收功率；

在所述第二报告模式下，直接反馈参考信号接收功率，在第一报告模式下，以差分参考信号接收功率的形式反馈参考信号接收功率。

39.根据权利要求36所述的方法，其特征在于，

在所述第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式反馈参考信号接收功率情况下，所述第一报告模式下的差分报告中的差分参考信号接收功率的步进量与所述第二报告模式下的差分报告中的差分参考信号接收功率的步进量不同，或者，与所述第一报告模式下的差分报告中的差分参考信号接收功率的步进量和所述第二报告模式下的差分报告中的差分参考信号接收功率的步进量分别被配置。

40.一种信息接收方法，应用于第二通信节点，其特征在于，包括：

接收第一通信节点发送的第一类信令，其中，所述第一类信令为所述第一通信节点在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下生成的信令；所述第一类信令中携带有与参考信号相关的信息；

其中，K为大于或者等于1的整数。

41.根据权利要求40所述的方法，其特征在于，接收第一通信节点发送的第一类信令包括：

通过以下至少之一信道接收所述第一类信令：物理上行控制信道PUCCH，物理随机接入信道PRACH；

其中，所述PRACH包括：基于竞争的PRACH或免竞争PRACH。

42.根据权利要求40所述的方法，其特征在于，在接收第一通信节点发送的第一类信令之前，所述方法还包括：

为所述第一通信节点配置以下至少之一信息：

第一类信令次数门限，其中，在所述第一类信令的发送次数超过所述第一类信令次数门限的情况下，停止发送所述第一类信令；

累计时间门限，其中，在计时单元的计时起点与发送所述第一类信令的时刻之间的时长超过所述累计时间门限的情况下，停止发送所述第一类信令；

PUCCH；

PRACH；

波束恢复的PRACH。

43.根据权利要求42所述的方法，其特征在于，为所述第一通信节点配置所述信息包括：

根据所述第一通信节点的能力为所述第一通信节点配置所述信息，其中，所述第一通信节点的能力包括以下至少之一：所述第一通信节点支持波束关联的能力，所述第一通信节点支持非波束关联的能力，所述第一通信节点支持部分波束关联的能力，所述第一通信节点的天线参数。

44.一种信息发送方法，应用于第二通信节点，其特征在于，包括：

向第一通信节点发送参考信号；

接收所述第一通信节点反馈的与所述参考信号相关的信息；其中，所述信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息。

45.根据权利要求44所述的方法，其特征在于，

所述信息中包括的所述参考信号相关索引的数目小于或等于所述第二通信节点为所述第一通信节点配置的参考信号相关索引的反馈数目。

46.根据权利要求44所述的方法，其特征在于，在满足以下至少之一条件时，所述信息中包括所述参考信号相关索引：

所述参考信号的参考信号接收功率相对于最大的参考信号接收功率的差值，小于或者等于第一门限；

所述参考信号的参考信号接收功率相对于所述参考信号所在分组内的最大参考信号接收功率的差值，小于或者等于第二门限；

所述参考信号的参考信号接收功率相对于指定参考信号下的参考信号接收功率的差值，小于或者等于第三门限；

所述参考信号的参考信号接收功率，相对于用于计算差分参考信号接收功率的参考功率的差值，小于或者等于第四门限；

所述参考信号的参考信号接收功率，大于或者等于第五门限。

47.一种信息发送装置，应用于第一通信节点，其特征在于，包括：

生成模块，用于在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下，生成第一类信令；

发送模块，用于向第二通信节点发送所述第一类信令；其中，所述第一类信令中携带有与参考信号相关的信息；

其中，K为大于或者等于1的整数。

48.一种信息发送装置，应用于第一通信节点，其特征在于，包括：

接收模块，用于接收第二通信节点发送的参考信号；

确定模块，用于确定与所述参考信号相关的信息，其中，所述信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息；

上报模块，用于将确定的所述信息反馈给所述第二通信节点。

49.一种信息接收装置，应用于第二通信节点，其特征在于，包括：

接收模块，用于接收第一通信节点发送的第一类信令，其中，所述第一类信令为所述第一通信节点在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下生成的信令；所述第一类信令中携带有与参考信号相关的信息；

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其中，K为大于或者等于1的整数。

50.一种信息发送装置，应用于第二通信节点，其特征在于，包括：

发送模块，用于向第一通信节点发送参考信号；

接收模块，用于接收所述第一通信节点反馈的与所述参考信号相关的信息；其中，所述信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息。

51.一种存储介质，其特征在于，所述存储介质包括存储的程序，其中，所述程序运行时执行权利要求1至46中任一项所述的方法。

52.一种处理器，其特征在于，所述处理器用于运行程序，其中，所述程序运行时执行权利要求1至46中任一项所述的方法。

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信息发送、接收方法及装置、存储介质、处理器

技术领域

[0001] 本发明涉及通信领域，具体而言，涉及一种信息发送、接收方法及装置、存储介质、处理器。

背景技术

[0002] 超宽带宽的高频段(即毫米波通信)，成为未来移动通信发展的重要方向，特别是，在频谱资源和物理网大量接入时，毫米波的优势变得越来越有吸引力，在很多标准组织，例如IEEE、3GPP都开始展开相应的标准化工作，例如，在3GPP标准组，高频段通信凭借着其大带宽的显著优势将会成为5G New Radio Access Technology(New RAT)的重要创新点。

[0003] 然而，高频段通信也面临着链路衰减的挑战，具体而言，包括传播路径损失大、空气(尤其是氧气)吸收更大、雨衰影响较重等。面对这些挑战，高频段通信系统可以利用高频段波长较短和易于天线集成等特点，通过多天线阵列和波束赋形方案来获取高天线增益和对抗信号传输损耗，进而以确保链路余量和提升通信鲁棒性。

[0004] 在天线权重(也称为，预编码、波束)训练过程中，高频段发送端发送训练导频，接收端接收信道并执行信道估计。然后，高频段接收端需要向训练发送端反馈信道状态信息，便于实现收发端从可选的收发端天线权重对中，找到可以用于多路数据传输所需要的多组收发端天线权重对，提升整体的频谱效率。

[0005] 相关技术中的毫米波通信系统中，信道质量报告中涉及到参考信号接收功率报告(RSRP)，用于支持对于参考信号的选择和波束的选择确定。但是，相关技术中，整个系统和用户端的实现复杂度无法控制，且配置和反馈的开销比较大。

[0006] 针对相关技术中的上述技术问题，目前尚未提出有效的解决方案。

发明内容

[0007] 本发明实施例提供了一种信息发送、接收方法及装置、存储介质、处理器，以至少解决如何上报参考信号相关的信息的问题。

[0008] 根据本发明的一个实施例，提供了一种信息发送方法，应用于第一通信节点，包括：在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下，生成第一类信令；向第二通信节点发送第一类信令；其中，第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0009] 根据本发明的一个实施例，提供了一种信息发送方法，应用于第一通信节点，包括：接收第二通信节点发送的参考信号；确定与参考信号相关的信息，其中，信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息；将确定的信息反馈给第二通信节点。

[0010] 根据本发明的一个实施例，提供了一种信息接收方法，应用于第二通信节点，包括：接收第一通信节点发送的第一类信令，其中，第一类信令为第一通信节点在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下生成的信令；第一类信令中

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携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0011] 根据本发明的一个实施例，提供了一种信息发送方法，应用于第二通信节点，包括：向第一通信节点发送参考信号；接收第一通信节点反馈的与参考信号相关的信息；其中，信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息。

[0012] 根据本发明的一个实施例，提供了一种信息发送装置，应用于第一通信节点，包括：

[0013] 生成模块，用于在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下，生成第一类信令；发送模块，用于向第二通信节点发送第一类信令；其中，第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0014] 根据本发明的一个实施例，提供了一种信息发送装置，应用于第一通信节点，包括：接收模块，用于接收第二通信节点发送的参考信号；确定模块，用于确定与参考信号相关的信息，其中，信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息；上报模块，用于将确定的信息反馈给第二通信节点。

[0015] 根据本发明的一个实施例，提供了一种信息接收装置，应用于第二通信节点，包括：接收模块，用于接收第一通信节点发送的第一类信令，其中，第一类信令为第一通信节点在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下生成的信令；第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0016] 根据本发明的一个实施例，提供了一种信息发送装置，应用于第二通信节点，包括：发送模块，用于向第一通信节点发送参考信号；接收模块，用于接收第一通信节点反馈的与参考信号相关的信息；其中，信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息。

[0017] 根据本发明的又一个实施例，还提供了一种存储介质，所述存储介质包括存储的程序，其中，所述程序运行时执行上述任一项所述的方法。

[0018] 根据本发明的又一个实施例，还提供了一种处理器，所述处理器用于运行程序，其中，所述程序运行时执行上述任一项所述的方法。

[0019] 通过本发明，由于在在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下生成携带有与参考信号相关的信息的第一类信令，将第一类信令发送给第二通信节点，或者在接收到第二通信节点发送的参考信号之后将与参考信号相关的信息发送给第二通信节点，即通过主动上报或第二通信节点指示的方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

附图说明

[0020] 此处所说明的附图用来提供对本发明的进一步理解，构成本申请的一部分，本发明的示意性实施例及其说明用于解释本发明，并不构成对本发明的不当限定。在附图中：

[0021] 图1是本发明实施例的一种信息发送方法的移动终端的硬件结构框图；

[0022] 图2是根据本发明实施例提供的信息发送方法的流程图一；

[0023] 图3是根据本发明实施例提供的信息发送方法的流程图二；

[0024] 图4是根据本发明实施例提供的信息接收方法的流程示意图一；

[0025] 图5是根据本发明实施例提供的信息发送方法的流程示意图二；

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[0026] 图6是根据本发明实施例提供的信息发送装置的结构框图一；

[0027] 图7是根据本发明实施例提供的信息发送装置的结构框图二；

[0028] 图8是根据本发明实施例提供的信息接收装置的结构框图一；

[0029] 图9是根据本发明实施例提供的信息接收装置的结构框图二；

[0030] 图10是根据本发明优选实施例1提供的基于触发条件的信道质量反馈的流程示意图；

[0031] 图11是根据本发明优选实施例3提供的参考信号与PRACH资源关联方法的示意图；

[0032] 图12是根据本发明优选实施例5提供的在波束报告反馈方法的示意图一；

[0033] 图13是根据本发明优选实施例5提供的在波束报告反馈方法的示意图二。

具体实施方式

[0034] 下文中将参考附图并结合实施例来详细说明本发明。需要说明的是，在不冲突的情况下，本申请中的实施例及实施例中的特征可以相互组合。

[0035] 需要说明的是，本发明的说明书和权利要求书及上述附图中的术语“第一”、“第二”等是用于区别类似的对象，而不必用于描述特定的顺序或先后次序。

[0036] 实施例1

[0037] 本申请实施例1所提供的方法实施例可以在移动终端、计算机终端或者类似的运算装置中执行。以运行在移动终端上为例，图1是本发明实施例的一种信息发送方法的移动终端的硬件结构框图。如图1所示，移动终端10可以包括一个或多个(图中仅示出一个)处理器102(处理器102可以包括但不限于微处理器MCU或可编程逻辑器件FPGA等的处理装置)、用于存储数据的存储器104、以及用于通信功能的传输装置106。本领域普通技术人员可以理解，图1所示的结构仅为示意，其并不对上述电子装置的结构造成限定。例如，移动终端10还可包括比图1中所示更多或者更少的组件，或者具有与图1所示不同的配置。

[0038] 存储器104可用于存储应用软件的软件程序以及模块，如本发明实施例中的信息发送方法对应的程序指令/模块，处理器102通过运行存储在存储器104内的软件程序以及模块，从而执行各种功能应用以及数据处理，即实现上述的方法。存储器104可包括高速随机存储器，还可包括非易失性存储器，如一个或者多个磁性存储装置、闪存、或者其他非易失性固态存储器。在一些实例中，存储器104可进一步包括相对于处理器102远程设置的存储器，这些远程存储器可以通过网络连接至移动终端10。上述网络的实例包括但不限于互联网、企业内部网、局域网、移动通信网及其组合。

[0039] 传输装置106用于经由一个网络接收或者发送数据。上述的网络具体实例可包括移动终端10的通信供应商提供的无线网络。在一个实例中，传输装置106包括一个网络适配器(Network Interface Controller，NIC)，其可通过基站与其他网络设备相连从而可与互联网进行通讯。在一个实例中，传输装置106可以为射频(Radio Frequency，RF)模块，其用于通过无线方式与互联网进行通讯。

[0040] 在本实施例中提供了一种运行于上述移动终端的信息发送方法，图2是根据本发明实施例提供的信息发送方法的流程图一，如图2所示，该流程包括如下步骤：

[0041] 步骤S202，在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下，生成第一类信令；

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[0042] 步骤S204，向第二通信节点发送第一类信令；其中，第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0043] 通过上述步骤，由于在在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下生成携带有与参考信号相关的信息的第一类信令，将第一类信令发送给第二通信节点，即通过主动上报方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0044] 需要说明的是，上述步骤S204可以表现为：通过以下至少之一信道向第二通信节点发送第一类信令：物理上行控制信道PUCCH，物理随机接入信道PRACH；其中，PRACH包括：基于竞争的PRACH或免竞争PRACH。

[0045] 需要说明的是，与参考信号相关的信息包括以下至少之一：参考信号索引；信道状态信息；参考信号接收功率。

[0046] 需要说明的是，第一类信令中直接携带与参考信号相关的信息或者第一类信令所使用的时频码资源位置指示与参考信号相关的信息。

[0047] 在本发明的一个实施例中，在上述步骤S204之前，上述方法还可以包括：接收第二通信节点为第一通信节点配置的以下至少之一门限信息：第一类信令次数门限，其中，在第一类信令的发送次数超过第一类信令次数门限的情况下，停止发送第一类信令；累计时间门限，其中，在计时单元的计时起点与发送第一类信令的时刻之间的时长超过累计时间门限的情况下，停止发送第一类信令。通过对主动上报的方式进行门限的配置，即对主动上报的方式进行配置限制，能够提高上报的效率。

[0048] 在本发明的一个实施例中，上述方法还可以包括以下至少之一：在第一类信令的发送次数超过第一类信令次数门限和/或在计时单元的计时时长超过累计时间门限的情况下，向高层发送指定信息；在发送达到第一类信令次数门限的第一类信令之后的第一预定时间内未收到第二通信节点发送的第一类信令的响应消息的情况下，向高层发送指定信息；在计时单元的计时时长超过累计时间门限之后的第二预定时间内高层发送指定信息。

[0049] 需要说明的是，指定信息包括以下至少之一信息：用于指示波束恢复失败的信息；无线链路失效的触发条件。

[0050] 需要说明的是，上述计时起点为以下之一：检测到链路或者波束失效的时刻；检测到链路或者波束失效的时刻所在的时间窗的标记时刻；波束失效检测结果达到预设门限的时刻；与波束失效检测结果达到预设门限的时刻所在的时间窗的标记时刻；第一次发送第一类信令的时刻；第一次发送第一类信令的时刻所在的时间窗的标记时刻；配置用于承载第一类信令的上行资源的时刻；配置用于承载第一类信令的上行资源的时刻所在的时间窗的标记时刻；第一类信令承载的参考信号索引的发送时刻；第一类信令承载的参考信号索引的发送时刻所在的时间窗的标记时刻；第一次使用PUCCH发送第一类信令的时刻；第一次使用PUCCH发送第一类信令的时刻所在的时间窗的标记时刻；第一次使用PRACH发送第一类信令的时刻；第一次使用PRACH发送第一类信令的时刻所在的时间窗的标记时刻。

[0051] 需要说明的是，时间窗的标记时刻包括以下之一：时间窗的开始时刻，时间窗的中间时刻，时间窗的结束时刻。

[0052] 需要说明的是，上述第一类信令的发送次数包括以下至少之一：使用PUCCH资源发送第一类信令的次数；使用PRACH资源发送第一类信令的次数；使用PRACH发送第一类信令

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的次数和使用PUCCH资源发送第一类信令的次数的总和。

[0053] 在本发明的一个实施例中，在N个PRACH所关联的参考信号满足信道特性条件的情况下，N个PRACH资源分配在相同的时域单元中或者N个PRACH支持频分复用FDM；其中，时域单元包括以下至少之一：时隙、子帧、符号，符号集合。

[0054] 在本发明的一个实施例中，上述参考信号包括以下至少之一：信道状态信息参考信号CSI-RS；同步信号块SS block。

[0055] 在本发明的一个实施例中，可以通过以下至少之一方式确定第一类信令的PRACH资源：通过与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时域位置，确定第一类信令所占用的PRACH资源的时域位置；通过与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH资源，确定第一类信令所占用的PRACH资源；通过满足相同信道特征条件的SS block对应的初始接入的PRACH的时域位置，确定第一类信令所占用的PRACH资源的时域位置；通过满足相同信道特征条件的SS block对应的初始接入的PRACH资源，确定第一类信令所占用的PRACH资源；与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时域偏置，与第一类信令所占用的PRACH资源的时域偏置相同；与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时频偏置，与第一类信令所占用的PRACH资源的时频偏置相同；与满足相同信道特征条件的SS block对应的初始接入的PRACH的时域偏置，与第一类信令所占用的PRACH资源的时域位置相同；与满足相同信道特征假设的SS block对应的初始接入的PRACH的时频偏置，与第一类信令所占用的PRACH资源的时频位置相同；其中，满足相同信道特征条件的SS block为与第一类信令所占用的PRACH所关联的CSI-RS的SS block。

[0056] 在本发明的一个实施例中，在上述步骤S104之前，上述方法还可以包括以下至少之一：接收第二通信节点发送的第二类信令，其中，第二类信令中携带预定的PRACH资源，其中，预定的PRACH资源为从已配置或者预定义的PRACH资源集合中选择的PRACH资源；预定的PRACH资源用于指示第一类信令所占用的PRACH资源的时域和/或频域位置；接收第二通信节点发送的第三类信令，其中，第三类信令中携带与第一类信令的PRACH资源所关联的预定的CSI-RS资源和/或SS block；其中，预定的CSI-RS资源和/或SS block为从已配置或者预定义的CSI-RS资源集合和/或SS block集合中选择的，预定的CSI-RS资源和/或SS block与第一类信令所占用的PRACH资源关联。

[0057] 在本发明的一个实施例中，第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的SS block的对应的初始接入的PRACH资源；第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的CSI-RS的满足相同信道特征条件的SS block对应的初始接入的PRACH资源。

[0058] 需要说明的是，第二类信令中包括第一比特地图，其中，第一比特地图中的比特位取值为第一指定值时，PRACH资源集合中与比特位对应的PRACH资源被选择；第三类信令中包括第二比特地图，其中，第二比特地图中的比特位取值为第二指定值时，CSI-RS资源集合和/或SS block集合中与比特位对应的CSI-RS资源和/或SS block被选择。

[0059] 在本发明的一个实施例中，上述方法还包括：接收第二通信节点配置的频域步进量，其中，频域步进量用于指示位于相同时域单元下的PRACH之间的频域间隔。

[0060] 需要说明的是，接收第二通信节点配置的频域步进量可以在上述步骤S104之前或

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之后执行，并不限于此。

[0061] 需要说明的是，通过PUCCH第一类信令和通过PRACH发送第一类信令使用相同的配置信息，其中，配置信息包括以下至少之一：第二通信节点响应窗口持续时间；第二通信节点响应窗口与向第二通信节点发送第一类信令的时间之间的时间偏置；控制信道资源集CORESET资源；搜索空间。

[0062] 需要说明的是，上述步骤的执行主体可以是第一通信节点，比如：终端等，但并不限于此。

[0063] 在本实施例中提供了一种运行于上述移动终端的信息发送方法，图3是根据本发明实施例提供的信息发送方法的流程图二，如图3所示，该流程包括如下步骤：

[0064] 步骤S302，接收第二通信节点发送的参考信号；

[0065] 步骤S304，确定与参考信号相关的信息，其中，信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息；

[0066] 步骤S306，将确定的信息反馈给第二通信节点。

[0067] 通过上述步骤，由于在接收到第二通信节点发送的参考信号之后将与参考信号相关的信息发送给第二通信节点，即通过第二通信节点指示的方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0068] 需要说明的是，上述信息中包括的参考信号相关索引的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关索引的反馈数目。

[0069] 需要说明的是，在满足以下至少之一条件时，信息中包括参考信号相关索引：参考信号的参考信号接收功率相对于最大的参考信号接收功率的差值，小于或者等于第一门限；参考信号的参考信号接收功率相对于参考信号所在分组内的最大参考信号接收功率的差值，小于或者等于第二门限；参考信号的参考信号接收功率相对于指定参考信号下的参考信号接收功率的差值，小于或者等于第三门限；参考信号的参考信号接收功率，相对于用于计算差分参考信号接收功率的参考功率的差值，小于或者等于第四门限；参考信号的参考信号接收功率，大于或者等于第五门限。

[0070] 需要说明的是，第一门限，第二门限，第三门限，第五门限通过以下之一方式确定：由第二通信节点配置的值，预定义的值；第四门限通过以下之一方式确定：第二通信节点配置的值，由差分参考信号接收功率的变化范围确定的值，预定义的值。

[0071] 需要说明的是，信息包括：第一信息和第二信息；其中，第一信息包括以下至少之一：参考信号相关索引的数目；参考信号分组的数目；参考信号分组的组索引；每个参考信号分组中最大的参考信号的接收功率值；所有参考信号的参考信号接收功率中最大的参考信号接收功率；用于计算差分参考信号接收功率的参考功率；与用于计算差分参考信号接收功率的参考功率所关联的参考信号相关索引；第二通信节点指定的参考信号相关索引；第二通信节点指定的参考信号的参考信号接收功率值；第二信息包括以下至少之一：参考信号相关索引，参考信号接收功率。

[0072] 需要说明的是，第二信息中包括的参考信号接收功率为差分参考信号接收功率。

[0073] 需要说明的是，第二信息中包括的参考信号相关索引用比特地图指示。

[0074] 需要说明的是，通过以下之一方式反馈第一信息和第二信息：均使用PUCCH资源反馈第一信息和第二信息；均使用PUSCH资源反馈第一信息和第二信息；使用PUCCH资源反馈

第一信息，而使用PUSCH反馈第二信息。

[0075] 需要说明的是，在使用PUCCH资源反馈第一信息，使用PUSCH反馈第二信息的情况下，上述方法还包括以下之一：第二通信节点不具备配置第一信息的能力，其中，第一信息用于指示第一通信节点以差分参考信号接收功率的方式反馈参考信号接收功率；第二通信节点具有配置第一信息的能力；第二通信节点不对第一通信节点配置第一信息；第二通信节点对第一通信节点配置第一信息。

[0076] 需要说明的是，第一信息的调制编码方式，与第二信息的调制编码方式不同。

[0077] 在本发明的一个实施例中，上述方法还包括以下至少之一：在参考信号为参考信号分组内的X个参考信号的情况下，以差分参考信号接收功率的形式反馈X个参考信号对应的参考信号接收功率；在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且参考信号为选择的参考信号的情况下，以差分参考信号接收功率的形式反馈与选择的参考信号对应的参考信号接收功率；在参考信号为J个参考信号的情况下，以差分参考信号接收功率的形式反馈与J个参考信号对应的参考信号接收功率；其中，X，Y，D，J为大于或等于1的正整数。

[0078] 需要说明的是，在参考信号为参考信号分组内的X个参考信号的情况下，用于计算X个参考信号的差分参考信号接收功率的参考功率包括以下至少之一：参考信号分组内的指定参考信号的参考信号接收功率；在参考信号分组外的指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；X个参考信号中的指定参考信号的参考信号接收功率。

[0079] 需要说明的是，在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且参考信号为选择的参考信号的情况下，用于计算选择的参考信号的差分参考信号接收功率的参考功率包括以下至少之一：D个参考信号分组内的指定参考信号的参考信号接收功率；D个参考信号分组外的指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；D个参考信号分组内的Y个参考信号中指定参考信号的参考信号接收功率。

[0080] 需要说明的是，在参考信号为J个参考信号的情况下，用于计算J个参考信号的差分参考信号接收功率的参考功率包括以下至少之一：J个参考信号中指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；J个参考信号外的指定参考信号的参考信号接收功率。

[0081] 需要说明的是，在指定参考信号位于一个或多个指定参考信号分组内的情况下，指定参考信号为一个或多个指定参考信号分组内具有最大或者最小参考信号接收功率的参考信号；或者，指定参考信号为所有参考信号中具有最大或者最小参考信号接收功率的参考信号。

[0082] 在本发明的一个实施例中，差分参考信号接收功率的步进量通过以下至少之一方式确定：根据预定义的步进量确定；根据用于计算差分参考信号接收功率的参考功率确定；根据用于计算差分参考信号接收功率的参考功率和第二通信节点配置的门限值确定；其中，通过多个标识反馈多个差分参考信号接收功率的情况下，差分参考信号接收功率的步进量为多个标识中第一标识所指示的第一差分参考信号接收功率与多个标识中第二标识所指示的第二差分参考信号接收功率之差，其中，第一标识与第二标识相邻。

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[0083] 需要说明的是，上述第一标识可以是数字，也可以是字母，但并不限于此。

[0084] 需要说明的是，以上述第一标识为数字为例进行说明，即上述多个差分参考信号接收功率可以通过数字方式进行反馈，比如，5个差分参考信号接收功率采用数字12345进行反馈，而数字2标识的差分参考信号接收功率为数字1标识的差分参考信号接收功率加上上述步进量后的值，上述数字3标识的差分参考信号接收功率为数字2标识的差分参考信号接收功率加上上述步进量后的值，依次类推。

[0085] 需要说明的是，可以通过以下至少之一方式反馈差分参考信号接收功率：对于不同类型的参考信号，以差分参考信号接收功率的形式分别反馈与不同类型的参考信号的参考信号接收功率；对于不同类型的参考信号，以差分参考信号接收功率的形式同时反馈不同类型的参考信号的参考信号接收功率；以差分参考信号接收功率的形式反馈第一类型的参考信号的参考信号接收功率，直接反馈第二类型的参考信号的参考信号接收功率；对于第二通信节点配置的不同参考信号集合，以差分参考信号接收功率的形式分别反馈不同参考信号集合的参考信号接收功率；对于第一通信节点反馈的不同参考信号分组，以差分参考信号接收功率的形式分别反馈不同参考信号分组的参考信号接收功率。

[0086] 需要说明的是，在以下至少之一条件下，以差分参考信号接收功率的形式反馈参考信号接收功率：参考信号的参考信号类型为指定参考信号类型；参考信号的数目大于或等于预定门限。

[0087] 在本发明的一个实施例中，在上述步骤S304之前，上述方法还可以包括：获取第二通信节点的配置的用于反馈参考信号相关的信息的报告模式，其中，报告模式包括以下至少之一：第一报告模式和第二报告模式；其中，第一报告模式和第二报告模式之间的关系包括以下至少之一：第一报告模式比第二报告模式有更高的配置优先级；在第一报告模式下用于限定反馈参考信号相关的信息的门限值小于在第二报告模式下用于限定反馈参考信号相关的信息的门限值；在第一报告模式下，向第二通信节点反馈第二通信节点为第一通信节点配置的所有的参考信号相关的信息；在第二报告模式下，向第二通信节点的参考信号相关的信息的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关的信息的反馈数目。

[0088] 需要说明的是，在报告模式为第一报告模式的情况下，参考信号的参考信号接收功率的顺序位置用于指示参考信号的参考信号相关索引。

[0089] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式反馈参考信号接收功率；在第一报告模式下，直接反馈参考信号接收功率，在第二报告模式下，以差分参考信号接收功率的形式反馈参考信号接收功率；在第二报告模式下，直接反馈参考信号接收功率，在第一报告模式下，以差分参考信号接收功率的形式反馈参考信号接收功率。

[0090] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式反馈参考信号接收功率情况下，第一报告模式下的差分报告中的差分参考信号接收功率的步进量与第二报告模式下的差分报告中的差分参考信号接收功率的步进量不同，或者，与第一报告模式下的差分报告中的差分参考信号接收功率的步进量和第二报告模式下的差分报告中的差分参考信号接收功率的步进量分别被配置。

[0091] 需要说明的是，上述图3所示实施例中的步骤的执行主体可以是第一通信节点比

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如终端，但并不限于此。

[0092] 通过以上的实施方式的描述，本领域的技术人员可以清楚地了解到根据上述实施例的方法可借助软件加必需的通用硬件平台的方式来实现，当然也可以通过硬件，但很多情况下前者是更佳的实施方式。基于这样的理解，本发明的技术方案本质上或者说对现有技术做出贡献的部分可以以软件产品的形式体现出来，该计算机软件产品存储在一个存储介质(如ROM/RAM、磁碟、光盘)中，包括若干指令用以使得一台终端设备(可以是手机，计算机，服务器，或者网络设备等)执行本发明各个实施例的方法。

[0093] 实施例2

[0094] 本发明实施例提供了一种信息接收方法，应用于第二通信节点，图4是根据本发明实施例提供的信息接收方法的流程示意图一，如图4所示，该方法包括：

[0095] 步骤S402，为所述第一通信节点配置以下至少之一信息：第一类信令次数门限，其中，在所述第一类信令的发送次数超过所述第一类信令次数门限的情况下，停止发送所述第一类信令；累计时间门限，其中，在计时单元的计时起点与发送所述第一类信令的时刻之间的时长超过所述累计时间门限的情况下，停止发送所述第一类信令；PUCCH；PRACH；波束恢复的PRACH；

[0096] 步骤S404，接收第一通信节点发送的第一类信令，其中，所述第一类信令为所述第一通信节点在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下生成的信令；所述第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0097] 通过上述步骤，由于在在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下接收第一通信节点发送的携带有与参考信号相关的信息的第一类信令，即通过第一通信节点主动上报方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0098] 需要说明的是，上述步骤S404可以与上述步骤S402结合，也可以单独执行，并不限于此。

[0099] 在本发明的一个实施例中，上述步骤S404可以表现为：通过以下至少之一信道接收所述第一类信令：物理上行控制信道PUCCH，物理随机接入信道PRACH；其中，所述PRACH包括：基于竞争的PRACH或免竞争PRACH。

[0100] 需要说明的是，上述步骤S402可以表现为：根据所述第一通信节点的能力为所述第一通信节点配置所述信息，其中，所述第一通信节点的能力包括以下至少之一：所述第一通信节点支持波束关联的能力，所述第一通信节点支持非波束关联的能力，所述第一通信节点支持部分波束关联的能力，所述第一通信节点的天线参数。

[0101] 需要说明的是，与参考信号相关的信息包括以下至少之一：参考信号索引；信道状态信息；参考信号接收功率。

[0102] 需要说明的是，第一类信令中直接携带与参考信号相关的信息或者第一类信令所使用的时频码资源位置指示与参考信号相关的信息。

[0103] 在本发明的一个实施例中，在N个PRACH所关联的参考信号满足信道特性条件的情况下，N个PRACH资源分配在相同的时域单元中或者N个PRACH支持频分复用FDM；其中，时域单元包括以下至少之一：时隙、子帧、符号，符号集合。

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[0104] 在本发明的一个实施例中，上述参考信号包括以下至少之一：信道状态信息参考信号CSI-RS；同步信号块SS block。

[0105] 在本发明的一个实施例中，在上述步骤S404之前，上述方法还可以包括以下至少之一：向第一通信节点发送第二类信令，其中，第二类信令中携带预定的PRACH资源，其中，预定的PRACH资源为从已配置或者预定义的PRACH资源集合中选择的PRACH资源；预定的PRACH资源用于指示第一类信令所占用的PRACH资源的时域和/或频域位置；向第一二通信节点发送第三类信令，其中，第三类信令中携带与第一类信令的PRACH资源所关联的预定的CSI-RS资源和/或SS block；其中，预定的CSI-RS资源和/或SS block为从已配置或者预定义的CSI-RS资源集合和/或SS block集合中选择的，预定的CSI-RS资源和/或SS block与第一类信令所占用的PRACH资源关联。

[0106] 在本发明的一个实施例中，第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的SS block的对应的初始接入的PRACH资源；第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的CSI-RS的满足相同信道特征条件的SS block对应的初始接入的PRACH资源。

[0107] 需要说明的是，第二类信令中包括第一比特地图，其中，第一比特地图中的比特位取值为第一指定值时，PRACH资源集合中与比特位对应的PRACH资源被选择；第三类信令中包括第二比特地图，其中，第二比特地图中的比特位取值为第二指定值时，CSI-RS资源集合和/或SS block集合中与比特位对应的CSI-RS资源和/或SS block被选择。

[0108] 在本发明的一个实施例中，上述方法还包括：为第一通信节点配置频域步进量，其中，频域步进量用于指示位于相同时域单元下的PRACH之间的频域间隔。

[0109] 需要说明的是，为第一通信节点配置频域步进量可以在上述步骤S304之前或之后执行，并不限于此。

[0110] 需要说明的是，通过PUCCH第一类信令和通过PRACH发送第一类信令使用相同的配置信息，其中，配置信息包括以下至少之一：第二通信节点响应窗口持续时间；第二通信节点响应窗口与向第二通信节点发送第一类信令的时间之间的时间偏置；控制信道资源集CORESET资源；搜索空间。

[0111] 需要说明的是，上述步骤的执行主体可以是第二通信节点，比如基站等，但并不限于此。

[0112] 本发明实施例还提供了一种信息发送方法，应用于第二通信节点，图5是根据本发明实施例提供的信息发送方法的流程示意图二，如图5所示，该方法包括：

[0113] 步骤S502，向第一通信节点发送参考信号；

[0114] 步骤S504，接收所述第一通信节点反馈的与所述参考信号相关的信息；其中，所述信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息。

[0115] 通过上述步骤，由于在向第一通信节点发送参考信号之后接收第一通信节点发送的与参考信号相关的信息，即第一通信节点通过第二通信节点指示的方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0116] 需要说明的是，上述信息中包括的参考信号相关索引的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关索引的反馈数目。

[0117] 需要说明的是，在满足以下至少之一条件时，信息中包括参考信号相关索引：参考

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信号的参考信号接收功率相对于最大的参考信号接收功率的差值，小于或者等于第一门限；参考信号的参考信号接收功率相对于参考信号所在分组内的最大参考信号接收功率的差值，小于或者等于第二门限；参考信号的参考信号接收功率相对于指定参考信号下的参考信号接收功率的差值，小于或者等于第三门限；参考信号的参考信号接收功率，相对于用于计算差分参考信号接收功率的参考功率的差值，小于或者等于第四门限；参考信号的参考信号接收功率，大于或者等于第五门限。

[0118] 需要说明的是，第一门限，第二门限，第三门限，第五门限通过以下之一方式确定：由第二通信节点配置的值，预定义的值；第四门限通过以下之一方式确定：第二通信节点配置的值，由差分参考信号接收功率的变化范围确定的值，预定义的值。

[0119] 需要说明的是，信息包括：第一信息和第二信息；其中，第一信息包括以下至少之一：参考信号相关索引的数目；参考信号分组的数目；参考信号分组的组索引；每个参考信号分组中最大的参考信号的接收功率值；所有参考信号的参考信号接收功率中最大的参考信号接收功率；用于计算差分参考信号接收功率的参考功率；与用于计算差分参考信号接收功率的参考功率所关联的参考信号相关索引；第二通信节点指定的参考信号相关索引；第二通信节点指定的参考信号的参考信号接收功率值；第二信息包括以下至少之一：参考信号相关索引，参考信号接收功率。

[0120] 需要说明的是，第二信息中包括的参考信号接收功率为差分参考信号接收功率。

[0121] 需要说明的是，第二信息中包括的参考信号相关索引用比特地图指示。

[0122] 需要说明的是，接收第一通信节点通过以下之一方式反馈的第一信息和第二信息：均使用PUCCH资源反馈第一信息和第二信息；均使用PUSCH资源反馈第一信息和第二信息；使用PUCCH资源反馈第一信息，而使用PUSCH反馈第二信息。

[0123] 需要说明的是，在使用PUCCH资源反馈第一信息，使用PUSCH反馈第二信息的情况下，上述方法还包括以下之一：第二通信节点不具备配置第一信息的能力，其中，第一信息用于指示第一通信节点以差分参考信号接收功率的方式反馈参考信号接收功率；第二通信节点具有配置第一信息的能力；第二通信节点不对第一通信节点配置第一信息；第二通信节点对第一通信节点配置第一信息。

[0124] 需要说明的是，第一信息的调制编码方式，与第二信息的调制编码方式不同。

[0125] 在本发明的一个实施例中，上述方法还包括以下至少之一：在参考信号为参考信号分组内的X个参考信号的情况下，以差分参考信号接收功率的形式接收X个参考信号对应的参考信号接收功率；在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且参考信号为选择的参考信号的情况下，以差分参考信号接收功率的形式接收与选择的参考信号对应的参考信号接收功率；在参考信号为J个参考信号的情况下，以差分参考信号接收功率的形式接收与J个参考信号对应的参考信号接收功率；其中，X,Y,D,J为大于或等于1的正整数。

[0126] 需要说明的是，在参考信号为参考信号分组内的X个参考信号的情况下，用于计算X个参考信号的差分参考信号接收功率的参考功率包括以下至少之一：参考信号分组内的指定参考信号的参考信号接收功率；在参考信号分组外的指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；X个参考信号中的指定参考信号的参考信号接收功率。

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[0127] 需要说明的是，在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且参考信号为选择的参考信号的情况下，用于计算选择的参考信号的差分参考信号接收功率的参考功率包括以下至少之一：D个参考信号分组内的指定参考信号的参考信号接收功率；D个参考信号分组外的指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；D个参考信号分组内的Y个参考信号中指定参考信号的参考信号接收功率。

[0128] 需要说明的是，在参考信号为J个参考信号的情况下，用于计算J个参考信号的差分参考信号接收功率的参考功率包括以下至少之一：J个参考信号中指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；J个参考信号外的指定参考信号的参考信号接收功率。

[0129] 需要说明的是，在指定参考信号位于一个或多个指定参考信号分组内的情况下，指定参考信号为一个或多个指定参考信号分组内具有最大或者最小参考信号接收功率的参考信号；或者，指定参考信号为所有参考信号中具有最大或者最小参考信号接收功率的参考信号。

[0130] 在本发明的一个实施例中，差分参考信号接收功率的步进量通过以下至少之一方式确定：根据预定义的步进量确定；根据用于计算差分参考信号接收功率的参考功率确定；根据用于计算差分参考信号接收功率的参考功率和第二通信节点配置的门限值确定；其中，通过多个标识接收多个差分参考信号接收功率的情况下，差分参考信号接收功率的步进量为多个标识中第一标识所指示的第一差分参考信号接收功率与多个标识中第二标识所指示的第二差分参考信号接收功率之差，其中，第一标识与第二标识相邻。

[0131] 需要说明的是，上述第一标识可以是数字，也可以是字母，但并不限于此。

[0132] 需要说明的是，以上述第一标识为数字为例进行说明，即上述多个差分参考信号接收功率可以通过数字方式进行接收，比如，5个差分参考信号接收功率采用数字12345进行接收，而数字2标识的差分参考信号接收功率为数字1标识的差分参考信号接收功率加上上述步进量后的值，上述数字3标识的差分参考信号接收功率为数字2标识的差分参考信号接收功率加上上述步进量后的值，依次类推。

[0133] 需要说明的是，可以通过以下至少之一方式接收差分参考信号接收功率：对于不同类型的参考信号，以差分参考信号接收功率的形式分别接收与不同类型的参考信号的参考信号接收功率；对于不同类型的参考信号，以差分参考信号接收功率的形式同时接收不同类型的参考信号的参考信号接收功率；以差分参考信号接收功率的形式接收第一类型的参考信号的参考信号接收功率，直接接收第二类型的参考信号的参考信号接收功率；对于第二通信节点配置的不同参考信号集合，以差分参考信号接收功率的形式分别接收不同参考信号集合的参考信号接收功率；对于第一通信节点接收的不同参考信号分组，以差分参考信号接收功率的形式分别接收不同参考信号分组的参考信号接收功率。

[0134] 需要说明的是，在以下至少之一条件下，以差分参考信号接收功率的形式接收参考信号接收功率：参考信号的参考信号类型为指定参考信号类型；参考信号的数目大于或等于预定门限。

[0135] 在本发明的一个实施例中，在上述步骤S504之前，上述方法还可以包括：为所述第一通信节点配置用于接收参考信号相关的信息的报告模式，其中，报告模式包括以下至少

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之一：第一报告模式和第二报告模式；其中，第一报告模式和第二报告模式之间的关系包括以下至少之一：第一报告模式比第二报告模式有更高的配置优先级；在第一报告模式下用于限定接收参考信号相关的信息的门限值小于在第二报告模式下用于限定接收参考信号相关的信息的门限值；在第一报告模式下，向第二通信节点接收第二通信节点为第一通信节点配置的所有的参考信号相关的信息；在第二报告模式下，向第二通信节点的参考信号相关的信息的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关的信息的反馈数目。

[0136] 需要说明的是，在报告模式为第一报告模式的情况下，参考信号的参考信号接收功率的顺序位置用于指示参考信号的参考信号相关索引。

[0137] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式接收参考信号接收功率；在第一报告模式下，直接接收参考信号接收功率，在第二报告模式下，以差分参考信号接收功率的形式接收参考信号接收功率；在第二报告模式下，直接接收参考信号接收功率，在第一报告模式下，以差分参考信号接收功率的形式接收参考信号接收功率。

[0138] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式接收参考信号接收功率情况下，第一报告模式下的差分报告中的差分参考信号接收功率的步进量与第二报告模式下的差分报告中的差分参考信号接收功率的步进量不同，或者，与第一报告模式下的差分报告中的差分参考信号接收功率的步进量和第二报告模式下的差分报告中的差分参考信号接收功率的步进量分别被配置。

[0139] 需要说明的是，上述图5所示实施例中的步骤的执行主体可以是第二通信节点比如基站，但并不限于此。

[0140] 通过以上的实施方式的描述，本领域的技术人员可以清楚地了解到根据上述实施例的方法可借助软件加必需的通用硬件平台的方式来实现，当然也可以通过硬件，但很多情况下前者是更佳的实施方式。基于这样的理解，本发明的技术方案本质上或者说对现有技术做出贡献的部分可以以软件产品的形式体现出来，该计算机软件产品存储在一个存储介质(如ROM/RAM、磁碟、光盘)中，包括若干指令用以使得一台终端设备(可以是手机，计算机，服务器，或者网络设备等)执行本发明各个实施例的方法。

[0141] 实施例3

[0142] 在本实施例中还提供了一种信息发送装置，该装置用于实现上述实施例及优选实施方式，已经进行过说明的不再赘述。如以下所使用的，术语“模块”可以实现预定功能的软件和/或硬件的组合。尽管以下实施例所描述的装置较佳地以软件来实现，但是硬件，或者软件和硬件的组合的实现也是可能并被构想的。

[0143] 图6是根据本发明实施例提供的信息发送装置的结构框图一，如图6所示，该装置位于第一通信节点中，包括：

[0144] 生成模块62，用于在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下，生成第一类信令；

[0145] 发送模块64，与上述生成模块62连接，用于向第二通信节点发送所述第一类信令；其中，所述第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0146] 通过上述装置，由于在在波束相关参数集合中的K个元素超过与K个元素对应的第

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一类门限的情况下生成携带有与参考信号相关的信息的第一类信令，将第一类信令发送给第二通信节点，即通过主动上报方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0147] 需要说明的是，上述发送模块62还用于通过以下至少之一信道向第二通信节点发送第一类信令：物理上行控制信道PUCCH，物理随机接入信道PRACH；其中，PRACH包括：基于竞争的PRACH或免竞争PRACH。

[0148] 需要说明的是，与参考信号相关的信息包括以下至少之一：参考信号索引；信道状态信息；参考信号接收功率。

[0149] 需要说明的是，第一类信令中直接携带与参考信号相关的信息或者第一类信令所使用的时频码资源位置指示与参考信号相关的信息。

[0150] 在本发明的一个实施例中，在上述步骤S204之前，上述装置还可以包括：接收模块，与上述发送模块64连接，用于接收第二通信节点为第一通信节点配置的以下至少之一门限信息：第一类信令次数门限，其中，在第一类信令的发送次数超过第一类信令次数门限的情况下，停止发送第一类信令；累计时间门限，其中，在计时单元的计时起点与发送第一类信令的时刻之间的时长超过累计时间门限的情况下，停止发送第一类信令。通过对主动上报的方式进行门限的配置，即对主动上报的方式进行配置限制，能够提高上报的效率。

[0151] 在本发明的一个实施例中，上述发送模块64还用于以下至少之一：在第一类信令的发送次数超过第一类信令次数门限和/或在计时单元的计时时长超过累计时间门限的情况下，向高层发送指定信息；在发送达到第一类信令次数门限的第一类信令之后的第一预定时间内未收到第二通信节点发送的第一类信令的响应消息的情况下，向高层发送指定信息；在计时单元的计时时长超过累计时间门限之后的第二预定时间内高层发送指定信息。

[0152] 需要说明的是，指定信息包括以下至少之一信息：用于指示波束恢复失败的信息；无线链路失效的触发条件。

[0153] 需要说明的是，上述计时起点为以下之一：检测到链路或者波束失效的时刻；检测到链路或者波束失效的时刻所在的时间窗的标记时刻；波束失效检测结果达到预设门限的时刻；与波束失效检测结果达到预设门限的时刻所在的时间窗的标记时刻；第一次发送第一类信令的时刻；第一次发送第一类信令的时刻所在的时间窗的标记时刻；配置用于承载第一类信令的上行资源的时刻；配置用于承载第一类信令的上行资源的时刻所在的时间窗的标记时刻；第一类信令承载的参考信号索引的发送时刻；第一类信令承载的参考信号索引的发送时刻所在的时间窗的标记时刻；第一次使用PUCCH发送第一类信令的时刻；第一次使用PUCCH发送第一类信令的时刻所在的时间窗的标记时刻；第一次使用PRACH发送第一类信令的时刻；第一次使用PRACH发送第一类信令的时刻所在的时间窗的标记时刻。

[0154] 需要说明的是，时间窗的标记时刻包括以下之一：时间窗的开始时刻，时间窗的中间时刻，时间窗的结束时刻。

[0155] 需要说明的是，上述第一类信令的发送次数包括以下至少之一：使用PUCCH资源发送第一类信令的次数；使用PRACH资源发送第一类信令的次数；使用PRACH发送第一类信令的次数和使用PUCCH资源发送第一类信令的次数的总和。

[0156] 在本发明的一个实施例中，在N个PRACH所关联的参考信号满足信道特性条件的情况下，N个PRACH资源分配在相同的时域单元中或者N个PRACH支持频分复用FDM；其中，时域

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单元包括以下至少之一：时隙、子帧、符号，符号集合。

[0157] 在本发明的一个实施例中，上述参考信号包括以下至少之一：信道状态信息参考信号CSI-RS；同步信号块SS block。

[0158] 在本发明的一个实施例中，上述装置还包括：确定模块，与上述发送模块64连接，用于可以通过以下至少之一方式确定第一类信令的PRACH资源：通过与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时域位置，确定第一类信令所占用的PRACH资源的时域位置；通过与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH资源，确定第一类信令所占用的PRACH资源；通过满足相同信道特征条件的SS block对应的初始接入的PRACH的时域位置，确定第一类信令所占用的PRACH资源的时域位置；通过满足相同信道特征条件的SS block对应的初始接入的PRACH资源，确定第一类信令所占用的PRACH资源；与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时域偏置，与第一类信令所占用的PRACH资源的时域偏置相同；与第一类信令的PRACH所关联的SS block对应的初始接入的PRACH的时频偏置，与第一类信令所占用的PRACH资源的时频偏置相同；与满足相同信道特征条件的SS block对应的初始接入的PRACH的时域偏置，与第一类信令所占用的PRACH资源的时域位置相同；与满足相同信道特征假设的SS block对应的初始接入的PRACH的时频偏置，与第一类信令所占用的PRACH资源的时频位置相同；其中，满足相同信道特征条件的SS block为与第一类信令所占用的PRACH所关联的CSI-RS的SS block。

[0159] 在本发明的一个实施例中，上述装置还包括：接收模块，与上述发送模块64连接，用于以下至少之一：接收第二通信节点发送的第二类信令，其中，第二类信令中携带预定的PRACH资源，其中，预定的PRACH资源为从已配置或者预定义的PRACH资源集合中选择的PRACH资源；预定的PRACH资源用于指示第一类信令所占用的PRACH资源的时域和/或频域位置；接收第二通信节点发送的第三类信令，其中，第三类信令中携带与第一类信令的PRACH资源所关联的预定的CSI-RS资源和/或SS block；其中，预定的CSI-RS资源和/或SS block为从已配置或者预定义的CSI-RS资源集合和/或SS block集合中选择的，预定的CSI-RS资源和/或SS block与第一类信令所占用的PRACH资源关联。

[0160] 在本发明的一个实施例中，第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的SS block的对应的初始接入的PRACH资源；第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的CSI-RS的满足相同信道特征条件的SS block对应的初始接入的PRACH资源。

[0161] 需要说明的是，第二类信令中包括第一比特地图，其中，第一比特地图中的比特位取值为第一指定值时，PRACH资源集合中与比特位对应的PRACH资源被选择；第三类信令中包括第二比特地图，其中，第二比特地图中的比特位取值为第二指定值时，CSI-RS资源集合和/或SS block集合中与比特位对应的CSI-RS资源和/或SS block被选择。

[0162] 在本发明的一个实施例中，上述接收模块还用于接收第二通信节点配置的频域步进量，其中，频域步进量用于指示位于相同时域单元下的PRACH之间的频域间隔。

[0163] 需要说明的是，通过PUCCH第一类信令和通过PRACH发送第一类信令使用相同的配置信息，其中，配置信息包括以下至少之一：第二通信节点响应窗口持续时间；第二通信节点响应窗口与向第二通信节点发送第一类信令的时间之间的时间偏置；控制信道资源集CORESET资源；搜索空间。

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[0164] 需要说明的是，上述装置可以位于第一通信节点中比如：终端中，但并不限于此。

[0165] 本发明实施例还提供了一种信息发送装置，应用于第一通信节点，图7是根据本发明实施例提供的信息发送装置的结构框图二，如图7所示，该装置包括：

[0166] 接收模块72，用于接收第二通信节点发送的参考信号；

[0167] 确定模块74，与上述接收模块72连接，用于确定与所述参考信号相关的信息，其中，所述信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息；

[0168] 上报模块76，与上述确定模块74连接，用于将确定的所述信息反馈给所述第二通信节点。

[0169] 通过上述装置，由于在接收到第二通信节点发送的参考信号之后将与参考信号相关的信息发送给第二通信节点，即通过第二通信节点指示的方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0170] 需要说明的是，上述信息中包括的参考信号相关索引的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关索引的反馈数目。

[0171] 需要说明的是，在满足以下至少之一条件时，信息中包括参考信号相关索引：参考信号的参考信号接收功率相对于最大的参考信号接收功率的差值，小于或者等于第一门限；参考信号的参考信号接收功率相对于参考信号所在分组内的最大参考信号接收功率的差值，小于或者等于第二门限；参考信号的参考信号接收功率相对于指定参考信号下的参考信号接收功率的差值，小于或者等于第三门限；参考信号的参考信号接收功率，相对于用于计算差分参考信号接收功率的参考功率的差值，小于或者等于第四门限；参考信号的参考信号接收功率，大于或者等于第五门限。

[0172] 需要说明的是，第一门限，第二门限，第三门限，第五门限通过以下之一方式确定：由第二通信节点配置的值，预定义的值；第四门限通过以下之一方式确定：第二通信节点配置的值，由差分参考信号接收功率的变化范围确定的值，预定义的值。

[0173] 需要说明的是，信息包括：第一信息和第二信息；其中，第一信息包括以下至少之一：参考信号相关索引的数目；参考信号分组的数目；参考信号分组的组索引；每个参考信号分组中最大的参考信号的接收功率值；所有参考信号的参考信号接收功率中最大的参考信号接收功率；用于计算差分参考信号接收功率的参考功率；与用于计算差分参考信号接收功率的参考功率所关联的参考信号相关索引；第二通信节点指定的参考信号相关索引；第二通信节点指定的参考信号的参考信号接收功率值；第二信息包括以下至少之一：参考信号相关索引，参考信号接收功率。

[0174] 需要说明的是，第二信息中包括的参考信号接收功率为差分参考信号接收功率。

[0175] 需要说明的是，第二信息中包括的参考信号相关索引用比特地图指示。

[0176] 需要说明的是，上述上报模块76还用于通过以下之一方式反馈第一信息和第二信息：均使用PUCCH资源反馈第一信息和第二信息；均使用PUSCH资源反馈第一信息和第二信息；使用PUCCH资源反馈第一信息，而使用PUSCH反馈第二信息。

[0177] 需要说明的是，在使用PUCCH资源反馈第一信息，使用PUSCH反馈第二信息的情况下，包括以下之一：第二通信节点不具备配置第一信息的能力，其中，第一信息用于指示第一通信节点以差分参考信号接收功率的方式反馈参考信号接收功率；第二通信节点具有配置第一信息的能力；第二通信节点不对第一通信节点配置第一信息；第二通信节点对第一

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通信节点配置第一信息。

[0178] 需要说明的是，第一信息的调制编码方式，与第二信息的调制编码方式不同。

[0179] 在本发明的一个实施例中，上述上报模块76还用于以下至少之一：在参考信号为参考信号分组内的X个参考信号的情况下，以差分参考信号接收功率的形式反馈X个参考信号对应的参考信号接收功率；在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且参考信号为选择的参考信号的情况下，以差分参考信号接收功率的形式反馈与选择的参考信号对应的参考信号接收功率；在参考信号为J个参考信号的情况下，以差分参考信号接收功率的形式反馈与J个参考信号对应的参考信号接收功率；其中，X，Y，D，J为大于或等于1的正整数。

[0180] 需要说明的是，在参考信号为参考信号分组内的X个参考信号的情况下，用于计算X个参考信号的差分参考信号接收功率的参考功率包括以下至少之一：参考信号分组内的指定参考信号的参考信号接收功率；在参考信号分组外的指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；X个参考信号中的指定参考信号的参考信号接收功率。

[0181] 需要说明的是，在从D个参考信号分组的每个参考信号分组中选择Y个参考信号，且参考信号为选择的参考信号的情况下，用于计算选择的参考信号的差分参考信号接收功率的参考功率包括以下至少之一：D个参考信号分组内的指定参考信号的参考信号接收功率；D个参考信号分组外的指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；D个参考信号分组内的Y个参考信号中指定参考信号的参考信号接收功率。

[0182] 需要说明的是，在参考信号为J个参考信号的情况下，用于计算J个参考信号的差分参考信号接收功率的参考功率包括以下至少之一：J个参考信号中指定参考信号的参考信号接收功率；第二通信节点配置的用于计算差分参考信号接收功率的参考值；J个参考信号外的指定参考信号的参考信号接收功率。

[0183] 需要说明的是，在指定参考信号位于一个或多个指定参考信号分组内的情况下，指定参考信号为一个或多个指定参考信号分组内具有最大或者最小参考信号接收功率的参考信号；或者，指定参考信号为所有参考信号中具有最大或者最小参考信号接收功率的参考信号。

[0184] 在本发明的一个实施例中，差分参考信号接收功率的步进量通过以下至少之一方式确定：根据预定义的步进量确定；根据用于计算差分参考信号接收功率的参考功率确定；根据用于计算差分参考信号接收功率的参考功率和第二通信节点配置的门限值确定；其中，通过多个标识反馈多个差分参考信号接收功率的情况下，差分参考信号接收功率的步进量为多个标识中第一标识所指示的第一差分参考信号接收功率与多个标识中第二标识所指示的第二差分参考信号接收功率之差，其中，第一标识与第二标识相邻。

[0185] 需要说明的是，上述第一标识可以是数字，也可以是字母，但并不限于此。

[0186] 需要说明的是，以上述第一标识为数字为例进行说明，即上述多个差分参考信号接收功率可以通过数字方式进行反馈，比如，5个差分参考信号接收功率采用数字12345进行反馈，而数字2标识的差分参考信号接收功率为数字1标识的差分参考信号接收功率加上上述步进量后的值，上述数字3标识的差分参考信号接收功率为数字2标识的差分参考信号

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接收功率加上上述步进量后的值，依次类推。

[0187] 需要说明的是，上述上报模块76还用于通过以下至少之一方式反馈差分参考信号接收功率：对于不同类型的参考信号，以差分参考信号接收功率的形式分别反馈与不同类型的参考信号的参考信号接收功率；对于不同类型的参考信号，以差分参考信号接收功率的形式同时反馈不同类型的参考信号的参考信号接收功率；以差分参考信号接收功率的形式反馈第一类型的参考信号的参考信号接收功率，直接反馈第二类型的参考信号的参考信号接收功率；对于第二通信节点配置的不同参考信号集合，以差分参考信号接收功率的形式分别反馈不同参考信号集合的参考信号接收功率；对于第一通信节点反馈的不同参考信号分组，以差分参考信号接收功率的形式分别反馈不同参考信号分组的参考信号接收功率。

[0188] 需要说明的是，在以下至少之一条件下，上述上报模块76还用于以差分参考信号接收功率的形式反馈参考信号接收功率：参考信号的参考信号类型为指定参考信号类型；参考信号的数目大于或等于预定门限。

[0189] 在本发明的一个实施例中，上述装置还可以包括：获取模块，与上述确定模块74连接，用于获取第二通信节点的配置的用于反馈参考信号相关的信息的报告模式，其中，报告模式包括以下至少之一：第一报告模式和第二报告模式；其中，第一报告模式和第二报告模式之间的关系包括以下至少之一：第一报告模式比第二报告模式有更高的配置优先级；在第一报告模式下用于限定反馈参考信号相关的信息的门限值小于在第二报告模式下用于限定反馈参考信号相关的信息的门限值；在第一报告模式下，向第二通信节点反馈第二通信节点为第一通信节点配置的所有的参考信号相关的信息；在第二报告模式下，向第二通信节点的参考信号相关的信息的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关的信息的反馈数目。

[0190] 需要说明的是，在报告模式为第一报告模式的情况下，参考信号的参考信号接收功率的顺序位置用于指示参考信号的参考信号相关索引。

[0191] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式反馈参考信号接收功率；在第一报告模式下，直接反馈参考信号接收功率，在第二报告模式下，以差分参考信号接收功率的形式反馈参考信号接收功率；在第二报告模式下，直接反馈参考信号接收功率，在第一报告模式下，以差分参考信号接收功率的形式反馈参考信号接收功率。

[0192] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式反馈参考信号接收功率情况下，第一报告模式下的差分报告中的差分参考信号接收功率的步进量与第二报告模式下的差分报告中的差分参考信号接收功率的步进量不同，或者，与第一报告模式下的差分报告中的差分参考信号接收功率的步进量和第二报告模式下的差分报告中的差分参考信号接收功率的步进量分别被配置。

[0193] 需要说明的是，上述装置可以位于第一通信节点比如终端中，但并不限于此。

[0194] 需要说明的是，上述各个模块是可以通过软件或硬件来实现的，对于后者，可以通过以下方式实现，但不限于此：上述模块均位于同一处理器中；或者，上述各个模块以任意组合的形式分别位于不同的处理器中。

[0195] 实施例4

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[0196] 本发明实施例提供了一种信息接收装置，应用于第二通信节点，图8是根据本发明实施例提供的信息接收装置的结构框图一，如图8所示，该装置包括：

[0197] 配置模块82，用于为所述第一通信节点配置以下至少之一信息：第一类信令次数门限，其中，在所述第一类信令的发送次数超过所述第一类信令次数门限的情况下，停止发送所述第一类信令；累计时间门限，其中，在计时单元的计时起点与发送所述第一类信令的时刻之间的时长超过所述累计时间门限的情况下，停止发送所述第一类信令；PUCCH；PRACH；波束恢复的PRACH；

[0198] 接收模块84，与上述配置模块82连接，用于接收第一通信节点发送的第一类信令，其中，所述第一类信令为所述第一通信节点在波束相关参数集合中的K个元素超过与所述K个元素对应的第一类门限的情况下生成的信令；所述第一类信令中携带有与参考信号相关的信息；其中，K为大于或者等于1的整数。

[0199] 通过上述装置，由于在在波束相关参数集合中的K个元素超过与K个元素对应的第一类门限的情况下接收第一通信节点发送的携带有与参考信号相关的信息的第一类信令，即通过第一通信节点主动上报方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0200] 需要说明的是，上述装置可以单独包括接收模块84，也可以同时包括接收模块84和配置模块82，但并不限于此。

[0201] 在本发明的一个实施例中，上述接收模块84还用于通过以下至少之一信道接收所述第一类信令：物理上行控制信道PUCCH，物理随机接入信道PRACH；其中，所述PRACH包括：基于竞争的PRACH或免竞争PRACH。

[0202] 需要说明的是，上述配置模块82还用于根据所述第一通信节点的能力为所述第一通信节点配置所述信息，其中，所述第一通信节点的能力包括以下至少之一：所述第一通信节点支持波束关联的能力，所述第一通信节点支持非波束关联的能力，所述第一通信节点支持部分波束关联的能力，所述第一通信节点的天线参数。

[0203] 需要说明的是，与参考信号相关的信息包括以下至少之一：参考信号索引；信道状态信息；参考信号接收功率。

[0204] 需要说明的是，第一类信令中直接携带与参考信号相关的信息或者第一类信令所使用的时频码资源位置指示与参考信号相关的信息。

[0205] 在本发明的一个实施例中，在N个PRACH所关联的参考信号满足信道特性条件的情况下，N个PRACH资源分配在相同的时域单元中或者N个PRACH支持频分复用FDM；其中，时域单元包括以下至少之一：时隙、子帧、符号，符号集合。

[0206] 在本发明的一个实施例中，上述参考信号包括以下至少之一：信道状态信息参考信号CSI-RS；同步信号块SS block。

[0207] 在本发明的一个实施例中，上述装置还可以包括以下至少之一：发送模块，与上述接收模块84连接，用于向第一通信节点发送第二类信令，其中，第二类信令中携带预定的PRACH资源，其中，预定的PRACH资源为从已配置或者预定义的PRACH资源集合中选择的PRACH资源；预定的PRACH资源用于指示第一类信令所占用的PRACH资源的时域和/或频域位置；向第一二通信节点发送第三类信令，其中，第三类信令中携带与第一类信令的PRACH资源所关联的预定的CSI-RS资源和/或SS block；其中，预定的CSI-RS资源和/或SS block为

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从已配置或者预定义的CSI-RS资源集合和/或SS block集合中选择的，预定的CSI-RS资源和/或SS block与第一类信令所占用的PRACH资源关联。

[0208] 在本发明的一个实施例中，第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的SS block的对应的初始接入的PRACH资源；第一类信令所占用的PRACH资源，为第一类信令所占用的PRACH关联的CSI-RS的满足相同信道特征条件的SS block对应的初始接入的PRACH资源。

[0209] 需要说明的是，第二类信令中包括第一比特地图，其中，第一比特地图中的比特位取值为第一指定值时，PRACH资源集合中与比特位对应的PRACH资源被选择；第三类信令中包括第二比特地图，其中，第二比特地图中的比特位取值为第二指定值时，CSI-RS资源集合和/或SS block集合中与比特位对应的CSI-RS资源和/或SS block被选择。

[0210] 在本发明的一个实施例中，上述配置模块82还用于为第一通信节点配置频域步进量，其中，频域步进量用于指示位于相同时域单元下的PRACH之间的频域间隔。

[0211] 需要说明的是，通过PUCCH第一类信令和通过PRACH发送第一类信令使用相同的配置信息，其中，配置信息包括以下至少之一：第二通信节点响应窗口持续时间；第二通信节点响应窗口与向第二通信节点发送第一类信令的时间之间的时间偏置；控制信道资源集CORESET资源；搜索空间。

[0212] 需要说明的是，上述装置可以位于第二通信节点中，比如终端中，但并不限于此。

[0213] 本发明实施例还提供了一种信息发送装置，应用于第二通信节点，图9是根据本发明实施例提供的信息接收装置的结构框图二，如图9所示，该装置包括：

[0214] 发送模块92，用于向第一通信节点发送参考信号；

[0215] 接收模块94，与上述发送模块92连接，用于接收所述第一通信节点反馈的与所述参考信号相关的信息；其中，所述信息包括以下至少之一：参考信号相关索引的信息，参考信号接收功率的信息。

[0216] 通过上述装置，由于在向第一通信节点发送参考信号之后接收第一通信节点发送的与参考信号相关的信息，即第一通信节点通过第二通信节点指示的方式实现了参考信号相关的信息的上报，因此，可以解决如何上报参考信号相关的信息的问题。

[0217] 需要说明的是，上述信息中包括的参考信号相关索引的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关索引的反馈数目。

[0218] 需要说明的是，在满足以下至少之一条件时，信息中包括参考信号相关索引：参考信号的参考信号接收功率相对于最大的参考信号接收功率的差值，小于或者等于第一门限；参考信号的参考信号接收功率相对于参考信号所在分组内的最大参考信号接收功率的差值，小于或者等于第二门限；参考信号的参考信号接收功率相对于指定参考信号下的参考信号接收功率的差值，小于或者等于第三门限；参考信号的参考信号接收功率，相对于用于计算差分参考信号接收功率的参考功率的差值，小于或者等于第四门限；参考信号的参考信号接收功率，大于或者等于第五门限。

[0219] 需要说明的是，第一门限，第二门限，第三门限，第五门限通过以下之一方式确定：由第二通信节点配置的值，预定义的值；第四门限通过以下之一方式确定：第二通信节点配置的值，由差分参考信号接收功率的变化范围确定的值，预定义的值。

[0220] 需要说明的是，信息包括：第一信息和第二信息；其中，第一信息包括以下至少之

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一:参考信号相关索引的数目;参考信号分组的数目;参考信号分组的组索引;每个参考信号分组中最大的参考信号的接收功率值;所有参考信号的参考信号接收功率中最大的参考信号接收功率;用于计算差分参考信号接收功率的参考功率;与用于计算差分参考信号接收功率的参考功率所关联的参考信号相关索引;第二通信节点指定的参考信号相关索引;第二通信节点指定的参考信号的参考信号接收功率值;第二信息包括以下至少之一:参考信号相关索引,参考信号接收功率。

[0221] 需要说明的是,第二信息中包括的参考信号接收功率为差分参考信号接收功率。

[0222] 需要说明的是,第二信息中包括的参考信号相关索引用比特地图指示。

[0223] 需要说明的是,上述接收模块94接收第一通信节点通过以下之一方式反馈的第一信息和第二信息:均使用PUCCH资源反馈第一信息和第二信息;均使用PUSCH资源反馈第一信息和第二信息;使用PUCCH资源反馈第一信息,而使用PUSCH反馈第二信息。

[0224] 需要说明的是,在使用PUCCH资源反馈第一信息,使用PUSCH反馈第二信息的情况下,上述方法还包括以下之一:第二通信节点不具备配置第一信息的能力,其中,第一信息用于指示第一通信节点以差分参考信号接收功率的方式反馈参考信号接收功率;第二通信节点具有配置第一信息的能力;第二通信节点不对第一通信节点配置第一信息;第二通信节点对第一通信节点配置第一信息。

[0225] 需要说明的是,第一信息的调制编码方式,与第二信息的调制编码方式不同。

[0226] 在本发明的一个实施例中,上述接收模块94还用于以下至少之一:在参考信号为参考信号分组内的X个参考信号的情况下,以差分参考信号接收功率的形式接收X个参考信号对应的参考信号接收功率;在从D个参考信号分组的每个参考信号分组中选择Y个参考信号,且参考信号为选择的参考信号的情况下,以差分参考信号接收功率的形式接收与选择的参考信号对应的参考信号接收功率;在参考信号为J个参考信号的情况下,以差分参考信号接收功率的形式接收与J个参考信号对应的参考信号接收功率;其中,X,Y,D,J为大于或等于1的正整数。

[0227] 需要说明的是,在参考信号为参考信号分组内的X个参考信号的情况下,用于计算X个参考信号的差分参考信号接收功率的参考功率包括以下至少之一:参考信号分组内的指定参考信号的参考信号接收功率;在参考信号分组外的指定参考信号的参考信号接收功率;第二通信节点配置的用于计算差分参考信号接收功率的参考值;X个参考信号中的指定参考信号的参考信号接收功率。

[0228] 需要说明的是,在从D个参考信号分组的每个参考信号分组中选择Y个参考信号,且参考信号为选择的参考信号的情况下,用于计算选择的参考信号的差分参考信号接收功率的参考功率包括以下至少之一:D个参考信号分组内的指定参考信号的参考信号接收功率;D个参考信号分组外的指定参考信号的参考信号接收功率;第二通信节点配置的用于计算差分参考信号接收功率的参考值;D个参考信号分组内的Y个参考信号中指定参考信号的参考信号接收功率。

[0229] 需要说明的是,在参考信号为J个参考信号的情况下,用于计算J个参考信号的差分参考信号接收功率的参考功率包括以下至少之一:J个参考信号中指定参考信号的参考信号接收功率;第二通信节点配置的用于计算差分参考信号接收功率的参考值;J个参考信号外的指定参考信号的参考信号接收功率。

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[0230] 需要说明的是，在指定参考信号位于一个或多个指定参考信号分组内的情况下，指定参考信号为一个或多个指定参考信号分组内具有最大或者最小参考信号接收功率的参考信号；或者，指定参考信号为所有参考信号中具有最大或者最小参考信号接收功率的参考信号。

[0231] 在本发明的一个实施例中，差分参考信号接收功率的步进量通过以下至少之一方式确定：根据预定义的步进量确定；根据用于计算差分参考信号接收功率的参考功率确定；根据用于计算差分参考信号接收功率的参考功率和第二通信节点配置的门限值确定；其中，通过多个标识接收多个差分参考信号接收功率的情况下，差分参考信号接收功率的步进量为多个标识中第一标识所指示的第一差分参考信号接收功率与多个标识中第二标识所指示的第二差分参考信号接收功率之差，其中，第一标识与第二标识相邻。

[0232] 需要说明的是，上述第一标识可以是数字，也可以是字母，但并不限于此。

[0233] 需要说明的是，以上述第一标识为数字为例进行说明，即上述多个差分参考信号接收功率可以通过数字方式进行接收，比如，5个差分参考信号接收功率采用数字12345进行接收，而数字2标识的差分参考信号接收功率为数字1标识的差分参考信号接收功率加上上述步进量后的值，上述数字3标识的差分参考信号接收功率为数字2标识的差分参考信号接收功率加上上述步进量后的值，依次类推。

[0234] 需要说明的是，上述接收模块94还用于可以通过以下至少之一方式接收差分参考信号接收功率：对于不同类型的参考信号，以差分参考信号接收功率的形式分别接收与不同类型的参考信号的参考信号接收功率；对于不同类型的参考信号，以差分参考信号接收功率的形式同时接收不同类型的参考信号的参考信号接收功率；以差分参考信号接收功率的形式接收第一类型的参考信号的参考信号接收功率，直接接收第二类型的参考信号的参考信号接收功率；对于第二通信节点配置的不同参考信号集合，以差分参考信号接收功率的形式分别接收不同参考信号集合的参考信号接收功率；对于第一通信节点接收的不同参考信号分组，以差分参考信号接收功率的形式分别接收不同参考信号分组的参考信号接收功率。

[0235] 需要说明的是，在以下至少之一条件下，以差分参考信号接收功率的形式接收参考信号接收功率：参考信号的参考信号类型为指定参考信号类型；参考信号的数目大于或等于预定门限。

[0236] 在本发明的一个实施例中，上述装置还包括：配置模块与上述接收模块94连接，用于为所述第一通信节点配置用于接收参考信号相关的信息的报告模式，其中，报告模式包括以下至少之一：第一报告模式和第二报告模式；其中，第一报告模式和第二报告模式之间的关系包括以下至少之一：第一报告模式比第二报告模式有更高的配置优先级；在第一报告模式下用于限定接收参考信号相关的信息的门限值小于在第二报告模式下用于限定接收参考信号相关的信息的门限值；在第一报告模式下，向第二通信节点接收第二通信节点为第一通信节点配置的所有的参考信号相关的信息；在第二报告模式下，向第二通信节点的参考信号相关的信息的数目小于或等于第二通信节点为第一通信节点配置的参考信号相关的信息的反馈数目。

[0237] 需要说明的是，在报告模式为第一报告模式的情况下，参考信号的参考信号接收功率的顺序位置用于指示参考信号的参考信号相关索引。

[0238] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式接收参考信号接收功率；在第一报告模式下，直接接收参考信号接收功率，在第二报告模式下，以差分参考信号接收功率的形式接收参考信号接收功率；在第二报告模式下，直接接收参考信号接收功率，在第一报告模式下，以差分参考信号接收功率的形式接收参考信号接收功率。

[0239] 需要说明的是，在第一报告模式和第二报告模式下，分别以差分参考信号接收功率的形式接收参考信号接收功率情况下，第一报告模式下的差分报告中的差分参考信号接收功率的步进量与第二报告模式下的差分报告中的差分参考信号接收功率的步进量不同，或者，与第一报告模式下的差分报告中的差分参考信号接收功率的步进量和第二报告模式下的差分报告中的差分参考信号接收功率的步进量分别被配置。

[0240] 需要说明的是，上述装置可以位于第二通信节点比如基站中，但并不限于此。

[0241] 需要说明的是，上述各个模块是可以通过软件或硬件来实现的，对于后者，可以通过以下方式实现，但不限于此：上述模块均位于同一处理器中；或者，上述各个模块以任意组合的形式分别位于不同的处理器中。

[0242] 实施例5

[0243] 本发明的实施例还提供了一种存储介质，该存储介质包括存储的程序，其中，上述程序运行时执行上述任一项所述的方法。

[0244] 可选地，在本实施例中，上述存储介质可以包括但不限于：U盘、只读存储器(Read-Only Memory，简称为ROM)、随机存取存储器(Random Access Memory，简称为RAM)、移动硬盘、磁碟或者光盘等各种可以存储程序代码的介质。

[0245] 本发明的实施例还提供了一种处理器，该处理器用于运行程序，其中，该程序运行时执行上述任一项方法中的步骤。

[0246] 可选地，本实施例中的具体示例可以参考上述实施例及可选实施方式中所描述的示例，本实施例在此不再赘述。

[0247] 为了更好地理解本发明实施例，以下结合优选的实施例对本发明做进一步解释。

[0248] 优选实施例中的参考信号至少包括如下之一：小区参考信号(CRS)，信道状态信息参考信号(CSI-RS)，波束管理的信道状态信息参考信号，信道状态信息干扰测量信号(CSI-IM)，解调参考信号(DMRS)，下行解调参考信号，上行解调参考信号，信道探测参考信号(SRS)，相位追踪参考信号(PT-RS)，移动相关参考信号(MRS)，波束参考信号(BRS)，波束细化参考信号(BRRS)，随机接入信道信号(RACH)，同步信号(SS)，同步信号块(SS block)，主同步信号(PSS)，副同步信号(SSS)。

[0249] 上述信道特征，可以包括物理传播信道特征，例如水平发送方位角，垂直发送方位角，水平接收方位角，垂直接收方位角等，也包括射频和基带电路的特征，例如天线阵子特征(element pattern)，天线摆放，以及基带时偏，频偏和相位噪声等；

[0250] 需要说明的是，上述波束可以为一种资源(包括如下之一或组合：发端预编码，收端预编码，天线端口，参考信号资源，天线权重矢量，天线权重矩阵等)，波束索引或符号可以被替换为资源索引，因为波束可以与一些时频码资源进行传输上的绑定。波束也可以为一种传输(发送/接收)方式；所述的传输方式可以包括空分复用、频域/时域分集等。

[0251] 上述接收波束指示为发送端可以通过当前参考信号和天线端口与UE反馈报告的

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参考信号(或基准参考信号)和天线端口的准共址(QCL)假设来进行指示。

[0252] 上述接收波束是指,无需指示的接收端的波束,或者发送端可以通过当前参考信号和天线端口与UE反馈报告的参考信号(或基准参考信号)和天线端口的准共址(QCL)指示下的接收端的波束资源。

[0253] 上述准共址(QCL)涉及的参数至少包括,多普勒扩展,多普勒平移,时延拓展,平均时延,平均增益,空间参数和空间接收参数。

[0254] 需要说明的是,在优选实施例中,使用差分参考信号接收功率反馈相当于以差分参考信号接收功率的形式反馈参考信号接收功率。

[0255] 优选实施例1

[0256] 本优选实施例侧重于在触发条件下的用户主动反馈信道质量信息(相当于上述实施例中的参考信号相关的信息),本优选实施例提供了一种信道相关信息的反馈方法,应用于第一通信节点(即UE用户端),该方法包括:根据波束相关参数集合中的K个元素的触发第一类门限生成第一类信令;向第一通信节点所述发送所述第一类信令;其中,K是大于或等于1的整数。该流程,也可以被称为波束恢复,或者用户主动的波束上报。

[0257] 其中,所述的波束相关参数集合,用于信道质量判决,波束相关参数集合包括以下至少之一:N个第一类波束链路的质量;N个第一类波束链路的质量与K个第二类的波束链路质量和的差值或者比值;N个第一类波束链路与K个第二类的波束链路的时频信道响应的相关性、或者频域信道响应的相关性,空域相关性;N个第一类波束链路的方位角与K个第二类的波束链路的方位角的差值或者比值;K个第二类波束链路质量;全部第二类波束链路质量;距离上次上行控制信道或数据信道成功接收的时间累计;未成功接收的累计次数;波束分组的调整信息;所述波束相关参数集合所包括的各个参数的加权值或者加权相关值。进一步的,所述信道质量判决,可以是要求波束相关参数集合中的元素连续C次触发判决门限,其中C是基站配置量,或者预定义量。其中,C为大于或等于1的整数

[0258] 其中,所述第二类波束链路是指来自S个已配置波束链路集合,或者来自S个已配置波束链路集合中已激活的S1个集合;进一步的,第一类波束链路是指,服务波束(serving beam)。

[0259] 所述第一类波束链路是指不来自S个已配置波束链路集合,或者不来自S个已配置波束链路集合中已激活的S1个集合,或者已配置的可选波束;进一步的,第二类波束链路是指,备选波束(candidate beam)

[0260] 所述已配置波束链路,是指第一通信节点报告给第二通信节点的波束链路,或者第二通信节点指示给第一通信节点的波束链路;

[0261] 其中N,S,S1是大于或等于1的整数,并且S1小于或等于S。

[0262] 进一步的,所述波束链路对应于以下之一:发送波束、接收波束、收发波束对、波束组、接收波束组、发送波束组、接收模式、天线组合,控制信道,下行参考信号,上行参考信号。

[0263] 所述波束链路质量包括以下至少之一或者组合:BLER,接收信号功率,RSRP,RSRQ,信道容量,接收端信干噪比,接收端信噪比。

[0264] 此外,第一类信令,可以称为波束恢复请求信令,包括参考信号索引,可选波束序号,或者相关联的信道状态信息(例如RSRP)。第一类信令,可以通过如下的信道传输之一或

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组合进行传输：物理上行控制信道(PUCCH)，物理随机接入信道(PRACH)，其中，物理随机接入信道，为基于竞争的物理随机接入信道或者免竞争的专属物理随机接入信道。

[0265] 图10是根据本发明优选实施例1提供的基于触发条件的信道质量反馈的流程示意图。基站配置周期的CSI-RS，用于检测波束失败。若所述的CSI-RS所关联下的BLER性能大于或者大于等于判决门限后，UE端判定波束失败事件成立(beam failure detection)。此外，基站配置同步块(SS block，SSB)和周期的CSI-RS资源，构成第一类波束链路质量。如果所述的第一类波束链路质量中一个CSI-RS资源所关联的信道质量(例如BLER或者RSRP)触发门限后，UE端宣布发现了新的备选波束(new candidate beam)。

[0266] 当全部的第二类波束链路质量(CSI-RS)触发门限，并且存在一个第一类波束链路质量(例如CSI-RS，或者SS block)触发门限，用户可以启动第一类信令发送流程，即在对应上行资源上，可以发送第一类信令，例如波束恢复请求信令。

[0267] 优选实施例2

[0268] 本优选实施例侧重于第一类信令发送的约束条件，考虑在触发条件满足，或者波束失败(beam failure)的情况下，用户会从备选的波束集合(即已配置的可选波束，第一类波束链路)中选择新的可用波束。但是，需要对于用户端的行为进行限制，可以确保UE在有效的时间约束和次数约束下，快速执行波束恢复流程，进而确保波束恢复性能，防止波束恢复时间过长，UE长时间等待有效波束。

[0269] 具体而言，对于第一类信令，包括如下配置信息之一或组合：第一类信令次数门限，累计时间门限。

[0270] 需要说明的是，上述配置约束条件如下：若配置信息为第一类信令次数门限时，第一类信令次数超过所述的第一类信令次数门限，第二通信节点停止发送第一类信令；或者，若配置信息为累计时间门限时，所关联的计时单元超过所述的累计时间门限，第二通信节点停止发送第一类信令；或者，若配置信息为累计时间门限和第一类信令次数门限时，所关联的计时单元超过所述的累计时间门限，和/或第一类信令次数超过所述的第一类信令次数门限，第二通信节点停止发送第一类信令。

[0271] 此外，考虑第一类信令无法有效发送，(即发生波束恢复失败后)，还包括至少如下之一：在第二通信节点向第一通信节点发送的第一类信令的次数，或者累计时间，或者组合，超过门限后，第二通信节点向高层告知第A类信息；在第二通信节点向第一通信节点发送的第一类信令的次数，或者累计时间，或者组合，超过门限后的Y个时间单位之内，第二通信节点向高层告知第A类信息；其中，Y为大于或等于0的整数。所述的第A类信息，表示波束恢复失败，和/或表示无线链路失效的触发条件。

[0272] 需要说明，关于累计时间的计算起点约束。对于第一类信令发送的约束而言，累计时间的起始点可以为如下之一：1)检测到所关联的链路或者波束失效时刻，或者检测到所关联的链路或者波束失效时刻所关联的时间窗的标记时刻；2)波束失效检测结果触发门限时刻，或者波束失效检测结果触发门限时刻所关联的时间窗的标记时刻3)第一次发送第一类信令时刻，或者第一次发送第一类信令时刻所关联的时间窗的标记时刻；4)第二通信节点配置用于承载第一类信令的上行资源的时刻，或者第二通信节点配置用于承载第一类信令的上行资源的时刻所关联的时间窗的标记时刻；5)第一类信令承载的参考信号索引的发送时刻，或者第一类信令承载的参考信号索引的发送时刻所关联的时间窗的标记时刻；6)

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第一次使用PUCCH发送第一类信令的时刻，或者第一次使用PUCCH发送第一类信令所关联的时间窗的标记时刻；7)第一次使用PRACH发送第一类信令的时刻，或者第一次使用PRACH发送第一类信令所关联的时间窗的标记时刻；其中，所述的时间窗标记时刻是指，所述的时间窗的开始时刻、或者中间时刻、或者结束时刻。

[0273] 需要说明的是，第一类信令的发送次数包括至少如下之一：1)所述的第一类信令次数，指使用PUCCH资源的发送第一类信令次数；2)所述的第一类信令次数，指使用PRACH资源的发送第一类信令次数；3)所述的第一类信令次数，指使用PRACH发送第一类信令次数和PUCCH资源的发送第一类信令次数的总和。

[0274] 优选实施例3

[0275] 本优选实施例侧重于第一类信令关联的PRACH资源的配置方法，由于第一类信令涉及使用PRACH，而在初始接入阶段已经有PRACH资源已经被预先配置，所以对于UE而言，应该限制用于发送第一类信令的PRACH资源配置。另外，因为在初始接入阶段PRACH仅会和SS block关联，但是对于第一类信令而言，可以与CSI-RS，SS block或者CSI-RS和SS block关联。因此，对于基站配置CSI-RS和SS block时，需要满足一定的UE端的假设，以便于UE支持相关的测量和第一类信令的上报。

[0276] 对于PRACH资源分配限制，支持如下至少之一：若N个所述的物理随机接入信道(PRACH)所关联的下行参考信号满足信道特性假设时，则N个PRACH资源分配在相同的时域单元，或者支持频分FDM；第一通信节点，不希望所关联的下行参考信号满足信道特性假设的物理随机接入信道(PRACH)分配在不同的时域单元；其中，所述的时域单元，包括时隙、子帧、符号或者符号集合。进一步的，下行参考信号包括如下之一或者组合：CSI-RS，SS block。

[0277] 具体而言，PRACH资源有如下特征，包括如下至少之一：第一类信令的PRACH所关联的SS block的对应的初始接入的PRACH的时域位置，确定第一类信令的PRACH资源的时域位置；其中，所述的初始接入的PRACH的时域位置，是由第一通信节点向第二通信节点发送的初始接入的PRACH的配置信令实现；而，时域位置，即时域偏置信息。

[0278] 第一类信令的PRACH所关联的SS block的对应的初始接入的PRACH资源，确定第一类信令的PRACH资源；第一类信令的PRACH所关联的CSI-RS的满足相同信道特征假设的SS block的对应的初始接入的PRACH的时域位置，确定第一类信令的PRACH资源的时域位置；第一类信令的PRACH所关联的CSI-RS的满足相同信道特征假设的SS block的对应的初始接入的PRACH资源，确定第一类信令的PRACH资源。

[0279] 第一通信节点，不希望第一类信令的PRACH所关联的SS block的对应的初始接入的PRACH的时域偏置，与第一类信令的PRACH资源的时域偏置不同；或者，第一通信节点，不希望第一类信令的PRACH所关联的SS block的对应的初始接入的PRACH的时频偏置，与第一类信令的PRACH资源的时频偏置不同。

[0280] 时频偏置的基准，可以为每个SS block burst的首个SS block所在的OFDM符号(或者该OFDM符号的首个资源单元(resource element，RE))，或者首个SS block所在的部分带宽(bandwidth part，BWP)的首个资源单元(resource element，RE)。

[0281] 第一通信节点，不希望第一类信令的PRACH所关联的CSI-RS的满足相同信道特征假设的SS block的对应的初始接入的PRACH的时域偏置，与第一类信令的PRACH资源的时域

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位置不同;或者,第一通信节点,不希望第一类信令的PRACH所关联的CSI-RS的满足相同信道特征假设的SS block的对应的初始接入的PRACH的时频偏置,与第一类信令的PRACH资源的时频位置不同;

[0282] 进一步地,从预配置集合中选择部分集合,用于PRACH-beam recovery,其特征包括如下至少之一或组合:第二通信节点向第一通信节点发送第二类信令,从已配置或者预定义的PRACH资源中,指示其中V个PRACH资源,用于指示第一类信令所关联的PRACH资源的时域和/或频域位置;第二通信节点向第一通信节点发送第三类信令,从已配置或者预定义的CSI-RS资源和/或SS block中,指示其中T个CSI-RS资源和/或SS block,与第一类信令的PRACH资源关联;第一类信令所关联的PRACH,使用第一类信令的PRACH所关联的SS block的对应的初始接入的PRACH资源;或者,第一通信节的默认配置如下:第一类信令所关联的PRACH,使用第一类信令的PRACH所关联的SS block的对应的初始接入的PRACH资源;第一类信令所关联的PRACH,使用第一类信令的PRACH所关联的CSI-RS的满足相同信道特征假设的SS block的对应的初始接入的PRACH资源;或者,第一通信节的默认配置如下:第一类信令所关联的PRACH,使用第一类信令的PRACH所关联的CSI-RS的满足相同信道特征假设的SS block的对应的初始接入的PRACH资源;其中,V和T是大于或等于1的整数。进一步的,从已有集合中选择特定集合,可以使用比特地图的方法。具体而言,如果比特地图中比特位指为特定值(例如1)时,表示指示所述比特所关联的PRACH资源。

[0283] 例如,基站已配置了16个周期的CSI-RS资源,而其中4个周期性的CSI-RS资源服务于当前的传输波束(即,第二类波束链路,serving beam),而其余的12个周期的CSI-RS资源用于发现新波束(即,第一类波束链路,new candidate beam identification)。使用比特地图来选择已配置16个周期的CSI-RS资源的4个资源,即比特地图为16'b1111_0000_0000_0000,来表示第二类波束链路;另外,用16个周期的CSI-RS资源中的12资源,即比特地图为16'b0000_1111_1111_1111来选择已配置的另外的12个资源。

[0284] 如果CSI-RS与SS block存在一对一对应关系,则比特地图为16'b0000_1111_1111_1111所对应的SS block所关联的PRACH资源,将会被配置作为第一类信令的专属上报资源。

[0285] 如果每四个CSI-RS与一个SS block关联时,SS block所关联的PRACH时频资源将该四个CSI-RS关联,但是每个CSI-RS将会被配置或者按照预定义规则来使用4个不同的序列来进行区分。

[0286] 此外,在支持配置多个QCL的CSI-RS和SS block的情况下,可以以SS block关联的PRACH为基准,然后以特定的频域步进量,来实现满足QCL关系的CSI-RS和SS block的配置。具体而言,第二通信节点向第一通信节点配置频域步进量,指示位于相同时域单元下的PRACH之间的频域间隔。多个QCL的CSI-RS使用相同的序列,但是通过不同的频域资源来支持基站端对于CSI-RS资源的区分。

[0287] 图11是根据本发明优选实施例3提供的参考信号与PRACH资源关联方法的示意图。假定,系统配置了4个CSI-RS资源作为第二类波束链路(即new candidate beam identification),而该四个CSI-RS资源共同与一个SS block满足信道特征假设(例如spatial QCL)。根据初始接入时SS block和PRACH的配置方法,CSI-RS资源与在相同时域资源,但是不同频域资源的PRACH进行一一映射。其中,第一个CSI-RS直接与SS block所关联

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的PRACH关联，而其余的CSI-RS依次与其他频域位置的PRACH关联。需要说明的是，如果对于SS block下，仅仅有一个CSI-RS被配置，这默认关联与之间满足关联关系的PRACH，即图中的PRACH-0。

[0288] 此外，PUCCH和PRACH都可以用于承载第一类信令，可以共享一些相同配置，或者使用相同的配置或者模式，包括如下至少之一或组合：第二通信节点响应窗口持续时间；第二通信节点响应窗口与第一类信令之间的时间偏置；CORESET资源；搜索空间。

[0289] 优选实施例4

[0290] 本优选实施例中第一通信节点(UE)基于准则反馈小于基站配置反馈限度的行为。

[0291] 通过接收第二通信节点(即，基站端)发送的参考信号，第一通信节点(即，UE端)确定参考信号相关索引，参考信号接收功率，或者参考信号相关索引和参考信号接收功率，进一步的，将所述的参考信号相关索引，或者参考信号接收功率，或者参考信号相关索引和参考信号接收功率，报告给第二通信节点。需要说明，这里参考信号相关索引，是用于指示发送波束信息，因此该报告可以称为波束报告(beam reporting)。通过对于参考信号资源的指示，例如CSI-RS resource或者SS block，来实现对于发送波束或者发送端空间滤波器的指示上报(例如，指示有效波束索引)。

[0292] 需要说明的，参考信号接收功率，是指RSRP(Reference Signal Received Power)，为了便于讨论，本专利下文中使用RSRP来代替参考信号接收功率的描述。

[0293] 在波束报告时，基站配置的参考信号相关索引的反馈数目N，而UE端反馈所述的被报告的参考信号相关索引的数目M，其中M小于或等于N，而M和N是大于或等于0的整数。进一步的，对于参考信号相关索引的反馈准则包括如下至少之一或组合：1)所述参考信号所关联的参考信号接收功率相对于最大的参考信号接收功率的差值，小于或者等于门限T-1；进一步的，T-1是第二通信节点配置，或者由差分的参考信号接收功率变化范围确定，或者在标准预定义；2)所述参考信号所关联的参考信号接收功率，相对于所述参考信号所在分组内最大参考信号接收功率的差值或者特定参考信号下的参考信号接收功率的差值，小于或者等于门限T-2；进一步的，T-2是第二通信节点配置，或者由差分的参考信号接收功率变化范围确定，或者在标准预定义；3)所述参考信号所关联的参考信号接收功率，相对于差分参考信号接收功率的参考功率的差值，小于或者等于门限T-3；进一步的，T-3是第二通信节点配置，或者由差分的参考信号接收功率变化范围确定，或者在标准预定义；4)所述参考信号所关联的参考信号接收功率，大于或者大于等于门限T-4；进一步的，T-4是第二通信节点配置，或者由差分的参考信号接收功率变化范围确定，或者在标准预定义。

[0294] 例如，基站端配置了8个CSI-RS resource用于波束训练，而后配置相关资源用于UE端反馈beam reporting，其中允许反馈4个波束资源。经过对于8个CSI resource进行信道测量后，UE端获得了相对应的RSRP结果如表1所述。其中CRI，为CSI-RS resource indication。

[0295] 表1

[0296]

CRI-0	-79dBm
CRI-1	-60dBm
CRI-2	-96dBm

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CRI-3	-74dBm
CRI-4	-95dBm
CRI-5	-130dBm
CRI-6	-110dBm
CRI-7	-86dBm

[0297] 根据反馈4个波束资源的限制，{CRI-0,CRI-1,CRI-3,CRI-7}以及其相应的RSRP测量结果可以被反馈给基站端。比如：

[0298] 情况1：若基站端配置了一个反馈的最小门限，即-85dB，则CRI-7将不能满足该门限限制，则用户端仅反馈如下信息：{[CRI-0,-79dBm],[CRI-1,-60dBm],[CRI-3,-74dBm]}。

[0299] 情况2：UE端使用4-bit差分上报，每个bit的步进为-1dB，并且最大的接收信号功率为绝对值报告，而其他报告基于其的相对值。具体而言，我们有如下的差分表格如下表2所示。

[0300] 表2

[0301]

4'b0000	-0 dBm
4'b0001	-1 dBm
4'b0010	-2 dBm
... ...	
4'b1111	-15 dBm

[0302] 当执行判定准则“所述参考信号所关联的参考信号接收功率相对于最大的参考信号接收功率的差值”，而判定门限基于差分表格的变化范围15个dB时。在UE端，由于最大的RSRP值为-60dBm，因此仅反馈-75dBm及其以上的波束，所以报告{[CRI-1,-60dBm],[CRI-3,-14dBm(i.e.,4'b1110)]}，而其他波束均不满足该准则。

[0303] 情况3：UE端使用4-bit差分报告，每个bit的步进量为-1dB。并且，最大的接收信号功率为绝对值，而其他报告是基于与之接收功率最接近并且已经可上报的RSRP的差分报告。在UE端，最大的RSRP值为-60dBm，因此，首先差分反馈[CRI-3,-14dBm(i.e.,4'b1110)]，然后基于-74dBm再进行差分上报[CRI-0,-5dBm(i.e.,4'b0101)]，再然后，基于-79dBm再进行差分报告[CRI-7,-7dBm(i.e.,4'b0111)]。在该情况下，UE端报告信息如下：{{[CRI-1,-60dBm],[CRI-3,-14dBm(i.e.,4'b1110)],[CRI-0,-5dBm(i.e.,4'b0101)],[CRI-7,-7dBm(i.e.,4'b0111)]}。

[0304] 需要说明，如果实际差分报告中参考RSRP测量值与报告值不符号时，应该以报告值中的参考RSRP作为基准进行差分报告。

[0305] 优选实施例5

[0306] 本优选实施例中第一通信节点(UE)反馈波束报告分为两个不同部分，进行区分性的反馈。

[0307] 对于波束报告而言，不同的内容下报告的紧迫性和优先级是不同的。因此，建议，将报告的内容才分成两级或者多级，其中每一个级别下有所对应的信息内容和调制编码模式，从而实现对于波束报告的灵活性的要求。

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[0308] 所述的波束报告内容，由第一信息和第二信息构成。其中，第一信息是由如下信息至少之一或组合构成：参考信号相关索引的数目；参考信号分组的数目；参考信号分组的组索引；分组中最大的参考信号的接收功率值；最大的参考信号接收功率值；差分报告中绝对的参考信号接收功率值；差分报告中绝对的参考信号接收功率值所关联的参考信号相关索引；第二通信节点指定的参考信号相关索引；第二通信节点指定的参考信号下的参考信号接收功率值。

[0309] 此外，第二信息是有由参考信号相关索引和/或参考信号接收功率构成。进一步的，对于参考信号分组，也被称为波束分组(beam group)的准则包括如下至少之一或组合：参考信号分组内，不同参考信号不能同时接收；参考信号分组内部，不同参考信号能同时接收；参考信号分组内部，W1个不同参考信号能同时接收；参考信号分组之间，不同参考信号不能同时接收；参考信号分组之间，不同参考信号能同时接收；参考信号分组之间，W2个不同参考信号能同时接收；其中，W1和W2为大于或等于1的正整数。进一步的，W1和W2需要由UE告知给基站，或者基站根据UE的能力确定。

[0310] 进一步的，在第二信息中，参考信号接收功率为相对接收功率；或者，在第二信息中，参考信号相关索引用比特地图指示；或者，第一信息的调制编码方式，与第二信息的调制编码方式不同。

[0311] 进一步的，对于第一信息和第二信息，有如下配置之一：第一信息和第二信息均使用PUCCH资源反馈；第一信息和第二信息均使用PUSCH资源反馈；第一信息使用PUCCH资源反馈，而第二信息使用PUSCH反馈。

[0312] 如果第一信息使用PUCCH资源反馈，而第二信息使用PUSCH反馈时，第二通信节点不能配置差分参考信号接收功率反馈；或者，第二通信节点能配置差分参考信号接收功率反馈；或者，第一通信节点，不希望第二通信节点配置差分参考信号接收功率反馈；或者，第一通信节点，希望第二通信节点配置绝对参考信号接收功率反馈。

[0313] 图12是根据本发明优选实施例5提供的在波束报告反馈方法的示意图一。根据表1所述描述的UE端的RSRP测量结果，UE将反馈内容分成两个部分，即第一信息和第二信息。其中，第一信息，承载最强的RSRP下的参考信号索引，和该索引下的RSRP；而，第二信息，承载其他的参考信号索引和该索引的RSRP。进一步的，第二信息采用差分RSRP报告，而第一信息使用绝对RSRP报告，并且报告结果作为第二报告中差分RSRP的参考值或者参考值之一。

[0314] 图13是根据本发明优选实施例5提供的在波束报告反馈方法的示意图二。根据表1所述的UE端的RSRP测量结果，并且根据分组准则“参考信号分组内部，不同参考信号能同时接收；参考信号分组之间，不同参考信号不能同时接收”。具体而言，根据该准则，UE将{CRI-1,CRI-3}分成第一个波束分组；而{CRI-0,CRI-7}作为第二波束分组，其中分组内不同参考信号可以同时接收，例如通过一个空间接收滤波器或者两个空间接收滤波器。

[0315] 进一步的，UE将反馈内容分成两个部分，即第一信息和第二信息。其中，第一信息承载了第一波束分组(等价于参考信号分组)和第二波束分组下的最强的RSRP的CRI信息和其RSRP；而第二信息，承载所述分组各自的其他CRI信息以及其在以各自分组内绝对RSRP为参考的差分RSRP报告。

[0316] 优选实施例6

[0317] 本优选实施例中，波束分组下的差分参考信号接收信号功率(RSRP)反馈。

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[0318] 在参考信号分组，或者波束分组下，为了节省反馈开销，有必要引入差分的RSRP反馈方法。进一步的，该方法需要明确在分组，特别是多个分组下，参考RSRP的确定与分组之间的关系问题。具体而言，包括如下至少之一或组合：

[0319] a)参考信号分组内，X个参考信号下反馈差分参考信号接收功率；

[0320] b)从D个参考信号分组中，每个分组选择Y个参考信号，则所述的参考信号下反馈差分参考信号接收功率；

[0321] c)在参考信号分组内部和参考信号分组之间，J个参考信号下反馈差分参考信号接收功率；

[0322] 其中X,Y,D,J为大于或等于1的正整数。

[0323] 情况a)，在参考信号分组内，X个参考信号下反馈差分参考信号接收功率时，则所述的差分参考信号接收功率的参考功率可以是以下至少之一：所述分组内，特定参考信号的参考信号接收功率；所述分组外，特定参考信号的参考信号接收功率；基站配置的差分参考信号接收功率报告的参考值；所述的X个参考信号内，特定参考信号的参考信号接收功率。

[0324] 需要说明的是，特定参考信号相当于上述实施例中的指定参考信号。

[0325] 情况b)，在从D个参考信号分组中，每个分组选择Y个参考信号，所述的参考信号下反馈差分参考信号接收功率时，所述的差分参考信号接收功率的参考功率可以是以下至少之一：所述D个参考信号分组内，特定参考信号的参考信号接收功率；所述D个参考信号分组外，特定参考信号的参考信号接收功率；基站配置的差分参考信号接收功率报告的参考值；从所述的D个参考信号分组的Y个参考信号内，特定参考信号的参考信号接收功率。

[0326] 情况c)，在参考信号分组内部和参考信号分组之间，J个参考信号下反馈差分参考信号接收功率时：

[0327] 所述的差分参考信号接收功率的参考功率可以是以下至少之一：所述J个参考信号下，特定参考信号的参考信号接收功率；基站配置的差分参考信号接收功率报告的参考值。所述J个参考信号外，特定参考信号的参考信号接收功率。

[0328] 对于上述的情况a)到情况c)中，所述的特定参考信号为分组内部参考信号下，具有最大或者最小参考信号接收功率的参考信号；或者，所述的特定参考信号为所有参考信号下，具有最大或者最小参考信号接收功率的参考信号。

[0329] 此外，对于差分参考信号接收功率反馈而言，除了参考值外，差分报告的步进量也非常重要。而，所述的差分参考信号接收功率下的步进量，可以通过以下至少之一或组合进行配置：预定义的步进量；根据差分参考信号接收功率的参考功率，确定步进量；根据差分参考信号接收功率的参考功率和第二通信节点配置的门限，确定步进量。

[0330] 而执行差分参考信号接收功率反馈的条件，包括至少如下之一：1)

[0331] 参考信号类型；2)所述的参考信号数目。例如，对于同时支持CSI-RS和SS block进行反馈时，可以仅CSI-RS支持差分报告，而SS block不支持差分报告。或者，CSI-RS和SS block可以分别进行差分报告，这意味着CSI-RS和SS block在差分报告时，RSRP的参考值可以不相关。

[0332] 例如，基站端配置了6个CSI-RS resource用于波束训练，而后配置相关资源用于UE端反馈beam reporting，其中允许反馈2个波束资源，并所述的2个波束资源需要满足可

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以同时接收的假设，即反馈一个波束分组。经过对于6个CSI resource进行信道测量后，UE端获得了相对应的RSRP结果如表1所述。同时，CRI-0和CRI-5可以同时接收，CRI-1和CRI-2和CRI-3和CRI-4可以同时接收。

[0333] 表3

[0334]

CRI-0	-79dBm
CRI-1	-60dBm
CRI-2	-66dBm
CRI-3	-74dBm
CRI-4	-95dBm
CRI-5	-100dBm

[0335] UE端选择了{CRI-1和CRI-2}执行波束分组上报，这时，CRI-1作为在该分组内部具有最大RSRP的参考信号索引，RSRP值{-60dBm}采用绝对或者非差分的RSRP报告；而，CRI-2的RSRP值[-66dBm]使用相对的RSRP报告。根据表2所描述的差分步进关系，则CRI-2下的相关报告为[CRI-2,-6dBm(i.e.,4'b0110)]。因此，该报告的内容信息如下：{[CRI-1,-60dBm],[CRI-2,-6dBm(i.e.,4'b0110)]}

[0336] 若基站配置了UE执行4个波束资源反馈，并所述的4个波束资源需要满足可以同时接收的假设，即反馈一个波束分组。同时，基站配置了波束选择的下限为-90dBm。当差分的步进配置为：分组内部最高的RSRP和基站配置下限的差值时，考虑一共有4-bit可以使用，则步进量计算公式如下：

[0337] Step value＝{Max of RSRP-Threshold}/(2^n-1)

[0338] 其中，Step value表示步进量；Max of RSRP表示最大的RSRP或者是分组内最大的RSRP，或者是参考的RSRP值；Threshold，表示基站配置的门限；而n表示差分报告的比特数。带入公式后，我们有步进量为(-60-(-90))/15＝2dB。另外，考虑CRI-4不满足门限要求，所以UE端仅报告了3个波束信息(即3个参考波束索引)。具体报告信息如下：{[CRI-1,-60dBm],[CRI-2,-6dBm(i.e.,4'b0011)]}{[CRI-3,-14dBm(i.e.,4'b0111)]}。

[0339] 优选实施例7

[0340] 本优选实施例中第二通信节点(gNB)指示下的波束反馈。

[0341] 对于基站配置的用于波束训练的参考信号，优先级可能不同。这主要是因为，一些参考信号可以是用于支持当前的服务波束或者可选波束集合；而，其他参考信号，可能仅仅是用于一般意义上的波束训练，发现新的潜在波束。在这种情况下，基站可以指定特定波束，要求UE一定进行上报，或者优先上报。

[0342] 具体而言，对于所述的第二通信节点(即基站)发送的参考信号，第二通信节点的配置参考信号的报告模式，其中报告模式包括如下至少之一或组合：第一报告模式；第二类报告模式；其中，第一报告模式比第二类报告模式有更高的优先级(或者，要求一定反馈波束报告)；或者，在第一报告模式下的门限，小于第二类报告模式下的门限。具体而言，在第一报告模式下，报告所关联的参考信号的参考信号相关索引和/或参考信号接收功率；在第二类报告模式下，可以报告或者可以不报告，所关联的参考信号的参考信号相关索引和/或参考信号接收功率。

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[0343] 进一步的，由于第一报告模式下参考信号一定需要被反馈，所以UE端可以不同反馈其对应的索引信息，而直接通过隐式的方法来反馈对应关系，例如通过参考信号接收功率的顺序位置指示所述的参考信号索引。

[0344] 对于如何来支持差分RSRP报告而言，第一报告模式与第二类报告模式，分别执行差分参考信号接收功率反馈；或者，第一报告模式下，使用绝对参考信号接收功率反馈，而第二类报告模式下，使用差分参考信号接收功率反馈；或者，第二类报告模式下，使用绝对参考信号接收功率反馈，而第一报告模式下，使用差分参考信号接收功率反馈。进一步的，第一报告模式与第二类报告模式，分别执行差分参考信号接收功率反馈，或者差分报告中步进量不同，或者步进量可以分别被配置。

[0345] 优选实施例8

[0346] 本优选实施例8侧重于根据UE的能力来限制基站配置范围。

[0347] 根据UE端能力的不同，基站侧可以配置的参数需要进行有效的限制，这一方面可以节省配置信令的开销，同时，也会利于信道质量反馈时不必要反馈资源的花费，和避免配置用户端无法支持的配置行为。

[0348] 本发明优选实施例提供了一种配置信息的方法，应用于第二通信节点，包括如下至少之一：

[0349] 由第一通信节点的能力，第二通信节点确定配置约束，涉及至少如下之一或组合：物理上行控制信道(PUCCH)，物理随机接入信道(PRACH)，波束恢复的物理随机接入信道(PRACH)，第一类信令次数门限，累计时间门限。

[0350] 进一步的，第一通信节点的能力涉及如下至少之一或组合：支持波束关联(beam correspondence)；支持非波束关联(non beam correspondence)；支持部分波束关联；天线参数。

[0351] 需要说明的是，所关联的下行参考信号满足信道特性假设的物理随机接入信道(PRACH)分配在相同的时域单元。其中，所述的时域单元，包括时隙、子帧、符号或者符号集合。

[0352] 进一步的，所述的天线参数，包括如下之一或组合：

[0353] 1)天线端口的数目；

[0354] 2)2-D天线组码本的维度大小和2-D天线组码本的个数；

[0355] 3)天线组下的2D波束码本的维度大小和2-D波束码本个数；

[0356] 4)面向大带宽的码本的维度大小和面向大带宽的码本的个数；

[0357] 5)面向小带宽的码本的维度大小和面向小带宽的码本的个数；

[0358] 6)面向极化的码本的维度大小和面向极化的码本的个数；

[0359] 7)码本量化的精度大小；

[0360] 8)下行接收码本是否和2)～5)中全部或任一码本之间关联；

[0361] 9)天线面板的个数；

[0362] 10)天线面板的行数；

[0363] 11)天线面板的列数；

[0364] 12)天线面板的拓扑形状；

[0365] 13)天线面板下的天线元素的行数；

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[0366] 14)天线面板下的天线的列数；

[0367] 15)天线极化特征。

[0368] 综上所述，基于本发明实施例提供的技术方案，对于用户主动的波束上报和基站指示的波束上报进行配置限制和绑定配置，具体包括，对于PRACH和PUCCH资源配置的限定和捆绑，用户主动的波束上报的时间约束配置，基站指示的波束反馈和分组反馈下RSRP差分报告和绝对RSRP报告的配合方法，可以有效提升波束上报的效率和节省配置和实际现实下的花销。

[0369] 显然，本领域的技术人员应该明白，上述的本发明的各模块或各步骤可以用通用的计算装置来实现，它们可以集中在单个的计算装置上，或者分布在多个计算装置所组成的网络上，可选地，它们可以用计算装置可执行的程序代码来实现，从而，可以将它们存储在存储装置中由计算装置来执行，并且在某些情况下，可以以不同于此处的顺序执行所示出或描述的步骤，或者将它们分别制作成各个集成电路模块，或者将它们中的多个模块或步骤制作成单个集成电路模块来实现。这样，本发明不限制于任何特定的硬件和软件结合。

[0370] 以上所述仅为本发明的优选实施例而已，并不用于限制本发明，对于本领域的技术人员来说，本发明可以有各种更改和变化。凡在本发明的原则之内，所作的任何修改、等同替换、改进等，均应包含在本发明的保护范围之内。

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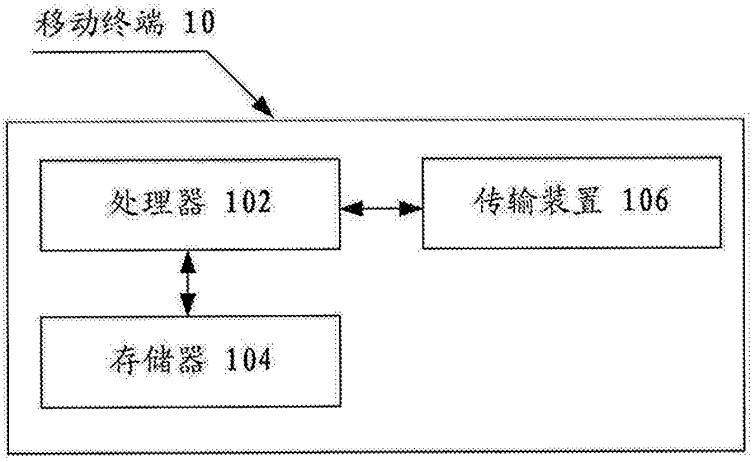


图1

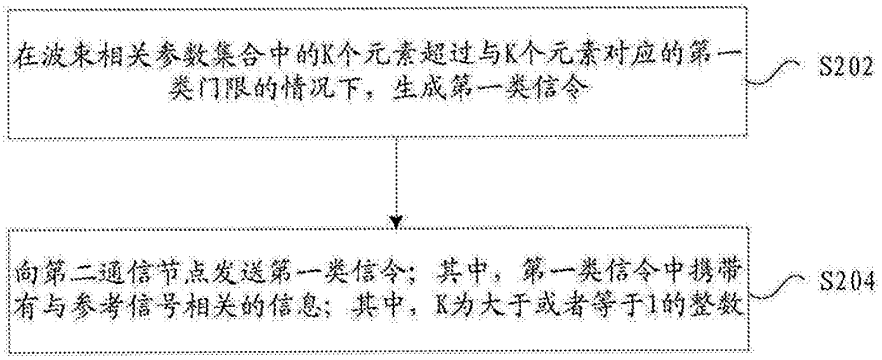


图2

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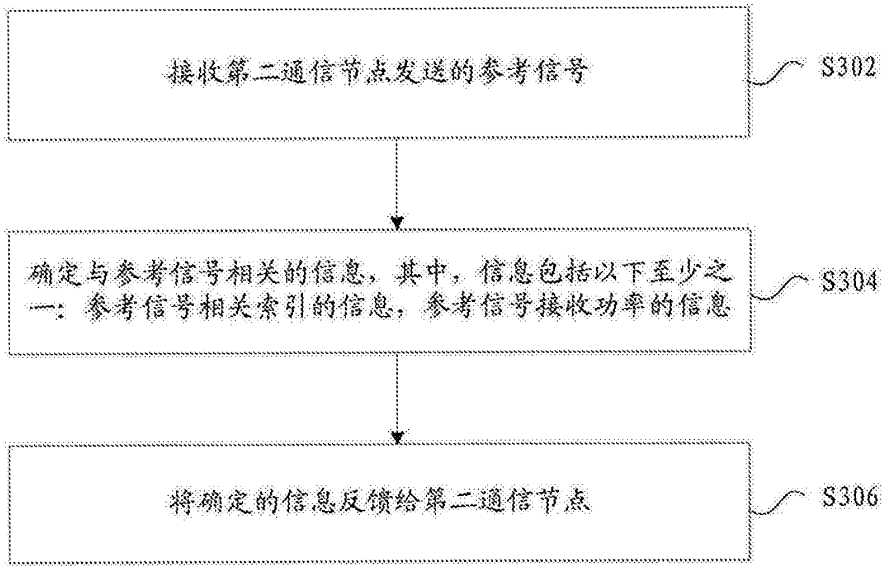


图3

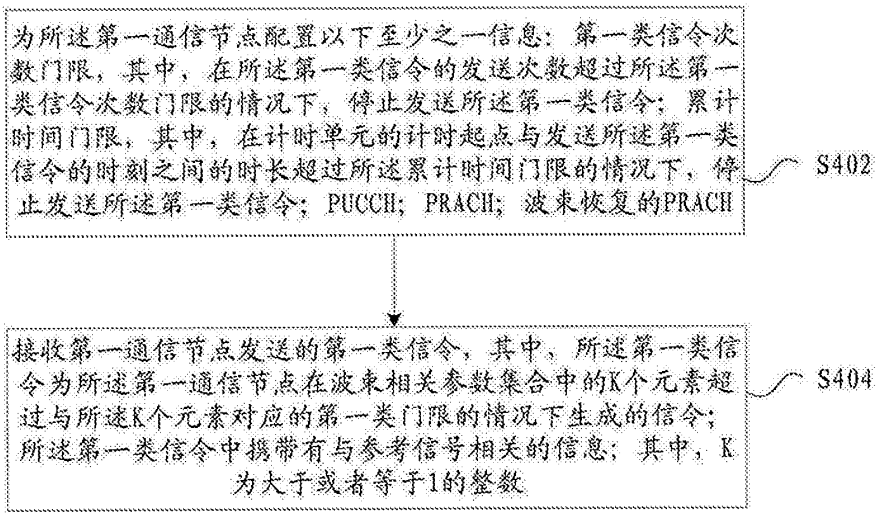


图4

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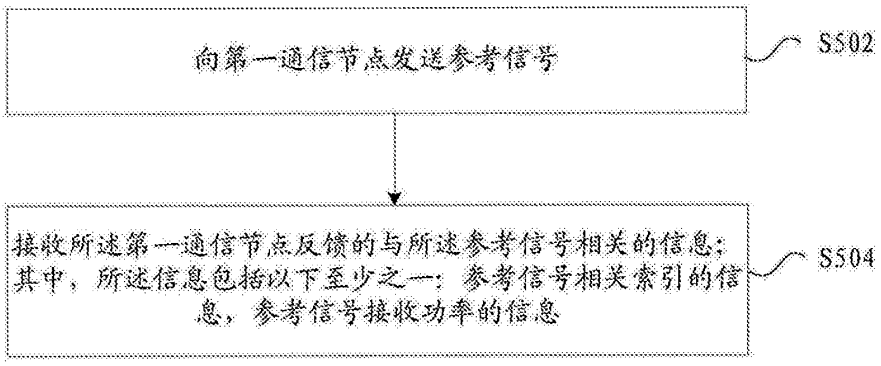


图5

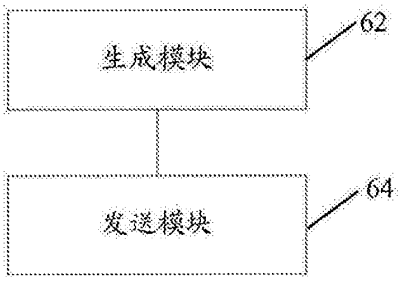


图6

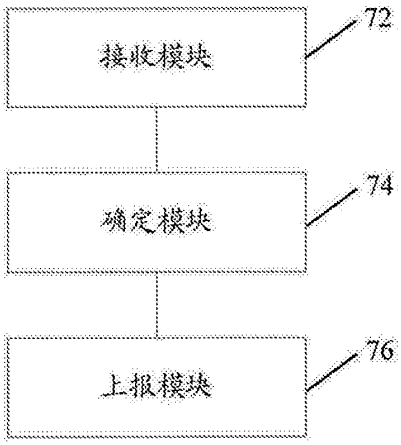


图7

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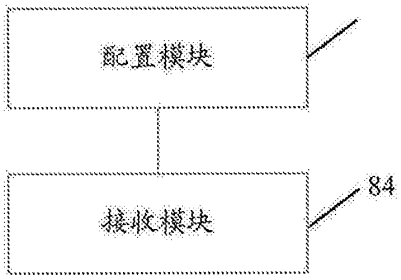

配置模块
接收模块
84

图8

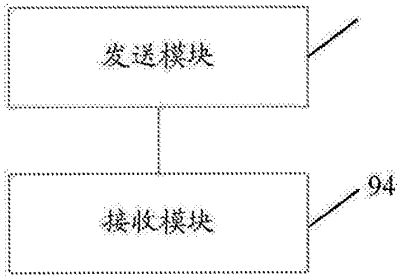

发送模块
接收模块
94

图9

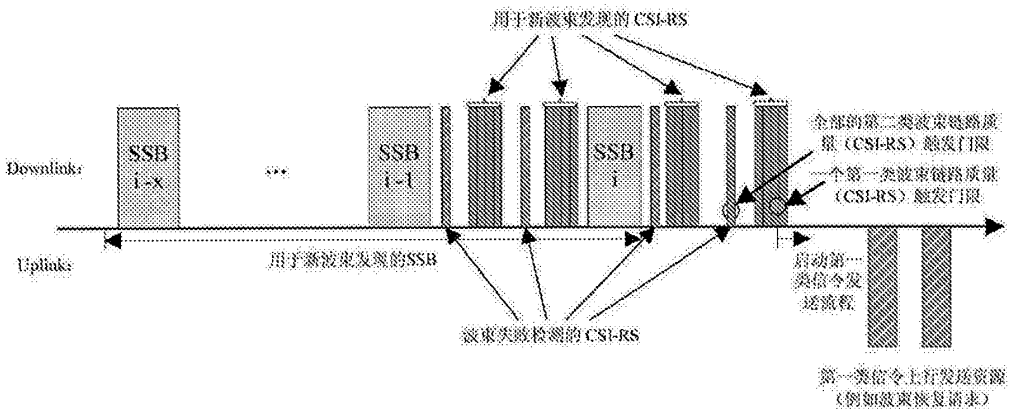

用于新波束发现的 CSI-RS
Downlink
SSB
i-X
...
SSB
i-1
SSB
i
全部的第二类波束链路质量（CSI-RS）触发门限
一个第一类波束链路质量（CSI-RS）触发门限
Uplink
用于新波束发现的SSB
启动第一类信令发送流程
波束失败检测的 CSI-RS
第一类信令上行发送资源（例如波束恢复请求）

图10

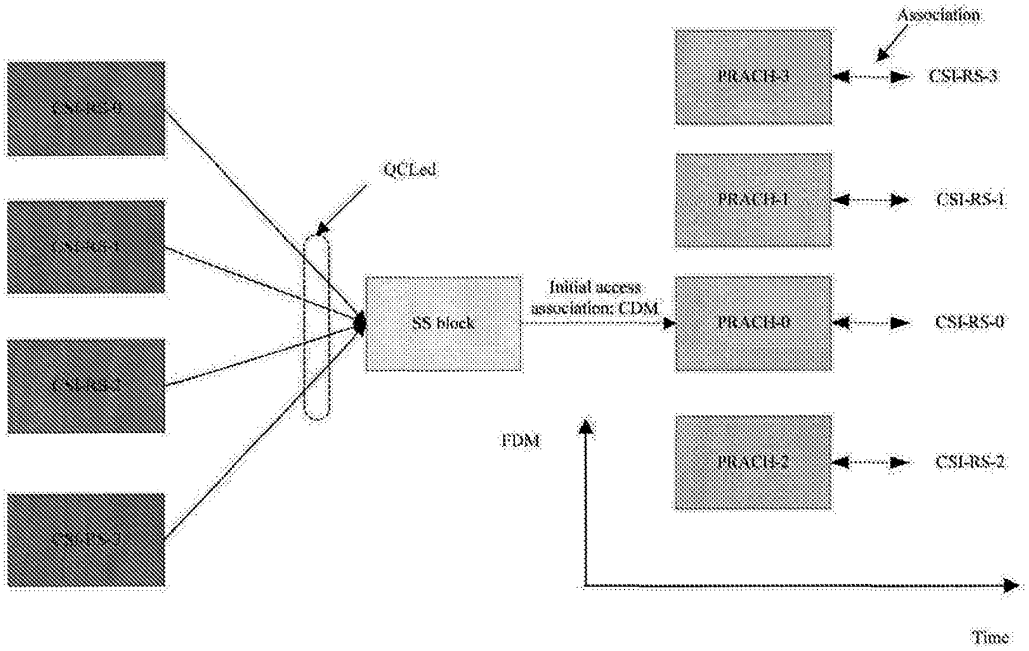


图11

第一报告部分	CRI-1
	CRI-1下的RSRP
第二报告部分	CRI-0
	CRI-0下的差分RSRP
	CRI-3
	CRI-3下的差分RSRP
	CRI-7
	CRI-7下的差分RSRP

图12

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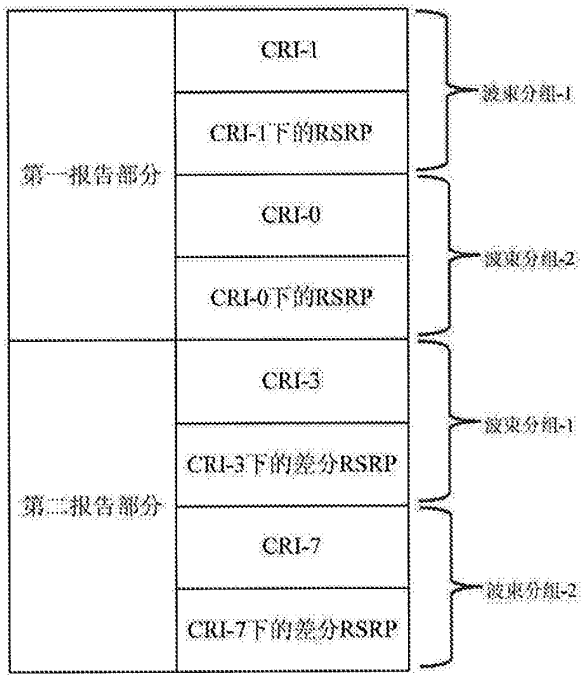


图13

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Espacenet

Bibliographic data: CN113039740 (A) — 2021-06-25

METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

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Applicant(s): FG INNOVATION CO LTD ± (鸿颖创新有限公司)

Classification: - international: ***H04L5/00***
- cooperative: **H04L5/0007 (KR)**; **H04L5/0023 (EP)**; **H04L5/0032 (KR, US)**; **H04L5/0044 (EP)**; **H04L5/005 (EP, KR, US)**; **H04L5/0053 (EP, KR)**; **H04L5/0098 (KR)**; **H04W72/042 (KR, US)**; **H04W72/044 (KR, US)**; **H04W72/048 (KR, US)**; H04L5/0007 (EP); H04L5/0098 (EP)

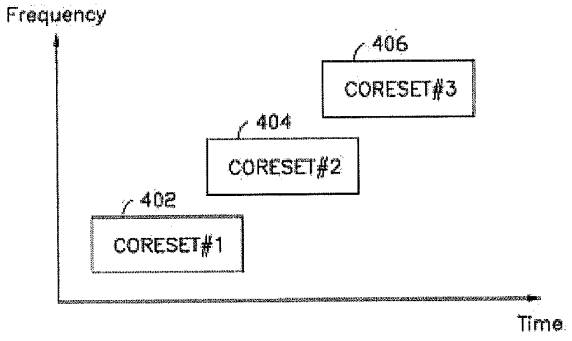
Application number: CN20198071732 20191022 Global Dossier

Priority number(s): US201862754165P 20181101 ; WO2019CN112403 20191022

Also published as: EP3874668 (A1) JP2022506048 (A) KR20210076989 (A) US11057896 (B2) US2020145982 (A1) more

Abstract of CN113039740 (A)

A method of wireless communications is provided. The method includes monitoring, by user equipment (UE), at least one CORESET of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the monitored CORESET(s).



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代理人 李艳霞
(51)Int.Cl.
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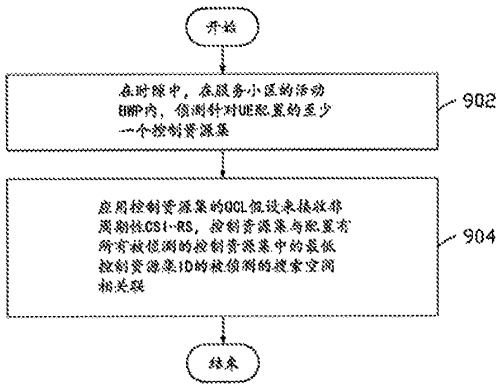
权利要求书3页 说明书16页 附图6页

(54)发明名称

确定用于波束操作的准共址(QCL)假设的方法和装置

(57)摘要

提供了一种无线通信的方法。该方法包括：用户设备(UE)侦测在一个时隙中的服务小区的活动BWP内针对UE配置的多个控制资源集CORESET(CORESET)中的至少一个控制资源集CORESET，以及由UE应用对一个或多个被侦测的控制资源集CORESET的集合中的第一控制资源集CORESET的第一准共址(QCL)假设以接收非周期性的信道状态信息-参考信号(CSI-RS)。第一控制资源集CORESET与被配置有被侦测的控制资源集CORESET中的最低控制资源集CORESET标识(ID)的被侦测的搜索空间相关联。



CN 113039740 A

1.一种用户设备UE,其特征在于,所述UE包括:

一个或多个非暂时性计算机可读介质,所述一个或多个非暂时性计算机可读介质具有包含在其上的计算机可执行指令;以及

至少一个处理器,所述至少一个处理器耦接到所述一个或多个非暂时性计算机可读介质,所述至少一个处理器被配置来执行所述计算机可执行指令以:

侦测在一个时隙中的服务小区的活动BWP内针对所述UE配置的多个控制资源集CORESET中的至少一个CORESET;以及

应用一个或多个被侦测的CORESET集合中的第一CORESET的第一准共址QCL假设以接收非周期性信道状态信息-参考信号CSI-RS;

其中,所述第一CORESET与被配置有一个或多个被侦测的CORESET的集合中的最低CORESET标识ID的被侦测的搜索空间相关联。

2.根据权利要求1所述的UE,其特征在于,所述至少一个处理器进一步被配置来执行所述计算机可执行指令以:

从所述第一CORESET获取调度所述非周期性CSI-RS的下行链路控制信息DCI,其中,携带所述DCI的物理下行控制信道PDCCH的最后一个符号的结束与携带所述非周期性CSI-RS的资源的第一符号的开始之间的调度偏移小于阈值。

3.根据权利要求1所述的UE,其特征在于,所述第一CORESET在一个时域中的至少一个符号中与所述多个CORESET中的第二CORESET重叠,所述第二CORESET是所述多个CORESET中的未被侦测的CORESET,并且所述未被侦测的CORESET与被配置给所述UE的未被侦测的搜索空间相关联。

4.根据权利要求3所述的UE,其特征在于,与所述第一CORESET相关联的所述侦测的搜索空间被配置有第一搜索空间ID,与所述第二CORESET相关联的所述未被侦测的搜索空间被配置有第二搜索空间ID,并且所述第一搜索空间ID低于所述第二搜索空间ID。

5.根据权利要求3所述的UE,其特征在于,所述第二CORESET被配置在以下各项中的一项上:

去激活带宽部分BWP;以及

去激活的辅小区SCell。

6.根据权利要求3所述的UE,其特征在于,所述第二CORESET在时域中的至少一个符号中进一步与所述一个或多个被侦测的CORESET的集合中的第三CORESET重叠。

7.根据权利要求1所述的UE,其特征在于,在所述服务小区的所述时隙和所述活动BWP中提供所述多个CORESET和携带所述非周期性CSI-RS的一个资源。

8.根据权利要求1所述的UE,其特征在于,所述至少一个处理器进一步被配置来执行所述计算机可执行指令以:

从所述第一CORESET获取调度物理下行链路共享信道PDSCH的DCI;以及

当携带所述DCI的PDCCH的最后符号的结束与所述PDSCH的第一符号的开始之间的调度偏移小于阈值时,应用第二CORESET的第二QCL假设以接收所述PDSCH;

其中,所述第二CORESET在一个时域中的至少一个符号中与所述PDSCH重叠。

9.根据权利要求8所述的UE,其特征在于,所述第二CORESET是所述多个CORESET中的未被侦测的CORESET,并且所述未被侦测的CORESET与被配置给所述UE的未被侦测的搜索空间

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相关联。

10.一种用户设备UE,其特征在于,所述UE包括:

一个或多个非暂时性计算机可读介质,所述一个或多个非暂时性计算机可读介质具有包含在其上的计算机可执行指令;以及

至少一个处理器,所述至少一个处理器耦接到所述一个或多个非暂时性计算机可读介质,所述至少一个处理器被配置来执行所述计算机可执行指令以:

侦测在一个时隙中的服务小区的活动BWP内针对所述UE配置多个控制资源集CORESET中的至少一个CORESET;

从物理下行链路控制信道PDCCH接收调度物理下行链路共享信道PDSCH的下行链路控制信息DCI;以及

当携带所述DCI的所述PDCCH的最后符号的结束和所述PDSCH的第一符号的开始之间的调度偏移小于阈值时,将准共址QCL假设用于所述PDCCH的接收以接收所述PDSCH;

其中,所述PDCCH在一个或者多个被侦测的CORESET的集合中的一个CORESET集合中被传输,并且所述一个或者多个被侦测的CORESET集合中的所述一个CORESET集合与被配置有所述一个或者多个被侦测的CORESET集合的集合中的最低控制资源集CORESET标识ID的被侦测的搜索空间相关联。

11.一种无线通信的方法,其特征在于,所述方法包括:

由用户设备UE侦测在一个时隙中的服务小区的活跃BWP内针对所述UE配置的多个控制资源集CORESET中的至少一个CORESET;以及

由所述UE应用一个或多个被侦测的CORESET中的一个CORESET的第一CORESET的第一准共址QCL假设以接收非周期性信道状态信息-参考信号CSI-RS;

其中,所述第一CORESET与被配置有一个或多个被侦测的CORESET的集合中的最CORESET标识ID的被侦测的搜索空间相关联。

12.根据权利要求11所述的方法,其特征在于,所述方法进一步包括:

所述UE从所述第一CORESET获取调度所述非周期性CSI-RS的下行链路控制信息DCI,其中,携带所述DCI的物理下行控制信道PDCCH的最后一个符号的结束与携带所述非周期性CSI-RS的资源的第一符号的开始之间的调度偏移小于阈值。

13.根据权利要求11所述的方法,其特征在于,所述第一CORESET在一个时域中的至少一个符号中与所述多个CORESET中的第二CORESET重叠,所述第二CORESET是所述多个CORESET中的未被侦测的CORESET,并且所述未被侦测的CORESET与被配置给所述UE的未被侦测的搜索空间相关联。

14.根据权利要求13所述的方法,其特征在于,与所述第一CORESET相关联的所述侦测的搜索空间被配置有第一搜索空间ID,与所述第二CORESET相关联的所述未被侦测的搜索空间被配置有第二搜索空间ID,并且所述第一搜索空间ID低于所述第二搜索空间ID。

15.根据权利要求13所述的方法,其特征在于,所述第二CORESET被配置在以下各项中的一项上:

去激活带宽部分BWP;以及

去激活的辅小区SCell。

16.根据权利要求13所述的方法,其特征在于,所述第二CORESET在时域中的至少一个

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符号中进一步与所述一个或多个被侦测的CORESET的集合中的第三CORESET重叠。

17.根据权利要求11的方法，其特征在于，在所述服务小区的所述时隙和所述活动BWP中提供所述多个CORESET和携带所述非周期性CSI-RS的一个资源。

18.根据权利要求11所述的方法，其特征在于，所述方法进一步包括：

所述UE从所述第一CORESET获取调度物理下行链路共享信道PDSCH的DCI；以及

当携带所述DCI的PDCCH的最后符号的结束与所述PDSCH的第一符号的开始之间的调度偏移小于阈值时，由所述UE应用第二CORESET的第二QCL假设以接收所述PDSCH；

其中，所述第二CORESET在一个时域中的至少一个符号中与所述PDSCH重叠。

19.根据权利要求18所述的方法，其特征在于，所述第二CORESET是所述多个CORESET中的未被侦测的CORESET，并且所述未被侦测的CORESET与被配置给所述UE的未被侦测的搜索空间相关联。

确定用于波束操作的准共址(QCL)假设的方法和装置

相关申请的交叉引用

[0001] 本申请要求于2018年11月1日提交的名称为“Method and Apparatus for Spatial QCL assumptions with Overlapped CORESETs”、申请号为62/754,165的美国临时专利申请的权益和优先权,所述申请的代理人案卷号为US75368(下文中称为“US75368申请”)。在此通过引用将US75368申请的公开内容完全并入本申请中。

技术领域

[0002] 本案总体上涉及无线通信,并且更具体地,涉及确定用于波束操作的准共址(Quasi Co-Location,QCL)假设的方法和装置。

背景技术

[0003] 下一代(例如,第五代(fifth generation,5G)新无线电(New Radio,NR))无线通信系统可利用波束成形技术来提供定向通信。例如,用户设备(User Equipment,UE)可以执行波束操作以将其波束切换到传输或接收信道或资源。UE应用的每个波束可以被认为是由相应的QCL假设确定的空间域滤波器。

[0004] 然而,当UE被配置有多个控制资源集CORESET(multiple Control Resource Set,CORESET)时,下一代无线通信系统的当前规范可能导致UE执行不利的波束切换。另外,虽然下一代无线通信系统使得能够利用灵活的资源分配方案,但是由于下一代无线通信系统的当前规范的模糊性,UE可能不能决定使用哪个QCL假设。

[0005] 因此,在本领域中需要当多个控制资源集CORESET被配置给UE时确定用于波束操作的QCL假设的方法和装置。

发明内容

[0006] 本案涉及用于确定QCL假设的方法和装置。

[0007] 根据本案的一个方面,提供了一种UE。所述UE包括:一个或多个非暂时性计算机可读介质,所述一个或多个非暂时性计算机可读介质具有包含在其上的计算机可执行指令,以及至少一个处理器,所述至少一个处理器耦接到所述一个或多个非暂时性计算机可读介质。所述至少一个处理器被配置为执行所述计算机可执行指令以:侦测在一个时隙中的服务小区的活动BWP内针对所述UE配置的多个控制资源集CORESET中的至少一个控制资源集CORESET;以及应用一个或多个被侦测的控制资源集CORESET中的一个控制资源集CORESET的第一控制资源集CORESET的第一QCL假设以接收非周期性信道状态信息-参考信号(Channel Status Information-Reference Signal,CSI-RS);其中,所述第一控制资源集CORESET与被配置有所述一个或多个被侦测控制资源集CORESET的集合中的最低控制资源集CORESET标识(Identity,ID)的被侦测的搜索空间相关联。

[0008] 根据本案的另一方面,提供了一种UE。所述UE包括:一个或多个非暂时性计算机可读介质,所述一个或多个非暂时性计算机可读介质具有包含在其上的计算机可执行指令,

以及至少一个处理器，所述至少一个处理器耦接到所述一个或多个非暂时性计算机可读介质。所述至少一个处理器被配置为执行所述计算机可执行指令以：侦测在一个时隙中的服务小区的活动BWP内针对所述UE配置的多个控制资源集CORESET中的至少一个控制资源集CORESET，从物理下行链路控制信道(Physical Downlink Shared Channel，PDCCH)接收调度物理下行链路共享信道(Physical Downlink Shared Channel，PDSCH)的下行链路控制信息(Downlink Control Information，DCI)，当携带DCI的PDCCH的最后符号与PDSCH的第一符号之间的调度偏移小于阈值时，将QCL假设应用于PDCCH的接收以接收PDSCH。PDCCH可以在一个或多个被侦测的控制资源集CORESET的集合中的一个控制资源集CORESET中被传输，并且一个或多个被侦测控制资源集CORESET的集合中的一个可以与被配置有一个或多个被侦测的控制资源集CORESET的集合中的最低控制资源集CORESETID的被侦测的搜索空间相关联。

[0009] 根据本案的另一方面，提供了一种无线通信的方法。该方法包括：由UE侦测在一个时隙中的服务小区的活动BWP内针对所述UE配置的多个控制资源集CORESET中的至少一个控制资源集CORESET；以及由UE应用一个或多个被侦测的控制资源集CORESET中的一个控制资源集CORESET的第一控制资源集CORESET的第一QCL假设以接收非周期性CSI-RS；所述第一控制资源集CORESET与被配置有所述一个或多个被侦测控制资源集CORESET的集合中的最低控制资源集CORESETID的被侦测的搜索空间相关联。

附图说明

[0010] 当结合附图阅读时，从以下详细描述中最佳地理解本案的方面。不同特征不是按比例绘制的。为了讨论的清楚起见，可以任意增大或减小不同特征的尺寸。

[0011] 图1是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。

[0012] 图2是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。

[0013] 图3是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。

[0014] 图4是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。

[0015] 图5是根据本案的示例性实施方式示出的PDSCH在时域中与控制资源集CORESET重叠的示意图。

[0016] 图6是根据本案的示例性实施方式示出的非周期性CSI-RS、PDSCH和控制资源集CORESET在时域中重叠的示意图。

[0017] 图7是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。

[0018] 图8是根据本案的示例性实施方式示出的经配置用于UE的多个控制资源集CORESET的示意图。

[0019] 图9是根据本案的示例性实施方式示出的在无线通信系统中确定QCL假设的方法的流程图。

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[0020] 图10是根据本案的各个方面示出的针对无线通信的节点的框图。

具体实施方式

[0021] 以下描述包含与本申请中的示例性实施方式有关的特定信息。本案中的附图及其随附详细描述仅仅针对示例性实施方式。然而，本案并不仅仅限于这些示例性实施方式。本领域技术人员将想到本案的其他变化和实施方式。除非另有说明，否则附图中的相同或对应的元件可由相同或对应附图标号指示。此外，本案中的附图和图示通常不是按比例绘制的，并且无意于实际相关尺寸相对应。

[0022] 出于一致性和易于理解的目的，在示例性附图中通过标记标示相同的特征(虽然在一些示例中未示出)。然而，不同实施方式中的特征在其他方面可能不同，因此不应狭义地局限于附图中所示的特征。

[0023] 说明书使用了短语“在一个实施方式中”或“在一些实施方式中”，其可以各自指代相同或不同实施方式的其中一个或多个。术语“耦接”被定义为直接地或通过中间部件间接地连接，并且不一定限于物理连接。在使用术语“包含”时表示“包括但不一定限于”；其具体指明所描述的组合、组、系列和等效物中的开放式包含或隶属成员。表述“A、B和C中的至少一者”或“以下项中的至少一者：A、B和C”表示“仅A，或仅B，或仅C，或A、B和C的任何组合”。

[0024] 另外，出于解释和非限制的目的，对诸如功能实体、技术、协议、标准等具体细节进行阐述，以提供对所描述技术的理解。在其他示例中，省略对公知的方法、技术、系统、架构等的详细描述，以免不必要的细节使描述不清楚。

[0025] 本领域技术人员将立即认识到本案中描述的任何网络功能或算法可由硬件、软件或软件和硬件的组合来实施。所描述的功能可对应于模块，这些模块可以是软件、硬件、固件或其任何组合。软件实施方式可包括存储在诸如存储器或其他类型的存储装置的计算机可读介质上的计算机可执行指令。例如，具有通信处理能力的一个或多个微处理器或通用计算机可使用对应的可执行指令予以编程，并执行所描述的网络功能或算法。这些微处理器或通用计算机可由专用集成电路(Applications Specific Integrated Circuitry，ASIC)、可编程逻辑阵列和/或使用一个或多个数字信号处理器(Digital Signal Processor，DSP)形成。虽然本说明书中描述的若干示例性实施方式是针对在计算机硬件上安装和执行的软件，但是作为固件或硬件或硬件与软件的组合而实施的替代示例性实施方式也在本案的范围内。

[0026] 计算机可读介质包括但不限于随机存取存储器(Random Access Memory，RAM)、只读存储器(Read Only Memory，ROM)、可擦除可编程只读存储器(Erasable Programmable Read-Only Memory，EPROM)、电可擦除可编程只读存储器(Electrically Erasable Programmable Read-Only Memory，EEPROM)、闪存、光盘只读存储器(Compact Disc Read-Only Memory，CD-ROM)、盒式磁带、磁带、磁盘存储器或能够存储计算机可读指令的任何其他等效介质。

[0027] 无线通信网络架构(例如，长期演进(Long Term Evolution，LTE)系统、LTE-Advanced(LTE-Advanced，LTE-A)系统，LTE-Advanced Pro系统或5G NR无线接入网络(Radio Access Network，RAN)通常包括至少一个基站(base station，BS)、至少一个UE以及提供连接到网络的一个或多个可选网络元件。UE通过由一个或多个基站建立的RAN与网

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络(例如,核心网络(Core Network,CN)、演进分组核心(Evolved Packet Core,EPC)网络、演进通用陆地无线接入网(Evolved Universal Terrestrial Radio Access Network,E-UTRAN)、5G核心(5G Core,5GC)或互联网)进行通信。

[0028] 应注意,在本申请中,UE可包括但不限于移动站、移动终端或装置、用户通信无线终端。例如,UE可以是便携式无线电设备,其包括但不限于具有无线通信能力的移动电话、平板电脑、可穿戴装置、传感器、车辆或个人数字助理(Personal Digital Assistant,PDA)。UE被配置来通过空中接口接收信号以及向无线电接入网络中的一个或多个小区传输信号。

[0029] BS可被配置来根据以下无线电接入技术(Radio Access Technologies,RAT)中的至少一个来提供通信服务:全球微波接入互操作性(Worldwide Interoperability for Microwave Access,WiMAX)、全球移动通信系统(Global System for Mobile communications,GSM,通常称为2G)、GSM演进的GSM增强型数据速率无线电接入网络(GSM EDGE Radio Access Network,GERAN)、通用分组无线电业务(General Packet Radio Service,GPRS)、基于基本宽带码分多址(Wideband-Code Division Multiple Access,W-CDMA)的通用移动通信系统(Universal Mobile Telecommunication System UMTS,通常称为3G)、高速分组接入(High-Speed Packet Access,HSPA)、LTE、LTE-A、eLTE(演进型LTE,例如,连接到5GC的LTE)、NR(通常称为5G)和/或LTE-A Pro。然而,本申请的范围不应局限于以上提到的协议。

[0030] BS可包括但不限于:UMTS中的节点B(node B,NB)、LTE或LTE-A中的演进节点B(evolved Node B,eNB)、UMTS中的无线电网络控制器(Radio Network Controller,RNC)、GSM/GERAN中的基站控制器(Base Station Controller,BSC)、与5GC连接的演进通用陆地无线电接入(Evolved Universal Terrestrial Radio Access,E-UTRA)BS中的ng-eNB、5G-RAN中的下一代节点B(generation Node B,gNB)以及能够控制无线通信并管理小区内的无线电资源的任何其他装置。BS可通过无线电接口服务一个或多个UE。

[0031] BS是可操作的以使用形成无线接入网的多个小区来向特定地理区域提供无线电覆盖。BS支持小区的操作。每个小区是可操作的以向其无线电覆盖范围内的至少一个UE提供服务。更具体地,每个小区(通常称为服务小区)提供服务以服务于其无线电覆盖范围内的一个或多个UE(例如,每个小区向其无线覆盖范围内的至少一个UE调度下行链路(Downlink,DL)和可选的上行链路资源,以用于下行链路和可选的上行链路分组传输)。BS可以通过多个小区与无线电通信系统中的一个或多个UE进行通信。小区可分配侧链路(Proximity Service,SL)资源来支持邻近服务(Proximity Service,ProSe)或车联网(Vehicle to Everything,V2X)服务。每个小区可具有与其他小区重叠的覆盖区域。

[0032] 如以上所讨论,针对NR的帧结构要支持灵活的配置以适应各种下一代(例如5G)通信要求,诸如增强型移动宽带(Enhanced Mobile Broadband,eMBB)、海量机器类通信(Massive Machine Type Communication,mMTC)、超可靠通信和低时延通信(Ultra-Reliable and Low-Latency Communication,URLLC),同时满足高可靠性、高数据速率和低时延要求。第三代合作伙伴计划(3^{rd} Generation Partnership Project,3GPP)中所协定的正交频分复用(Orthogonal Frequency-Division Multiplexin,OFDM)技术可用作NR波形的基准。还可以使用可扩展的OFDM参数集,诸如自适应子载波间距、信道带宽和循环前缀

(Cyclic Prefix,CP)。另外,针对NR考虑两种编码方案:(1)低密度奇偶校验(Low-Density Parity-Check,LDPC)码和(2)极化码。编码方案调适可基于信道状态和/或服务应用来配置。

[0033] 此外,以下内容也被考虑,在单个NR帧的传输时间间隔TX中,应至少包括DL传输数据、保护时段和上行链路(Uplink,UL)传输数据,其中例如基于NR的网络动态性,DL传输数据、保护时段、UL传输数据的各个部分也应该是可配置的。此外,还可在NR帧中提供侧链路资源以支持ProSe服务或V2X服务。

[0034] 另外,术语"系统"和"网络"在本文中可以可互换地使用。术语"和/或"在本文中仅是用于描述相关联对象的关联关系,并且表示可存在三种关系。例如,A和/或B可指示:A单独存在,A和B同时存在,或B单独存在。另外,字符"/"在本文中通常表示前者和后者相关联对象处于"或"关系。

[0035] 在一些实施方式中,当在时域中多个搜索空间重叠时,UE可以执行以下过程以确定默认PDSCH波束:

>对于侦测与不同控制资源集 CORESET 相关联的多个搜索空间的 UE,对于单个小区操作或者对于相同频带中与载波聚合(CA)的操作,

>如果搜索空间的侦测时机在时域中重叠,并且搜索空间与具有不同准共址(QCL)-TypeD 属性的不同控制资源集 CORESET 相关联,UE 可以侦测与给定的控制资源集 CORESET 相关联的搜索空间,该搜索空间包含服务小区中具有最低服务小区索引的活动 DL BWP 中的活动 DL BWP 中的公共搜索空间(Common Search Space,CSS),以及给定控制资源集 CORESET 相同的 QCL-TypeD 属性相关联的任何其他控制资源集 CORESET,

>如果两个或更多个控制资源集 CORESET 包含 CSS,则 UE 可以选择在具有最低服务小区索引的服务小区中的活动 DL BWP 中的侦测时机中的包含具有最低搜索空间 ID 的搜索空间的控制资源集 CORESET,并且

>如果没有控制资源集 CORESET 包含 CSS,则 UE 可以选择在具有最低服务小区索引的服务小区中的活动 DL BWP 中的侦测时机中的包含具有最低搜索空间 ID 的搜索空间的控制资源集 CORESET。

[0036] 为此,关于同步信号块(Synchronization Signal Block,SSB)的QCL假设和关于信道状态信息-参考信号(Channel Status Information-Reference Signal,CSI-RS)(或跟踪参考信号(Tracking Reference Signal,TRS))的QCL假设可以被认为是两个不同的QCL假设,即使CSI-RS源自相同的SSB。QCL假设可基于不同参数,例如空间域QCL参数(例如,

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QCL TypeD参数)，或基于平均延迟、延迟扩展、多普勒频移和多普勒扩展中的至少一者获取的QCL参数。

[0037] 此外，UE可以执行如下的过程：

> >如果 DL DCI 的接收和对应的 PDSCH 的接收之间的调度偏移（例如，这意味着携带 DCI 的 PDCCH 的最后符号和 PDSCH 的第一符号之间的时间间隔）小于阈值（例如，阈值-调度-偏移），UE 可以假设服务小区的 PDSCH 的解调-参考信号（Demodulation-Reference Signal，DM-RS）端口相对于 QCL 假设，与传输配置指示（Transmission Configuration Indication，TCI）状态的 RS 准共址，QCL 假设可用于最新时隙中的最低控制资源集 CORESET ID 的 PDCCH QCL 指示，其中为 UE 配置服务小区的活跃 BWP 中的最新时隙中的一个或多个控制资源集 CORESET。

[0038] 以这种方式，如果PDSCH的DM-RS的QCL假设不同于在时域中的至少一个符号中与PDSCH重叠的PDCCH的DM-RS的假设，则可以期望UE优先与该控制资源集CORESET相关联的PDCCH的接收。这也可以应用于带内CA情况(例如，PDSCH和控制资源集CORESET在不同的分量载波(Component Carrier，CC)中)。

[0039] 在本实施方式的一些实施方式中，UE可以配置有多个控制资源集CORESET，但不是所有的控制资源集CORESET都可以由UE侦测。例如，如果UE配置有在时域中的至少一个符号(例如，OFDM符号)中彼此重叠的两个控制资源集CORESET，则UE可以基于特定优先级规则或预配置来选择这些控制资源集CORESET中的一个控制资源集CORESET进行侦测。

[0040] 在本实施方式的一些实施方式中，如果所侦测的控制资源集CORESET与CSS和最低搜索空间ID相关联，则UE可以对控制资源集CORESET进行优先化和侦测。相比之下，未被侦测的控制资源集CORESET可为例如由于QCL-TypeD冲突而与未被侦测的搜索空间配置相关联的控制资源集CORESET。未被侦测的控制资源集CORESET可以被配置在去激活的BWP上、去激活的辅小区(Secondary Cell，SCell)上、或者服务小区的与其他被侦测的控制资源集CORESET相同的活动BWP上。在一些其他的实施方式中，未被侦测的控制资源集CORESET可以包含与对应于同步信号(Synchronization Signal，SS)/物理广播信道(Physical Broadcast Channel，PBCH)块的至少一个资源元素(Resource Element，RE)重叠的PDCCH。在一些其他的实施方式中，未被侦测的控制资源集CORESET可以是被配置用于在非连续接收(Discontinuous Reception，DRX)模式下操作的UE的控制资源集CORESET。

[0041] 用于默认PDSCH波束的未被侦测的控制资源集CORESET

[0042] 在一些实施方式中，当未被侦测的控制资源集CORESET具有配置的控制资源集CORESET中的最低控制资源集CORESET ID时，未被侦测的控制资源集CORESET可以被用于接收PDSCH的波束指示。

[0043] 例如，如果DL DCI的接收和对应的PDSCH之间的调度偏移小于阈值(例如，阈值-调度-偏移)，UE可假设PDSCH的DM-RS端口相对于QCL假设与处于TCI状态的RS准共址。QCL假设可以用于在最新时隙中具有最低控制资源集CORESET ID的PDCCH QCL指示(例如，控制资源

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集CORESET)，其中为UE配置服务小区的活跃BWP中的最新时隙中的一个或多个控制资源集CORESET。

[0044] 图1是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。如图1所示，UE配置有时域中的至少一个符号中重叠的两个控制资源集CORESET，控制资源集CORESET#1 102和控制资源集CORESET#2 104。UE可以从控制资源集CORESET#2 104接收DCI以调度PDSCH106。由于例如优先级规则，控制资源集CORESET#1 102可以不被UE侦测(例如，控制资源集CORESET#1102未被配置有CSS，和/或与具有最低搜索空间ID的未被侦测的搜索空间相关联)。未被侦测的搜索空间可以具有在与该未被侦测的搜索空间重叠的那些搜索空间中的最低搜索空间ID。例如，如果控制资源集CORESET#1 102与配置有第一搜索空间ID的未被侦测的搜索空间相关联，并且控制资源集CORESET#2 104与配置有第二搜索空间ID的侦测搜索空间相关联，则第一搜索空间ID可以低于第二搜索空间ID。

[0045] 目前，假设控制资源集CORESET#1 102具有最低的控制资源集CORESET ID，如果控制资源集CORESET#2 104与对应的PDSCH 106之间的调度偏移11小于阈值(例如，阈值-调度-偏移)，由控制资源集CORESET#1 102的TCI状态确定的RX波束可能需要用于接收PDSCH106。在这种情况下，为了遵循3GPP规范，UE被迫针对控制资源集CORESET#2104和PDSCH106使用不同的RX波束。然而，这种类型的波束切换是不期望的并且需要被防止。

[0046] 情况1.1

[0047] 在本实施方式的一些实施方式中，具有最低控制资源集CORESET ID的控制资源集CORESET可以不被视为未被侦测的控制资源集CORESET。在这种情况下，如果搜索空间的侦测时机在时域上重叠，并且搜索空间与具有不同QCL-TypeD属性的不同控制资源集CORESET关联，UE可以在具有最低服务小区索引的服务小区的活动DL BWP中的侦测时机中选择具有最低控制资源集CORESET ID的控制资源集CORESET。可侦测与具有相同QCL-TypeD参数的控制资源集CORESET相关联的任何重叠搜索空间。

[0048] 在一些其他的实施方式中，UE可以根据预定义的优先级顺序(从高优先级到低优先级)选择以下控制资源集CORESET来侦测：

1)与CSS相关联的控制资源集CORESET；

2)与具有最低搜索空间ID的搜索空间相关联的控制资源集CORESET；以及

3)包含最低控制资源集CORESET ID的控制资源集CORESET。

[0049] 当两个或多个控制资源集CORESET在时域中重叠时，该优先级规则可以被用于确定RX波束的QCL假设。

[0050] 情况1.2

[0051] 在本实施方式的一些实施方式中，为了避免不利的波束切换，未被侦测的控制资源集CORESET可以对UE是透明的。例如，如果DL DCI的接收和对应的PDSCH之间的调度偏移小于阈值(例如，阈值-调度-偏移)，则UE可假设PDSCH的DM-RS端口相对于QCL假设与处于TCI状态的RS准共址。QCL假设可以用于在最新时隙中具有最低控制资源集CORESET ID的被侦测的PDCCH QCL指示，其中为UE配置服务小区的活跃BWP中的最新时隙中的一个或多个控制资源集CORESET。

[0052] 在这种情况下，未被侦测的PDCCH/控制资源集CORESET可不被用于被调度的PDSCH的接收的QCL假设。

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[0053] 在本实施方式的一些实施方式中，当UE在具有最低服务小区索引的服务小区的活动DL BWP中优先侦测与给定控制资源集CORESET(包含被侦测的PDCCH)相关联的搜索空间时，PDCCH是被侦测的PDCCH。这个UE可以被配置为侦测与不同控制资源集CORESET相关联的多个搜索空间(例如，针对单个小区操作或者针对利用相同频带中的CA的操作)。

[0054] 情况1.3

[0055] 在本实施方式的一些实施方式中，未被侦测的控制资源集CORESET可以被UE视为未经配置的控制资源集CORESET。例如，当UE不侦测控制资源集CORESET时，用于控制资源集CORESET的RRC配置可以不用于其他目的，但是当在后续时隙中的两个或更多个控制资源集CORESET之间不存在冲突时，RRC配置可以仍然由UE存储并且再次变得有效。UE操作的实例描述如下：

>对于侦测与不同控制资源集 CORESET 相关联的多个搜索空间的 UE，对于单个小区操作或者对于相同频带中的 CA 的操作，

>如果搜索空间的侦测时机在时域上存在重叠且搜索空间与具有不同的 QCL-TypeD 属性的控制资源集 CORESET 关联，且搜索空间没有被 UE 侦测，

>UE 未侦测的控制资源集 CORESET 对 UE 是透明的，在对应的时隙中被处理为空白 RE；或

>至少，UE 未侦测的控制资源集 CORESET 可以不被用于波束指示或 QCL 指示的目的。

[0056] 在本实施方式的一些实施方式中，UE可以维护和存储未被侦测的控制资源集CORESET的RRC配置。该RRC配置可以经由MAC-CE和/或DCI来更新。

[0057] 在一些其他的实施方式中，UE可以释放针对未被侦测的控制资源集CORESET的RRC配置。释放的RRC配置可以不被UE更新或存储。

[0058] 情况1.4

[0059] 当前，在未被侦测的控制资源集CORESET上不存在明确的措辞：其QCL假设应当由重叠的侦测的控制资源集CORESET维护、无效、或覆盖。该问题的示例性解决方案被描述为以下不同的情况。

[0060] 情况1.4.1

[0061] 在情况1.4.1中，UE可以存储和维持未被侦测的控制资源集CORESET的QCL假设。UE操作的实例描述如下：

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>对于侦测与不同控制资源集 CORESET 相关联的多个搜索空间的 UE，对于单个小区操作或者对于利用相同频带中的 CA 的操作，

>如果搜索空间的侦测时机在时域上存在重叠且 UE 未侦测到一个或多个搜索空间，

>UE 可以存储和维持针对非未被侦测的控制资源集 CORESET 的 QCL 假设。

[0062] 在本实施方式的一些实施方式中，可以经由MAC-CE和/或DCI来更新未被侦测的控制资源集CORESET的QCL假设。

[0063] 在本实施方式的一些实施方式中，如果UE支持多个RX波束，则可以使用未被侦测的控制资源集CORESET的QCL假设。

[0064] 在本实施方式的一些实施方式中，未被侦测的控制资源集CORESET的QCL假设可以被用于这个控制资源集CORESET在时域中的未重叠符号。

[0065] 在本实施方式的一些实施方式中，未被侦测的控制资源集CORESET的QCL假设可以被用作波束指示、QCL指示或是QCL链的一部分。

[0060] 情况1.4.2

[0060] 在情况1.4.2中，UE可以释放或者暂停未被侦测的控制资源集CORESET的QCL假设。UE操作的实例描述如下：

>对于侦测与不同控制资源集 CORESET 相关联的多个搜索空间的 UE，对于单个小区操作或者对于相同频带中的 CA 的操作，

>如果搜索空间的侦测时机在时域上存在重叠且 UE 未侦测到一个或多个搜索空间，

>UE 可以释放针对与这个搜索空间相关的未被侦测的控制资源集 CORESET 和未重叠的控制资源集 CORESET 的 QCL 假设，或者

> UE 可暂停针对时隙的 QCL 假设，其中控制资源集 CORESET 重叠且未被 UE 侦测，但将针对未重叠的控制资源集 CORESET 的 QCL 假设保持在相同的搜索空间中，或者

> UE 可以释放或暂停针对未被侦测的控制资源集CORESET的重叠部分的QCL假设，但是保持针对控制资源集CORESET的未重叠部分（例如，在一个或两个 OFDM 符号内）使用配置的 QCL 假设。

[0068] 选项#3

[0069] 在该选项中，UE可以通过另一QCL假设来覆盖未被侦测的控制资源集CORESET的

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QCL假设。UE操作的实例描述如下：

>对于侦测与不同 CORESET 相关联的多个搜索空间的 UE，对于单个小区操作或者对于在相同频带中的 CA 的操作，

>如果搜索空间的侦测时机在时域上存在重叠且 UE 未侦测到一个或多个搜索空间，

>UE 可以通过被侦测的 CORESET 来覆盖针对未被侦测的控制资源集 CORESET 的 QCL 假设。

[0070] 在本实施方式的一些实施方式中，未被侦测的控制资源集CORESET的QCL假设可以仅在未被侦测的控制资源集CORESET的重叠符号中被覆盖。

[0071] 在一些其他的实施方式中，可在未被侦测的控制资源集CORESET的整个时间间隔中覆盖未被侦测的控制资源集CORESET的QCL假设。

[0072] 用于无线电链路侦测器(RADIOLINK MONITOR,RLM)RS选择的非选择控制资源集CORESET

[0073] 在一些实施方式中，针对UE的RLM RS选择过程被描述如下：

>UE 不需要使用非周期性或半永久 RS 进行无线电链路侦测，并且

>UE 在与具有最短侦测周期的搜索空间相关联的控制资源集 CORESET 中选择被提供用于 PDCCH 接收的活动 TCI 状态的 N_{RLM} RS，并且

>如果多个 CORESET 与具有相同周期的搜索空间相关联，则 UE 可以选择具有最高控制资源集 CORESET ID 的控制资源集 CORESET。

[0074] 图2是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。如图2所示，UE被配置有控制资源集CORESET#1 202、控制资源集CORESET#2 204和控制资源集CORESET#3 206，其中控制资源集CORESET#1 202在时域中的至少一个符号上与控制资源集CORESET#2 204重叠。

[0075] 假设控制资源集CORESET#1 202具有比重叠的控制资源集CORESET#2 204更高的控制资源集CORESET ID，则在UE未侦测控制资源集CORESET#2 204的情况下，上述RLM RS选择过程可能是不明确的。

[0076] 鉴于此问题，一些实施方式提供用于改善针对RLM RS选择过程的UE行为的方法。

[0077] 情况2.1

[0078] 在此情况下，当存在被配置给UE的多个控制资源集CORESET时，UE可以选择具有最低控制资源集CORESET ID的控制资源集CORESET来侦测。RLM RS选择过程如下文所述：

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>UE不需要使用非周期性或半永久RS进行无线电链路侦测，并且

>UE 在与具有最短侦测周期的搜索空间相关联的控制资源集CORESET中选择被提供用于PDCCH接收的活动TCI状态的N_{RLM} RS，并且

>如果多个CORESET与具有相同周期的搜索空间相关联，则UE可以选择具有包含活动的TCI状态的最低控制资源集CORESET ID的控制资源集CORESET来侦测。

[0079] 情况2.2

[0080] 在这种情况下，为了避免不存在用于选择的TCI状态(或者TCI状态无效)的情况，所选择的控制资源集CORESET可以是在RLM RS选择过程期间由UE侦测控制资源集CORESET且配置有TCI状态的控制资源集CORESET。

[0081] 用于默认的非周期性CSI-RS波束的未被侦测的控制资源集CORESET

[0082] 在一些实施方式中，如果在与非周期性CSI-RS相同的符号中不存在被传输的PDSCH，则可从具有最低控制资源集CORESET ID的控制资源集CORESET导出非周期性CSI-RS的默认QCL假设。下面描述由UE应用的用于确定默认QCL假设的示例过程：

>UE在对调度PDSCH的DCI译码成功后，如果与CSI-RS相同的符号中只有PDSCH被传输，非周期性CSI-RS的默认QCL假设可遵循PDSCH的QCL假设（假设DCI的接收与PDSCH之间的调度偏移大于或等于阈值），并且

>如果在与CSI-RS相同的符号中不存在PDSCH被传输，则可从具有最低控制资源集CORESET ID的控制资源集CORESET导出非周期性CSI-RS的默认QCL假设。

[0083] 如上所述，具有最低控制资源集CORESET ID的控制资源集CORESET可以是未被侦测的控制资源集CORESET。如果未被侦测的控制资源集CORESET被用于波束指示，则可能发生不利的波束切换，如图3所示。

[0084] 图3是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。如图3所示，UE被配置有在时域中的至少一个符号中重叠的两个控制资源集CORESET，控制资源集CORESET#1 302和控制资源集CORESET#2 304。另外，UE可以从控制资源集CORESET#2 304接收DCI以在资源306中发送非周期性CSI-RS。

[0085] 假设控制资源集CORESET#1 302具有最低的控制资源集CORESET ID并且不被UE侦测，基于上述过程，当控制资源集CORESET#2 304中的DCI的接收与资源306之间的调度偏移31小于阈值(例如，阈值-调度-偏移)时，控制资源集CORESET#1 302可被用于接收携带非周期性CSI-RS的资源306的波束指示(或QCL假设)，但这可能导致不利的波束切换。

[0086] 鉴于该问题，在本实施方式的一些实施方式中，具有最低控制资源集CORESET ID

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的控制资源集CORESET可以被期望由UE侦测并且包含至少一个激活的TCI状态。

[0087] 图4是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。如图4所示，UE被配置有控制资源集CORESET#1 402、控制资源集CORESET#2 404和控制资源集CORESET#3 406。控制资源集CORESET#1 402可以在时域中的至少一个符号中与控制资源集CORESET#2 404重叠，并且控制资源集CORESET#2 404可以在时域中的至少一个符号中进一步与控制资源集CORESET#3 406重叠。

[0088] 在此示例性实施方式中，UE可仅侦测控制资源集CORESET#1 402，或同时侦测控制资源集CORESET#1 402和控制资源集CORESET#3 406两者。如果UE侦测控制资源集CORESET#1 402和控制资源集CORESET#3 406，则控制资源集CORESET#2 404可以是仅有的未被侦测的控制资源集CORESET，并且其针对波束指示的QCL假设可以遵循在本案中描述的过程。相比之下，如果UE仅侦测控制资源集CORESET#1 402，则控制资源集CORESET#2 404和控制资源集CORESET#3 406两者可以变为重叠的未被侦测的控制资源集CORESET，并且其针对波束指示的QCL假设可以保持相同的空间QCL，或者被具有最低控制资源集CORESET ID的未被侦测的控制资源集CORESET覆盖。

[0089] 去优先级的PDSCH

[0090] 在一些实施方式中，当PDSCH在时域中与一个或多个控制资源集CORESET重叠时，PDSCH的接收可以被去优先化。该PDSCH可以被称为去优先化的PDSCH，这意味着用于接收该PDSCH的优先级等级可以被降低。

[0091] 图5是根据本案的示例性实施方式示出的PDSCH在时域中与控制资源集CORESET重叠的示意图。如图5所示，UE可以在控制资源集CORESET#1 502中接收DCI以调度在时域中与控制资源集CORESET#2 508重叠的PDSCH 504。在此示例性实施方式中，PDSCH 504可包含携带在时域中不与控制资源集CORESET#2 508重叠的非周期性CSI-RS的资源506。资源506的位置可以由从控制资源集CORESET#1 502获取的DCI来调度或确定。调度偏移51可以是(在控制资源集CORESET#1502中)携带DCI的PDCCH的最后符号的结束与PDSCH 504的第一符号的开始之间的时间间隔。在这个示例性实施方式中，调度偏移51可以小于阈值(例如，阈值-调度-偏移)。

[0092] 在本实施方式的一些实施方式中，可以在服务小区的活跃BWP中的时隙中提供被配置给UE的所有控制资源集CORESET(例如，控制资源集CORESET#1 502和控制资源集CORESET#2 508)和携带非周期性CSI-RS的资源(例如，图5中的资源506)。

[0093] 在本实施方式的一些实施方式中，控制资源集CORESET#2 508可以是与被配置给UE的未被侦测的搜索空间相关联的未被侦测的控制资源集CORESET。

[0094] 下面描述确定携带非周期性CSI-RS的PDSCH 504或资源506的QCL假设的技术。

[0095] 情况3.1

[0096] 在这种情况下，PDSCH 504的QCL假设可遵循在时域中的至少一个符号中与PDSCH 504重叠的控制资源集CORESET#2 508的QCL假设。例如，UE可以假设PDSCH 504的DM-RS端口相对于被用于PDCCH QCL指示(例如，对应于控制资源集CORESET#2 508)的QCL假设与在TCI状态中指示的RS是准共址的，该PDCCH QCL指示具有最新时隙中的最低控制资源集CORESET ID，在该最新时隙中为UE配置服务小区的活动BWP内的一个或多个控制资源集CORESET。

[0097] 这种情况也可以应用于带内CA情况(其中PDSCH和控制资源集CORESET在不同的CC

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中)。

[0098] 情况3.2

[0099] 在这种情况下,在成功解码DCI调度PDSCH 504之后,如果在与具有非周期性CSI-RS的资源506相同的符号中仅发送PDSCH504,针对非周期性CSI-RS资源506的默认QCL假设可遵循PDSCH 504的QCL假设,即使由于与控制资源集CORESET#2 508在时域中的至少一个OFDM符号中重叠,PDSCH504的接收被去优先化。

[0100] 在这种实施方式的一些实施方式中,如果在至少一个OFDM符号上在时域中存在针对单个PDSCH的多个QCL假设,则非周期CSI RS可以遵循与对准的PDSCH符号相同的QCL假设。

[0101] 情况3.3

[0102] 当前,在去优先化的PDSCH上不存在明确的表述:其QCL假设应当由重叠的控制资源集CORESET维护、无效、或覆盖。下面描述该问题的示例解决方案。

[0103] 情况3.3.1

[0104] 在情况3.3.1中,UE可以存储和维持去优先化的PDSCH(例如,PDSCH 504)的QCL假设,如果该PDSCH的DMRS的QCL假设(例如,QCL-TypeD参数)不同于在时域中在至少一个符号中重叠PDSCH的PDCCH的DMRS(例如,在图5所示的控制资源集CORESET#2 508中)。可预期UE优先化与该CORESET(例如,CORESET#2508)相关联的PDCCH的接收。在本实施方式的一些实施方式中,如果UE支持多个RX波束,则去优先化的PDSCH的QCL假设仍然可以用于该PDSCH。在一些其他的实施方式中,去优先化的PDSCH的QCL假设可以用于与CORESET#2508的未重叠部分。在一些其他实施例中,QCL假设可用于波束指示目的或用于建构QCL链。

[0105] 情况3.3.2

[0106] 在情况3.3.2中,UE可以释放、或部分地释放去优先化的PDSCH(例如,PDSCH504)的QCL假设,如果该PDSCH的DMRS的QCL假设(例如,QCL-TypeD参数)不同于在时域中的至少一个符号中重叠PDSCH的PDCCH的DMRS(例如,在CORESET#2508中)。可以期望UE优先接收与该控制资源集CORESET(例如,控制资源集CORESET#2 508)相关联的PDCCH。例如,UE可以在时域中释放仅针对与控制资源集CORESET#2 508的重叠部分的PDSCH 504的QCL假设,同时保持针对未重叠部分的QCL假设。

[0107] 情况3.3.3

[0108] 在情况3.3.3中,UE可以通过重叠的被侦测的控制资源集CORESET(例如,控制资源集CORESET#1 502)来覆盖去优先化的PDSCH(例如,PDSCH 504)的QCL假设,如果该PDSCH的DMRS的QCL假设(例如,QCL-TypeD参数)不同于在时域中的至少一个符号中重叠PDSCH的PDCCH的DMRS(例如,在控制资源集CORESET#2508中)。可以期望UE优先接收与该控制资源集CORESET相关联的PDCCH。

[0109] 在本实施方式的一些实施方式中,如果选择了两个或更多个控制资源集CORESET,则UE可以选择具有最低控制资源集CORESET ID的控制资源集CORESET以覆盖去优先化的PDSCH的QCL假设。在本实施方式的一些实施方式中,UE可以在时域中利用CORESET重写仅用于重叠部分的去优先化的PDSCH的QCL假设,同时维持用于未重叠部分的QCL假设。

[0110] 用于重叠的应用CSI-RS和控制资源集CORESET的去优先级的PDSCH

[0111] 图6是根据本案的示例性实施方式示出的非周期性CSI-RS、PDSCH和控制资源集

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CORESET在时域中重叠的示意图。如图6所示，UE可以在控制资源集CORESET#1 602中接收DCI以调度在时域中与控制资源集CORESET#2 608重叠的PDSCH 604。类似于图5，PDSCH 604还可以包含携带非周期性CSI-RS的资源606，但是资源606在时域中与控制资源集CORESET#2 608重叠。另外，调度偏移61可以是携带DCI(在控制资源集CORESET#1 602中)的PDCCH的最后符号的结束与PDSCH 604的第一符号的开始之间的时间间隔。在此示例性实施方式中，调度偏移61可小于阈值(例如，阈值-调度-偏移)。

[0112] 在本实施方式的一些实施方式中，UE可以应用所侦测和优先化的控制资源集CORESET(例如，控制资源集CORESET#2 608)的QCL假设作为用于接收非周期性CSI-RS资源(例如，资源606)的默认波束。在一些实施方式中，资源606中的非周期性CSI-RS的符号的重叠部分和未重叠部分两者可使用相同的QCL假设。在一些其他的实施方式中，资源606中仅非周期性CSI-RS的重叠部分可使用与重叠的控制资源集CORESET#2 608相同的QCL假设，并且资源606中非周期性CSI-RS的未重叠部分可保持使用原始QCL配置。

[0113] 针对未被侦测的控制资源集CORESET的去优先级PDSCH

[0114] 如上所述，如果PDSCH DMRS的QCL假设(例如，QCL-TypeD)不同于在时域中的至少一个符号中与其重叠的PDCCH DMRS的QCL假设，则可以期望UE优先于PDSCH接收与该控制资源集CORESET相关联的PDCCH。

[0115] 然而，如果UE未侦测该控制资源集CORESET(例如，由于意外地与其他控制资源集CORESET重叠)，UE的行为可能不清楚，因为UE可能不知道是否要对未被侦测的控制资源集CORESET的QCL假设进行优先化，如图7所示。

[0116] 图7是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。在示例性实施方式中，UE可以从控制资源集CORESET#1 702接收DCI以调度在时域中与控制资源集CORESET#2706重叠的PDSCH 704，其中控制资源集CORESET#2 706和控制资源集CORESET#3 708在时域中与不同的QCL假设在至少一个符号中重叠。此外，控制资源集CORESET#3由UE侦测，而控制资源集CORESET#2未被侦测。如上所述，可能不清楚PDSCH 704的接收是否应当改变其针对未侦测和重叠的控制资源集CORESET#2706的QCL假设。

[0117] 鉴于此，以下描述了用于确定与控制资源集CORESET重叠的PDSCH的QCL假设的技术。

[0118] 情况4.1

[0119] 在这种情况下，PDSCH可以具有与重叠的未被侦测的控制资源集CORESET相同的QCL假设。例如，在图7中，如果DCI的接收和对应的PDSCH 704之间的调度偏移71小于阈值(例如，阈值-调度-偏移)，则PDSCH 704的QCL假设可以遵循重叠的未被侦测的控制资源集CORESET#2 706的QCL假设。这种情况也可以应用于带内CA情况(例如，PDSCH和重叠的控制资源集CORESET在不同的CC中)。

[0120] 情况4.2

[0121] 图8是根据本案的示例性实施方式示出的针对UE配置的多个控制资源集CORESET的示意图。在示例性实施方式中，UE可以从控制资源集CORESET#1 802接收DCI以调度在时域中与控制资源集CORESET#2 806重叠的PDSCH 804。另外，控制资源集CORESET#2 806由UE侦测。

[0122] 在这种情况下，如果DCI的接收与相应的PDSCH 804之间的调度偏移81小于阈值

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(例如,阈值-调度-偏移),并且PDSCH 804的DMRS的QCL假设不同于重叠的被侦测的PDCCH(在CORESET#2806中),可以期望UE优先接收与该控制资源集CORESET(例如,控制资源集CORESET#2 806)相关联的被侦测的PDCCH。这种情况也可以应用于带内CA情况(例如,PDSCH和控制资源集CORESET在不同的CC中)。

[0123] 图9是根据本案的示例性实施方式示出的用于在无线通信系统中确定QCL假设的方法的流程图。在动作902,UE可以侦测在时隙中的服务小区的活跃BWP内针对UE配置的多个控制资源集CORESET中的至少一个控制资源集CORESET。在动作904中,UE可以应用控制资源集CORESET的QCL假设来接收非周期性CSI-RS。控制资源集CORESET可以与被配置有被侦测的控制资源集CORESET中的最低控制资源集CORESETID的被侦测的搜索空间相关联。

[0124] 在本实施方式的一些实施方式中,UE可以在时隙中的服务小区的活跃BWP内侦测针对UE配置的多个控制资源集CORESET中的至少一个控制资源集CORESET。另外,当携带DCI的PDCCH的最后符号的结束和PDSCH的第一符号的开始之间的调度偏移小于阈值时,UE可以从PDCCH接收调度PDSCH的DCI,并且针对PDCCH的接收应用QCL假设以接收PDSCH。该PDCCH可以在一个或多个被侦测的控制资源集CORESET的集合中的一个中被传输,其中该被侦测的控制资源集CORESET(PDCCH在其中被传输)可以与被配置有被侦测的控制资源集CORESET中的最低控制资源集CORESET ID的被侦测的搜索空间相关联。

[0125] 图10是根据本申请的各个方面示出的用于无线通信的节点的框图。如图10所示,节点1000可包括收发器1020、处理器1028、存储器1034、一个或多个呈现部件1038和至少一根天线1036。节点1000还可包括RF频谱带模块、BS通信模块、网络通信模块和系统通信管理模块、输入/输出(I/O)端口、I/O部件和电源(图10中未明确示出)。这些部件中的每一者可通过一条或多条总线1040直接或间接进行彼此通信。在一个实施方式中,节点1000可以是执行本文例如参考图1至图9所描述的各种功能的UE或BS。

[0126] 具有发射器1022(例如,传输(transmitting/transmission)电路)和接收器1024(例如,接收(receiving/reception)电路)的收发器1020可被配置来发射和/或接收时间和/或频率资源划分信息。在一些实施方式中,收发器1020可被配置来在不同类型的子帧和时隙中进行发射,所述子帧和时隙包括但不限于可使用、不可使用和可灵活使用的子帧和时隙格式。收发器1020可被配置来接收数据和控制信道。

[0127] 节点1000可包括各种计算机可读介质。计算机可读介质可以是可由节点1000接入的任何可用介质,并且包括易失性和非易失性介质、可移动和不可移动介质两者。作为示例性而非限制,计算机可读介质可包括计算机存储介质和通信介质。计算机存储介质包括通过用于存储诸如计算机可读指令、数据结构、程序模块或数据等信息的任何方法或技术实施的易失性和非易失性的介质、可移动和不可移动介质两者。

[0128] 计算机存储介质包括RAM、ROM、EEPROM、闪存或其他存储技术、CD-ROM、数字多功能盘(Digital Versatile Disks,DVD)或其他光盘存储装置、磁卡带、磁带、磁盘存储装置或其他磁存储装置。计算机存储介质不包含传播的数据信号。通信介质典型地包含计算机可读指令、数据结构、程序模块或采用诸如载波或其他传输机制的经调制的数据信号中的其他数据,并且包括任何信息传送介质。术语"经调制的数据信号"是指这样的信号:通过将信息编码在信号中的方式设置或更改了其特性中的一个或多个特性。举例来说而非限制,通信介质包括有线介质,诸如有线网络或直接有线连接;以及无线介质,诸如声学、RF、红外和

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其他无线介质。以上各项中的任一者的组合也应该包括在计算机可读介质的范围内。

[0129] 存储器1034可包括易失性和/或非易失性存储器形式的计算机存储介质。存储器1034可以是可移动的、不可移动的或其组合。示例性存储器包括固态存储器、硬盘驱动器、光盘驱动器等。如图10所示，存储器1034可存储计算机可读的计算机可执行的指令1032(例如，软件代码)，所述计算机可读的计算机可执行的指令1032被配置为在被执行时致使处理器1028执行本文例如参考图1至9所描述的各种功能。可选地，指令1032可不由处理器1028直接执行，而是被配置为使节点1000(例如，在被编译和执行时)执行本文所描述的各种功能。

[0130] 处理器1928(例如，具有处理电路)可包括智能硬件装置，例如，中央处理单元(Central Processing Unit,CPU)、微控制器、ASIC等。处理器1028可包括存储器。处理器1028可处理从存储器1034接收的数据1030和指令1032，以及通过收发器1020、基带通信模块和/或网络通信模块的信息。处理器1028还可处理要发送到收发器1020以通过天线1036发射的信息、要发送到网络通信模块以发射到核心网络的信息。

[0131] 一个或多个呈现部件1038向人或其他装置呈现数据指示。示例性的一个或多个呈现组件1038包括显示装置、扬声器、打印部件、振动部件等。

[0132] 从以上描述中明显看出，在不背离在本申请中描述的概念的范围的情况下，可以使用各种技术来实施所述概念。而且，虽然已经具体参考某些实施方式来描述了这些概念，但是本领域技术人员可以认识到，在不背离那些概念的范围的情况下，可以作出形式和细节上的改变。由此，所描述的实施方式在所有方面都将视为说明性的而非限制性的。还应该理解，本申请不限于上文描述的特定实施方式，而是在不背离本公开的范围的情况下，许多重新布置、修改和替换都是可能的。

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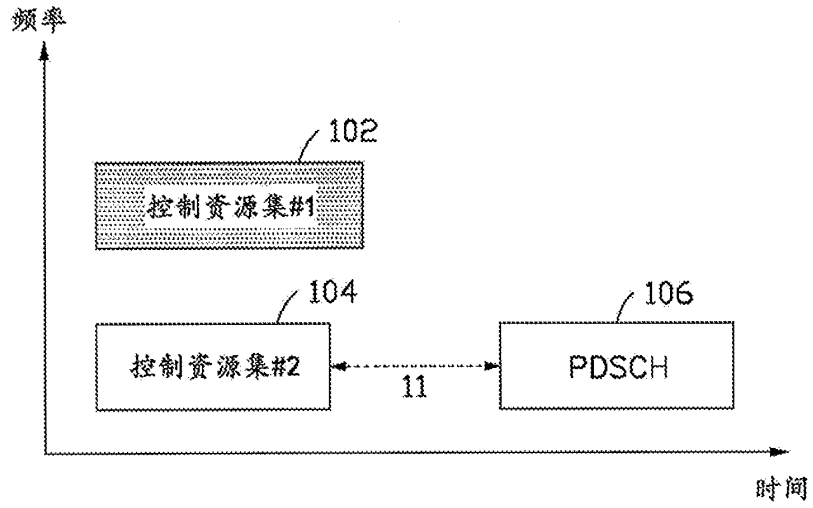

频率
102
控制资源集#1
104
106
控制资源集#2
11
PDSCH
时间

图1

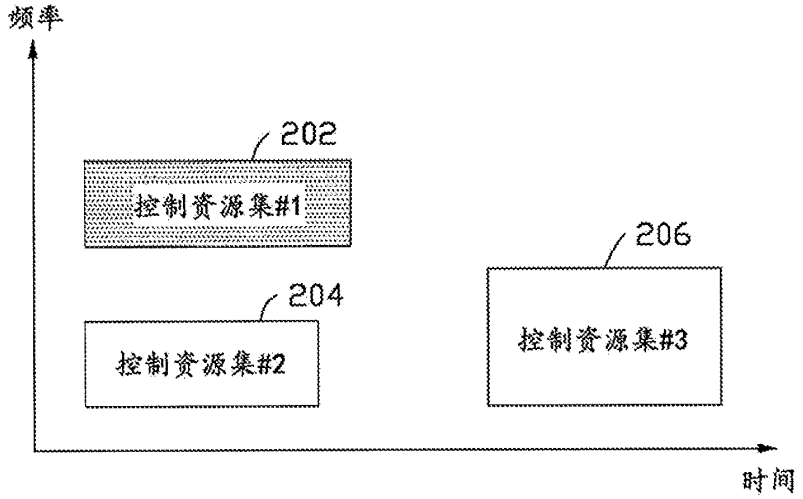

频率
202
控制资源集#1
206
204
控制资源集#3
控制资源集#2
时间

图2

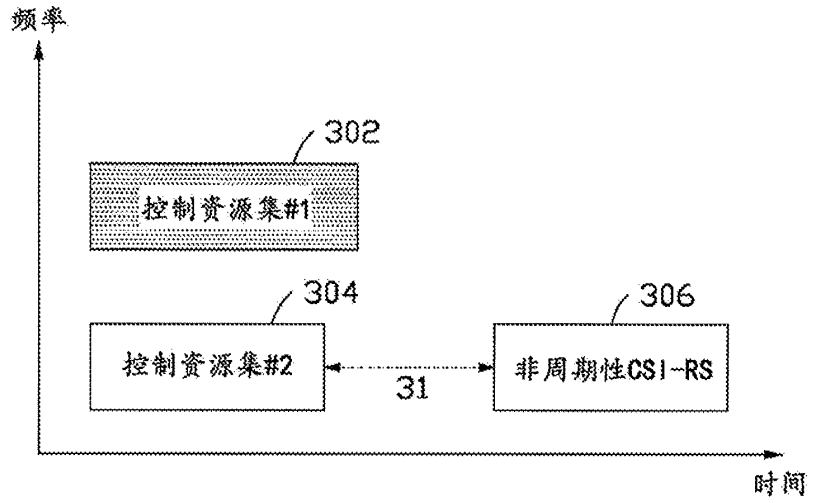

频率
302
控制资源集#1
304
控制资源集#2
31
306
非周期性CSI-RS
时间

图3

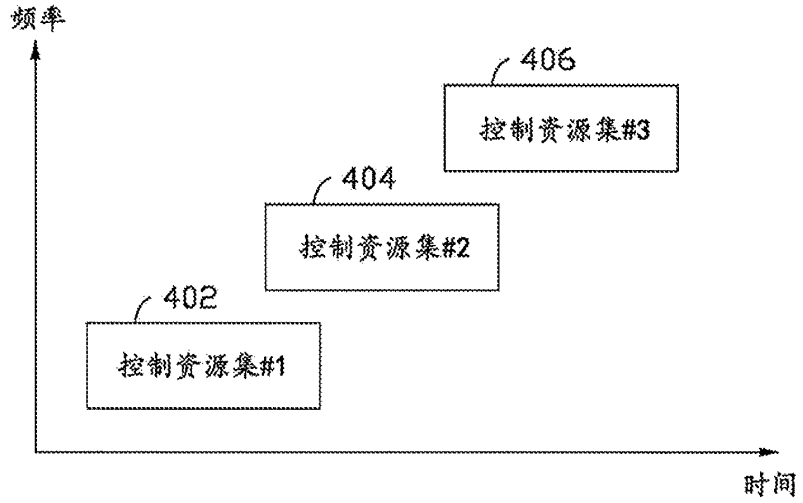

频率
406
控制资源集#3
404
控制资源集#2
402
控制资源集#1
时间

图4

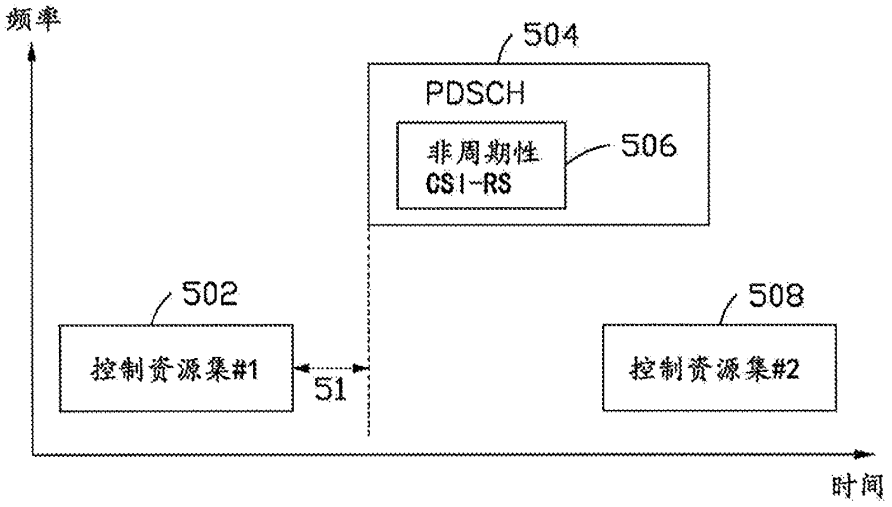

频率
504
PDSCH
非周期性
CSI-RS
506
502
控制资源集#1
51
508
控制资源集#2
时间

图5

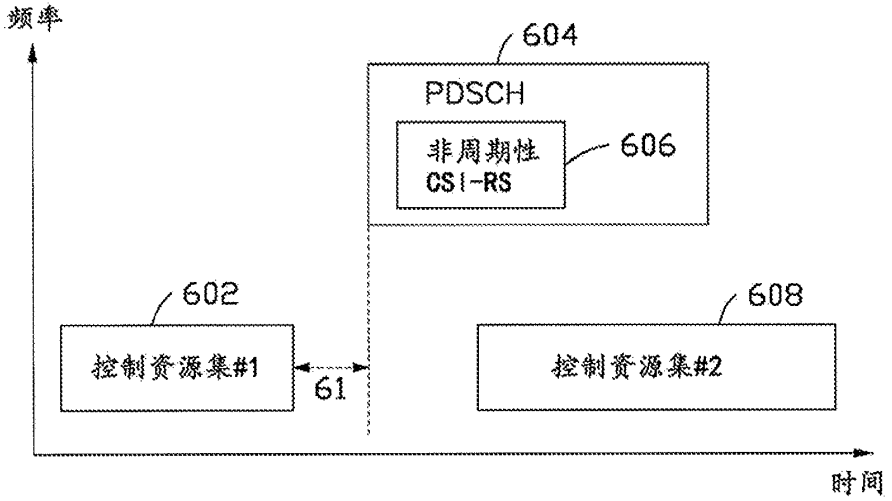

频率
604
PDSCH
非周期性
CSI-RS
606
602
控制资源集#1
61
608
控制资源集#2
时间

图6

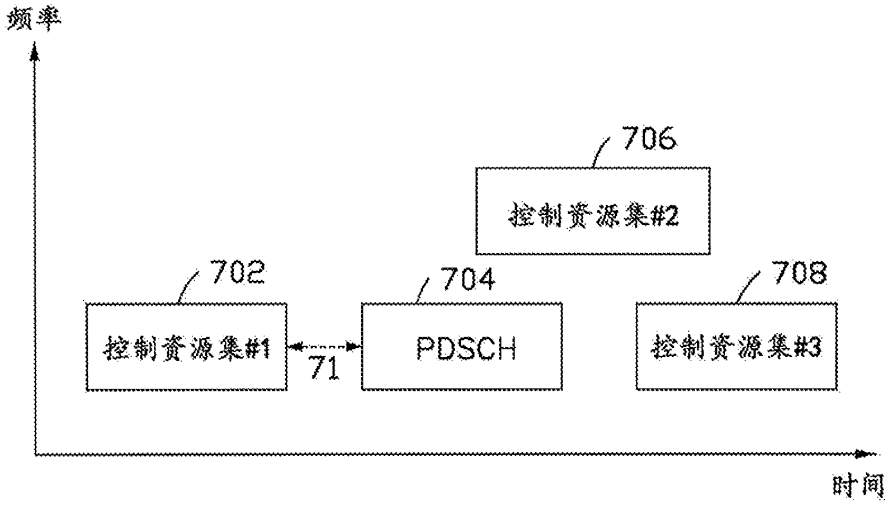


图7

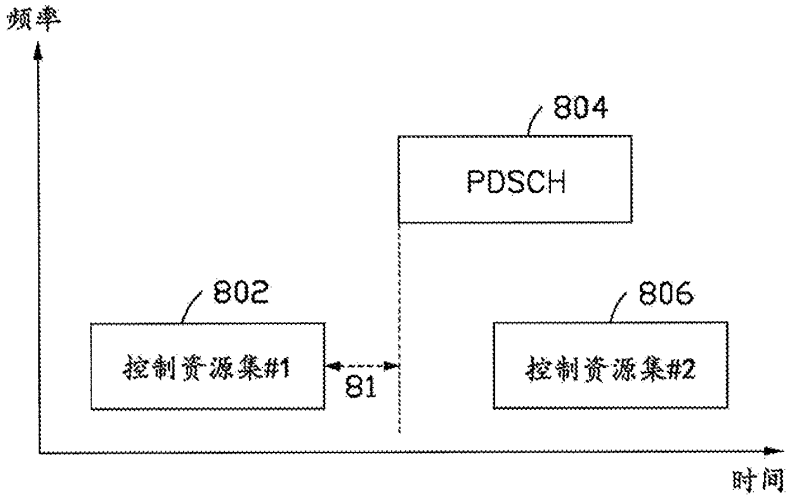


图8

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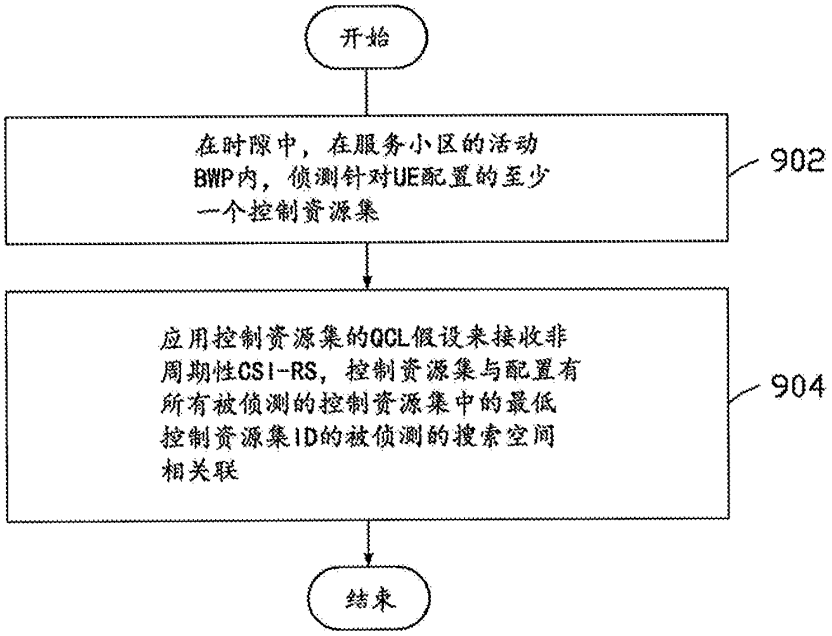


图9

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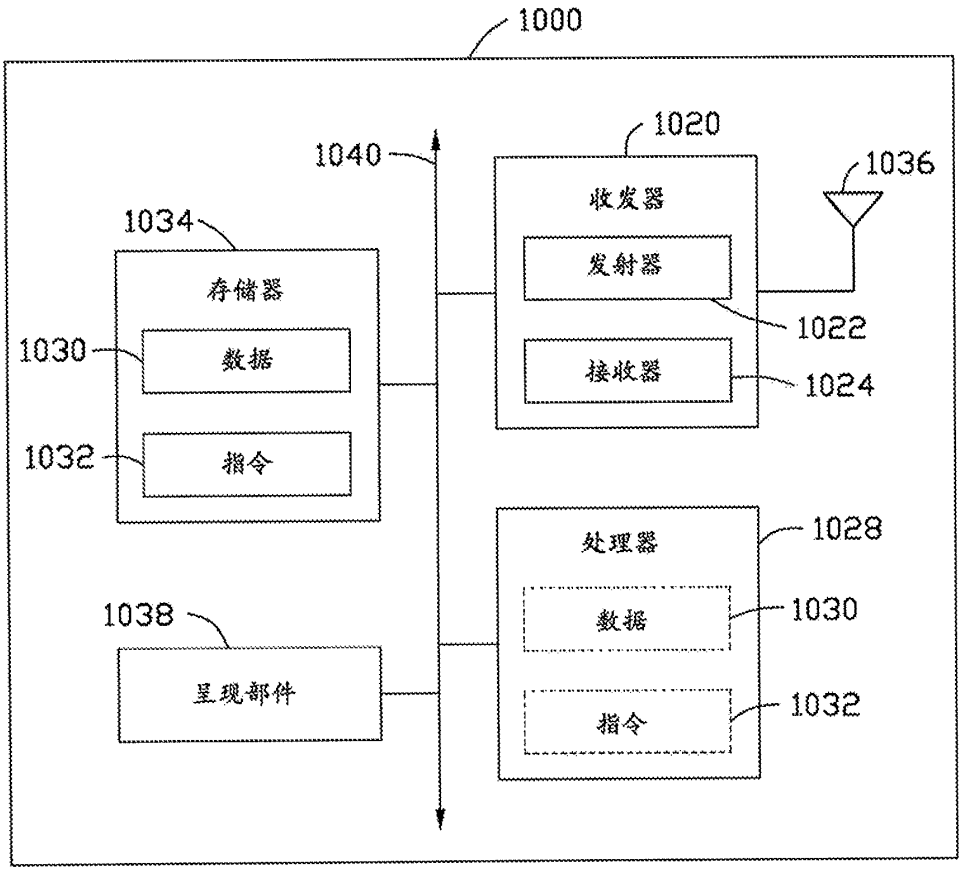

1000
1020
1040
1036
收发器
1034
发射器
存储器
1030
数据
1022
接收器
1024
1032
指令
处理器
1028
1038
数据
1030
呈现部件
指令
1032

图10

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Espacenet

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METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

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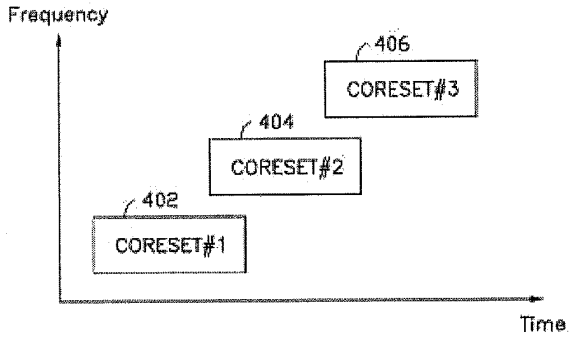
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Abstract not available for EP3874668 (A1)
Abstract of corresponding document: US2020145982 (A1)

A method of wireless communications is provided. The method includes monitoring, by a user equipment (UE), at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the monitored CORESET(s).



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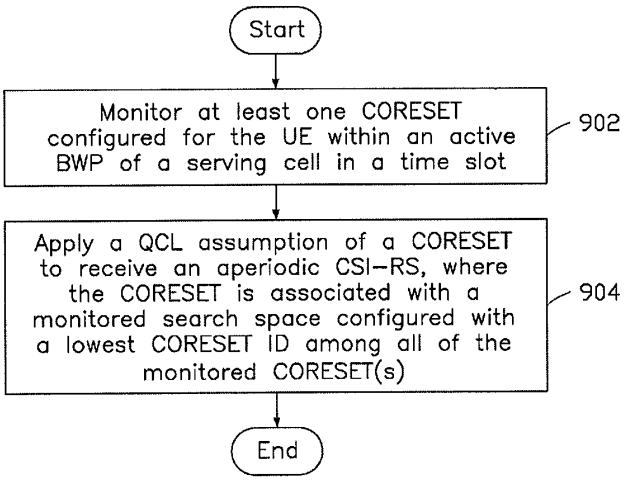


FIG. 9

(57) Abstract: A method of wireless communications is provided. The method includes monitoring, by a user equipment (UE), at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the monitored CORESET (s).

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METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] The present application claims the benefit of and priority to a provisional U.S. Patent Application Serial No. 62/754,165, filed on November 1, 2018, entitled "Method and Apparatus for Spatial QCL assumptions with Overlapped CORESETs," with Attorney Docket No. US75368 (hereinafter referred to as "US75368 application"). The disclosure of the US75368 application is hereby incorporated fully by reference into the present application.

FIELD

[0002] The present disclosure generally relates to wireless communications, and more particularly, to methods and apparatuses of determining Quasi Co-Location (QCL) assumptions for beam operations.

BACKGROUND

[0003] The next generation (e.g., Fifth Generation (5G) New Radio (NR)) wireless communication system may utilize beamforming technologies to provide directional communications. For example, a User Equipment (UE) may perform beam operations to switch its beam(s) to transmit or receive channels or resources. Each beam the UE applies may be considered as a spatial domain filter that is determined by a corresponding QCL assumption.

[0004] However, current specifications for the next generation wireless communication system may cause a UE to perform unfavorable beam switching when the UE is configured with multiple Control Resource Sets (CORESETs). In addition, although the next generation wireless communication system enables utilizing a flexible resource allocation scheme, a UE is likely unable to decide which QCL assumption to use due to the ambiguity of the current specifications for the next generation wireless communication system.

[0005] Therefore, there is a need in the art for methods and apparatuses of determining QCL assumptions for beam operations when multiple CORESETs are configured to a UE.

SUMMARY

[0006] The present disclosure is directed to methods and apparatuses for determining QCL

assumptions.

[0007] According to an aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, and apply a first QCL assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET may be associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

[0008] According to another aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, receive Downlink Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH) from a Physical Downlink Control Channel (PDCCH), and apply a QCL assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between a last symbol of the PDCCH carrying the DCI and a first symbol of the PDSCH is less than a threshold. The PDCCH may be transmitted in one of a set of one or more monitored CORESETs, and the one of the set of one or more monitored CORESETs may be associated with a monitored search space configured with a lowest CORESET ID among the set of one or more monitored CORESETs.

[0009] According to another aspect of the present disclosure, a method of wireless communications is provided. The method includes monitoring, by a UE, at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first QCL assumption of a first CORESET of the set of one or more monitored CORESETs to receive an aperiodic CSI-RS. The first CORESET may be associated with a monitored search space configured with a lowest CORESET ID among the set of one or more monitored CORESETs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Aspects of the present disclosure are best understood from the following detailed description when read with the accompanying figures. Various features are not drawn to scale. Dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

[0011] Fig. 1 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0012] Fig. 2 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0013] Fig. 3 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0014] Fig. 4 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0015] Fig. 5 is a schematic diagram illustrating a PDSCH overlapping a CORESET in the time domain, in accordance with an example implementation of the present disclosure.

[0016] Fig. 6 is a schematic diagram illustrating that an aperiodic CSI-RS, a PDSCH, and a CORESET are overlapped in the time domain, in accordance with an example implementation of the present disclosure.

[0017] Fig. 7 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0018] Fig. 8 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0019] Fig. 9 is a flowchart for a method of determining QCL assumptions in a wireless communication system, in accordance with an example implementation of the present disclosure.

[0020] Fig. 10 is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure.

DETAILED DESCRIPTION

[0021] The following description contains specific information pertaining to example implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely example implementations. However, the

present disclosure is not limited to merely these example implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale and are not intended to correspond to actual relative dimensions.

[0022] For the purpose of consistency and ease of understanding, like features may be identified (although, in some examples, not shown) by the same numerals in the example figures. However, the features in different implementations may be differed in other respects, and thus shall not be narrowly confined to what is shown in the figures.

[0023] The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent. The expression "at least one of A, B and C" or "at least one of the following: A, B and C" means "only A, or only B, or only C, or any combination of A, B and C."

[0024] Additionally, for the purposes of explanation and non-limitation, specific details, such as functional entities, techniques, protocols, standard, and the like are set forth for providing an understanding of the described technology. In other examples, detailed description of well-known methods, technologies, systems, architectures, and the like are omitted so as not to obscure the description with unnecessary details.

[0025] Persons skilled in the art will immediately recognize that any network function(s) or algorithm(s) described in the present disclosure may be implemented by hardware, software or a combination of software and hardware. Described functions may correspond to modules which may be software, hardware, firmware, or any combination thereof. The software implementation may comprise computer executable instructions stored on computer readable medium such as memory or other type of storage devices. For example, one or more microprocessors or general-purpose computers with communication processing capability may be programmed with corresponding executable instructions and carry out the described network function(s) or

algorithm(s). The microprocessors or general-purpose computers may be formed of Applications Specific Integrated Circuitry (ASIC), programmable logic arrays, and/or using one or more Digital Signal Processor (DSPs). Although some of the example implementations described in this specification are oriented to software installed and executing on computer hardware, nevertheless, alternative example implementations implemented as firmware or as hardware or combination of hardware and software are well within the scope of the present disclosure.

[0026] The computer readable medium includes but is not limited to Random Access Memory (RAM), Read Only Memory (ROM), Erasable Programmable Read-Only Memory (EPROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), flash memory, Compact Disc Read-Only Memory (CD-ROM), magnetic cassettes, magnetic tape, magnetic disk storage, or any other equivalent medium capable of storing computer-readable instructions.

[0027] A radio communication network architecture (e.g., a Long Term Evolution (LTE) system, an LTE-Advanced (LTE-A) system, an LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network (RAN)) typically includes at least one Base Station (BS), at least one User Equipment (UE), and one or more optional network elements that provide connection towards a network. The UE communicates with the network (e.g., a Core Network (CN), an Evolved Packet Core (EPC) network, an Evolved Universal Terrestrial Radio Access Network (E-UTRAN), a 5G Core (5GC), or an internet), through a RAN established by one or more BSs.

[0028] It should be noted that, in the present application, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, a vehicle, or a Personal Digital Assistant (PDA) with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

[0029] A BS may be configured to provide communication services according to at least one of the following Radio Access Technologies (RATs): Worldwide Interoperability for Microwave Access (WiMAX), Global System for Mobile communications (GSM, often referred to as 2G), GSM Enhanced Data rates for GSM Evolution (EDGE) Radio Access Network (GERAN), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS, often referred to as 3G) based on basic Wideband-Code Division Multiple Access (W-CDMA), High-Speed Packet Access (HSPA), LTE, LTE-A, eLTE (evolved LTE, e.g., LTE connected to 5GC),

NR (often referred to as 5G), and/or LTE-A Pro. However, the scope of the present application should not be limited to the above-mentioned protocols.

[0030] A BS may include, but is not limited to, a node B (NB) as in the UMTS, an evolved Node B (eNB) as in the LTE or LTE-A, a Radio Network Controller (RNC) as in the UMTS, a Base Station Controller (BSC) as in the GSM/GERAN, a ng-eNB as in an Evolved Universal Terrestrial Radio Access (E-UTRA) BS in connection with the 5GC, a next generation Node B (gNB) as in the 5G-RAN, and any other apparatus capable of controlling radio communication and managing radio resources within a cell. The BS may serve one or more UEs through a radio interface.

[0031] The BS is operable to provide radio coverage to a specific geographical area using a plurality of cells forming the radio access network. The BS supports the operations of the cells. Each cell is operable to provide services to at least one UE within its radio coverage. More specifically, each cell (often referred to as a serving cell) provides services to serve one or more UEs within its radio coverage (e.g., each cell schedules the Downlink (DL) and optionally uplink resources to at least one UE within its radio coverage for DL and optionally uplink packet transmissions). The BS can communicate with one or more UEs in the radio communication system through the plurality of cells. A cell may allocate Sidelink (SL) resources for supporting Proximity Service (ProSe) or Vehicle to Everything (V2X) service. Each cell may have overlapped coverage areas with other cells.

[0032] As discussed above, the frame structure for NR is to support flexible configurations for accommodating various next generation (e.g., 5G) communication requirements, such as Enhanced Mobile Broadband (eMBB), Massive Machine Type Communication (mMTC), Ultra-Reliable and Low-Latency Communication (URLLC), while fulfilling high reliability, high data rate and low latency requirements. The Orthogonal Frequency-Division Multiplexing (OFDM) technology as agreed in the 3rd Generation Partnership Project (3GPP) may serve as a baseline for NR waveform. The scalable OFDM numerology, such as the adaptive sub-carrier spacing, the channel bandwidth, and the Cyclic Prefix (CP) may also be used. Additionally, two coding schemes are considered for NR: (1) Low-Density Parity-Check (LDPC) code and (2) Polar Code. The coding scheme adaption may be configured based on the channel conditions and/or the service applications.

[0033] Moreover, it is also considered that in a transmission time interval TX of a single NR

frame, a DL transmission data, a guard period, and an Uplink (UL) transmission data should at least be included, where the respective portions of the DL transmission data, the guard period, the UL transmission data should also be configurable, for example, based on the network dynamics of NR. In addition, SL resources may also be provided in an NR frame to support ProSe services or V2X services.

[0034] In addition, the terms "system" and "network" herein may be used interchangeably. The term "and/or" herein is only an association relationship for describing associated objects, and represents that three relationships may exist. For example, A and/or B may indicate that: A exists alone, A and B exist at the same time, or B exists alone. In addition, the character "/" herein generally represents that the former and latter associated objects are in an "or" relationship.

[0035] In some implementations, a UE may perform the following processes to determine a default PDSCH beam when multiple search spaces are overlapped in the time domain:

> for a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with Carrier Aggregation (CA) in the same frequency band,
>
> > if the monitoring occasions of the search space are overlapped in the time domain and the search spaces are associated with different CORESETs having different Quasi Co-Location (QCL)-TypeD properties, the UE may monitor the search spaces associated with a given CORESET containing a Common Search Space (CSS) in the active DL BWP in the serving cell with the lowest serving cell index and any other CORESET associated with the same QCL-TypeD properties as the given CORESET,
> >
> > > if two or more CORESETs contain the CSS, the UE may select the CORESET containing the search space having the lowest search space ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index, and
> > >
> > > if none of the CORESETs contains the CSS, the UE may select the CORESET containing the search space having the lowest search space ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index.

[0036] For this purpose, the QCL assumption with respect to the Synchronization Signal

Block (SSB) and the QCL assumption with respect to the Channel Status Information-Reference Signal (CSI-RS) (or Tracking Reference Signal (TRS)) may be considered as two different QCL assumptions, even if the CSI-RS is sourced from the same SSB. The QCL assumption may be based on different parameters, such as the spatial-domain QCL parameters (e.g., QCL TypeD parameter), or the QCL parameters obtained based on at least one of the average delay, the delay spread, the Doppler shift, and the Doppler spread.

[0037] In addition, the UE may perform the process described below:

> if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH (e.g., which means a time interval between the last symbol of the PDCCH carrying the DCI and the first symbol of the PDSCH) is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the Demodulation-Reference Signal (DM-RS) ports of the PDSCH of a serving cell are quasi co-located with the RS(s) in the Transmission Configuration Indication (TCI) state with respect to the QCL assumption(s) used for the PDCCH QCL indication of the lowest CORESET ID in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE.

[0038] In this manner, if the QCL assumption of the DM-RSs of a PDSCH is different from that of the DM-RSs of a PDCCH overlapping the PDSCH in at least one symbol in the time domain, the UE may be expected to prioritize the reception of the PDCCH associated with that CORESET. This may also apply to the intra-band CA case (e.g., the PDSCH and the CORESET are in different Component Carriers (CCs)).

[0039] In some of the present implementations, a UE may be configured with multiple CORESETs, but not all of them may be monitored by the UE. For example, if a UE is configured with two CORESETs that overlap each other in at least one symbol (e.g., an OFDM symbol) in the time domain, the UE may select one of the CORESETs to monitor based on certain priority rule(s) or pre-configuration(s).

[0040] In some of the present implementations, the UE may prioritize and monitor a CORESET if the monitored CORESET is associated with a CSS and the lowest search space ID. By contrast, a non-monitored CORESET may be a CORESET that is associated with a non-monitored search space configuration, for example, due to QCL-TypeD conflicts. The non-

monitored CORESET may be configured on a deactivated BWP, on a deactivated Secondary Cell (SCell), or on the same active BWP of a serving cell as other monitored CORESET(s). In some other implementations, the non-monitored CORESET may contain a PDCCH that overlaps with at least one Resource Element (RE) corresponding to a Synchronization Signal (SS)/Physical Broadcast Channel (PBCH) block. In some other implementations, the non-monitored CORESET may be a CORESET configured for a UE that operates under a Discontinuous Reception (DRX) mode.

[0041] **NON-MONITORED CORESET FOR A DEFAULT PDSCH BEAM**

[0042] In some implementations, a non-monitored CORESET may be used for a beam indication for receiving a PDSCH when the non-monitored CORESET has the lowest CORESET ID among the configured CORESETs.

[0043] For example, if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the DM-RS ports of the PDSCH may be quasi co-located with the RS(s) in the TCI state with respect to the QCL assumption(s). The QCL assumption(s) may be used for a PDCCH QCL indication (e.g., CORESET) with the lowest CORESET ID in the latest slot, where one or more CORESETs, in the latest slot, within the active BWP of the serving cell are configured for the UE.

[0044] Fig. 1 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 1, the UE is configured with two CORESETs, CORESET#1 102 and CORESET#2 104, overlapping in at least one symbol in the time domain. The UE may receive DCI from CORESET#2 104 to schedule PDSCH 106. CORESET#1 102 may not be monitored by the UE due to, for example, priority rules (e.g., CORESET#1 102 is not configured with a CSS, and/or is associated with a non-monitored search space having the lowest search space ID). The non-monitored search space may have the lowest search space ID among those search spaces overlapping this non-monitored search space. For example, if CORESET#1 102 is associated with a non-monitored search space that is configured with a first search space ID, and CORESET#2 104 is associated with a monitored search space that is configured with a second search space ID, the first search space ID may be lower than the second search space ID.

[0045] Currently, assuming that CORESET#1 102 has the lowest CORESET ID, if the scheduling offset 11 between CORESET#2 104 and the corresponding PDSCH 106 is less than a

threshold (e.g., Threshold-Sched-Offset), an RX beam which is determined by the TCI state of CORESET#1 102 may be required to be used to receive PDSCH 106. In this case, the UE is forced to use different RX beams for CORESET#2 104 and PDSCH 106 in order to follow the 3GPP specification. This type of beam switching, however, is undesirable and needs to be prevented.

[0046] **Case 1.1**

[0047] In some of the present implementations, the CORESET having the lowest CORESET ID may not be taken as a non-monitored CORESET. In such a case, if the monitoring occasions of the search space are overlapped in the time domain and the search spaces are associated with different CORESETs having different QCL-TypeD properties, the UE may select the CORESET having the lowest CORESET ID in the monitoring occasions in the active DL BWP of a serving cell with the lowest serving cell index. Any overlapped search space(s) associated with the CORESET(s) having the same QCL-TypeD parameter may be monitored.

[0048] In some other implementations, the UE may select the following CORESETs to monitor according to a predefined priority order (from high priority to low priority):

1) CORESET associated with a CSS;
2) CORESET associated with a search space having the lowest search space ID; and
3) CORESET containing the lowest CORESET ID.

[0049] This priority rule may be used for determining the QCL assumptions of the RX beams when two or more CORESETs are overlapped in the time domain.

[0050] **Case 1.2**

[0051] In some of the present implementations, to avoid unfavourable beam switching, the non-monitored CORESETs may be transparent to the UE. For example, if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the DM-RS ports of the PDSCH are quasi co-located with the RS(s) in the TCI state with respect to the QCL assumption(s). The QCL assumption(s) may be used for a monitored PDCCH QCL indication with the lowest CORESET ID in the latest slot, where one or more CORESETs, in the latest slot, within the active BWP of the serving cell are configured for the UE.

[0052] In this case, the non-monitored PDCCH/CORESET may not be used for the QCL assumption for reception of the scheduled PDSCH.

[0053] In some of the present implementations, a PDCCH is a monitored PDCCH when a UE

prioritizes to monitor the search space(s) associated with a given CORESET (containing the monitored PDCCH) in an active DL BWP of a serving cell having the lowest serving cell index. This UE may be configured to monitor multiple search spaces associated with different CORESETs (e.g., for a single cell operation or for an operation with CA in the same frequency band).

[0054] **Case 1.3**

[0055] In some of the present implementations, a non-monitored CORESET may be treated as a non-configured CORESET by a UE. For example, an RRC configuration for a CORESET may not be used for other purposes when the UE does not monitor the CORESET, but the RRC configuration may still be stored by the UE and become valid again when there is no collision between two or more CORESETs in the subsequent time slots. An example of the UE's operation is described below:

> for a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and the search spaces are associated with different CORESETs having different QCL-TypeD properties, and the search spaces are not monitored by the UE,
> >
> > > the CORESETs that UE does not monitor are transparent to the UE, and treated as blank REs in the corresponding slots; or
> >
> > > at least, the CORESETs that the UE does not monitor may not be used for beam-indication or QCL-indication purposes.

[0056] In some of the present implementations, the UE may maintain and store the RRC configuration of the non-monitored CORESET(s). This RRC configuration may be updated via MAC-CE(s) and/or DCI.

[0057] In some other implementations, the UE may release the RRC configuration for the non-monitored CORESET(s). The released RRC configuration may not be updated or stored by the UE.

[0058] **Case 1.4**

[0059] Currently, there is no clear wording on a non-monitored CORESET whether its QCL

assumption should be maintained, be invalidated, or be overridden by the overlapped monitored CORESET. Example solutions for this issue are described below as different cases.

[0060] Case 1.4.1

[0061] In Case 1.4.1, the UE may store and maintain the QCL assumption of the non-monitored CORESET. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search spaces are not monitored by the UE,
> >
> > > the UE may store and maintain the QCL assumption for the non-monitored CORESET(s).

[0062] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be updated via a MAC-CE and/or the DCI.

[0063] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used if the UE supports multiple RX beams.

[0064] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used for the non-overlapped symbols of this CORESET in the time domain.

[0065] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used as a beam indication, a QCL indication, or being part of a QCL chain.

[0066] Case 1.4.2

[0067] In Case 1.4.2, the UE may release or suspend the QCL assumption of the non-monitored CORESET. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search space(s) are not monitored by the UE,
> >
> > > the UE may release the QCL assumption for the non-monitored CORESET(s) and for the non-overlapped CORESET(s) related to this search

space, or

> the UE may suspend the QCL assumption for the slots in which the CORESETs are overlapped and non-monitored by the UE, but keep the QCL assumption for the non-overlapped CORESETs in the same search space, or

> the UE may release or suspend the QCL assumption for the overlapped parts of the non-monitored CORESET(s), but keep using the configured QCL assumptions for the non-overlapped parts of the CORESETs (e.g., within one or two OFDM symbols).

[0068] **Option #3**

[0069] In this option, the UE may override the QCL assumption of the non-monitored CORESET by another QCL assumption. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,

> if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search spaces are not monitored by the UE,

> the UE may override the QCL assumption for the non-monitored CORESET(s) by the monitored CORESET.

[0070] In some of the present implementations, the QCL assumption of the non-monitored CORESET may only be overridden in the overlapped symbols of the non-monitored CORESET.

[0071] In some other implementations, the QCL assumption of the non-monitored CORESET(s) may be overridden in the whole-time interval of the non-monitored CORESET.

[0072] **NON-SELECTED CORESET FOR RADIO LINK MONITOR (RLM) RS SELECTION**

[0073] In some implementations, an RLM RS selection process for a UE is described as follows:

> the UE is not required to use an aperiodic or semi-persistent RS for radio link monitoring, and

> the UE selects N_{RLM} RS(s) provided for the active TCI states for a PDCCH reception in the CORESET(s) associated with the search space(s) with the shortest monitoring periodicity, and

> if multiple CORESETs are associated with the search space(s) with the same periodicity, the UE may select the CORESET(s) with the highest CORESET ID.

[0074] Fig. 2 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 2, the UE is configured with CORESET#1 202, CORESET#2 204, and CORESET#3 206, where CORESET#1 202 overlaps CORESET#2 204 in at least one symbol in the time domain.

[0075] Assuming that CORESET#1 202 has a higher CORESET ID than the overlapped CORESET#2 204, the above-described RLM RS selection process may be ambiguous in a case that CORESET#2 204 is not monitored by the UE.

[0076] In view of this issue, some of the present implementations provide methods to improve the UE's behavior for the RLM RS selection process.

[0077] **Case 2.1**

[0078] In this case, the UE may select the CORESET(s) with the lowest CORESET ID to monitor when there are multiple CORESETs configured to the UE. An example RLM RS selection process is described below:

> the UE is not required to use an aperiodic or semi-persistent RS for radio link monitoring, and

> the UE selects N_{RLM} RS provided for the active TCI states for a PDCCH reception in the CORESET(s) associated with the search space(s) with the shortest monitoring periodicity, and

> if multiple CORESETs are associated with the search space(s) with the same periodicity, the UE may select the CORESET(s) with the lowest CORESET ID containing an active TCI-state to monitor.

[0079] **Case 2.2**

[0080] In this case, to avoid a case that there are no TCI states (or TCI states are not valid) for

selection, the selected CORESET(s) may be monitored by the UE and be configured with TCI state(s) during the RLM RS selection process.

[0081] **NON-MONITORED CORESET FOR A DEFAULT APERIODIC CSI-RS BEAM**

[0082] In some implementations, if there is no PDSCH transmitted in the same symbols as the aperiodic CSI-RS, the default QCL assumption of the aperiodic CSI-RS may be derived from the CORESET with the lowest CORESET ID. An example process applied by a UE for determining a default QCL assumption is described below:

> after the UE successfully decodes the DCI scheduling a PDSCH, if there is only PDSCH(s) transmitted in the same symbols as the CSI-RS, the default QCL assumption of the aperiodic CSI-RS may follow the QCL assumption of the PDSCH (assuming that the scheduling offset between the reception of DCI and the PDSCH is larger than, or equal to, a threshold), and

> if there is no PDSCH transmitted in the same symbols as the CSI-RS, the default QCL assumption of the aperiodic CSI-RS may be derived from the CORESET with the lowest CORESET ID.

[0083] As described above, the CORESET with the lowest CORESET ID may be a non-monitored CORESET. If the non-monitored CORESET is used for a beam indication, an unfavourable beam switching may happen, as shown in Fig. 3.

[0084] Fig. 3 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As show in Fig. 3, the UE is configured with two CORESETs, CORESET#1 302 and CORESET#2 304, overlapping in at least one symbol in the time domain. In addition, the UE may receive DCI from CORESET#2 304 to transmit the aperiodic CSI-RS in resource 306.

[0085] Assuming that CORESET#1 302 has the lowest CORESET ID and is not monitored by the UE, based on the above-described process, CORESET#1 302 may be used for the beam indication (or QCL assumption) for receiving resource 306 carrying the aperiodic CSI-RS when the scheduling offset 31 between the reception of the DCI in CORESET#2 304 and the resource 306 is less than a threshold (e.g., Threshold-Sched-Offset), but this may result in an unfavourable beam switching.

[0086] In view of this issue, in some of the present implementations, the CORESET with the lowest CORESET ID may be expected to be monitored by the UE and contain at least one activated TCI state.

[0087] Fig. 4 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 4, the UE is configured with CORESET#1 402, CORESET#2 404 and CORESET#3 406. CORESET#1 402 may overlap CORESET#2 404 in at least one symbol in the time domain, and CORESET#2 404 may further overlap CORESET#3 406 in at least one symbol in the time domain.

[0088] In this example implementation, the UE may monitor CORESET#1 402 only, or monitor both of CORESET#1 402 and CORESET#3 406 simultaneously. If the UE monitors CORESET#1 402 and CORESET#3 406, then CORESET#2 404 may be the only non-monitored CORESET, and its QCL assumption for the beam indication may follow the processes described in the present disclosure. By contrast, if the UE only monitors CORESET#1 402, then both CORESET#2 404 and CORESET#3 406 may become overlapped non-monitored CORESETs, and their QCL assumptions for the beam indication may either remain the same spatial QCLs, or be overridden by the non-monitored CORESET with the lowest CORESET ID.

[0089] **DEPRIORITIZED PDSCH**

[0090] In some implementations, the reception of a PDSCH may be deprioritized when the PDSCH overlaps one or more CORESETs in the time domain. This PDSCH may be referred to as a deprioritized PDSCH, which means that the level of priority for receiving this PDSCH may be reduced.

[0091] Fig. 5 is a schematic diagram illustrating a PDSCH overlapping a CORESET in the time domain, in accordance with example implementations of the present disclosure. As shown in Fig. 5, the UE may receive DCI in CORESET#1 502 to schedule PDSCH 504 that overlaps CORESET#2 508 in the time domain. In this example implementation, PDSCH 504 may contain resource 506 carrying an aperiodic CSI-RS that does not overlap CORESET#2 508 in the time domain. The location of resource 506 may be scheduled or determined by the DCI obtained from CORESET#1 502. The scheduling offset 51 may be a time interval between the end of the last symbol of the PDCCH carrying the DCI (in CORESET#1 502) and the beginning of the first symbol of PDSCH 504. In this example implementation, the scheduling offset 51 may be less than a threshold (e.g., Threshold-Sched-Offset).

[0092] In some of the present implementations, all CORESETs configured to the UE (e.g., CORESET#1 502 and CORESET#2 508) and the resource carrying the aperiodic CSI-RS (e.g., resource 506 in Fig. 5) may be provided in a time slot in an active BWP of a serving cell.

[0093] In some implementations of the present implementation, CORESET#2 508 may be a non-monitored CORESET associated with a non-monitored search space configured to the UE.

[0094] Techniques for determining the QCL assumption for PDSCH 504 or resource 506 carrying the aperiodic CSI-RS are described below.

[0095] **Case 3.1**

[0096] In this case, the QCL assumption of PDSCH 504 may follow the QCL assumption of CORESET#2 508 that overlaps PDSCH 504 in at least one symbol in the time domain. For example, the UE may assume that the DM-RS ports of PDSCH 504 are quasi co-located with the RS(s) indicated in the TCI state with respect to the QCL assumption(s) used for the PDCCH QCL indication (e.g., corresponding to CORESET#2 508) with the lowest CORESET ID in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE.

[0097] This case may also be applied to the intra-band CA case (in which the PDSCH and the CORESET are in different CCs).

[0098] **Case 3.2**

[0099] In this case, after a successful decoding of the DCI scheduling PDSCH 504, if only PDSCH 504 is transmitted in the same symbols as resource 506 having the aperiodic CSI-RS, the default QCL assumption for the aperiodic CSI-RS resource 506 may follow the QCL assumption of PDSCH 504, even if the reception of PDSCH 504 is deprioritized because of being overlapped with CORESET#2 508 in at least one OFDM symbol in the time domain.

[00100] In some of such implementations, if there are multiple QCL assumptions for a single PDSCH in the time domain over at least one OFDM symbol, the aperiodic CSI RS may follow the same QCL assumption(s) as the aligned PDSCH symbols.

[00101] **Case 3.3**

[00102] Currently, there is no clear wording on a deprioritized PDSCH whether its QCL assumption should be maintained, invalidated, or overridden by the overlapped CORESET. Example solutions for this issue are described below.

[00103] **Case 3.3.1**

[00104] In Case 3.3.1, the UE may store and maintain the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508 shown in Fig. 5) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET (e.g., CORESET#2 508). In some of the present implementations, the QCL assumption of the deprioritized PDSCH may still be used for this PDSCH if the UE supports multiple RX beams. In some other implementations, the QCL assumption of the deprioritized PDSCH may be used for the non-overlapped portion with CORESET#2 508. In some other implementations, the QCL assumption may be used for beam indication purposes or for building a QCL chain.

[00105] **Case 3.3.2**

[00106] In Case 3.3.2, the UE may release, or partially release, the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET (e.g., CORESET#2 508). For example, the UE may release the QCL assumption of PDSCH 504 only for the overlapped portion with CORESET#2 508 in the time domain, while maintaining this QCL assumption for the non-overlapped portion.

[00107] **Case 3.3.3**

[00108] In Case 3.3.3, the UE may override the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504) by an overlapped monitored CORESET (e.g., CORESET#1 502), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET.

[00109] In some of the present implementations, if two or more CORESETs are chosen, the UE may select the CORESET with the lowest CORESET ID to override the QCL assumption of the deprioritized PDSCH. In some of the present implementations, the UE may overwrite the QCL assumption of the deprioritized PDSCH only for the overlapped portion with the CORESET(s) in the time domain while maintaining this QCL assumption for the non-overlapped portion.

[00110] **DEPRIORITIZED PDSCH FOR OVERLAPPED APERIODIC CSI-RS AND CORESET**

[00111] Fig. 6 is a schematic diagram illustrating that an aperiodic CSI-RS, a PDSCH, and a CORESET are overlapped in the time domain, in accordance with example implementations of the present disclosure. As shown in Fig. 6, the UE may receive DCI in CORESET#1 602 to schedule PDSCH 604 that overlaps CORESET#2 608 in the time domain. Similar to Fig. 5, PDSCH 604 may also contain resource 606 carrying an aperiodic CSI-RS, but resource 606 overlaps CORESET#2 608 in the time domain. In addition, the scheduling offset 61 may be a time interval between the end of last symbol of the PDCCH carrying the DCI (in CORESET#1 602) and the beginning of the first symbol of PDSCH 604. In this example implementation, the scheduling offset 61 may be less than a threshold (e.g., Threshold-Sched-Offset).

[00112] In some of the present implementations, the UE may apply the QCL assumption of the monitored and prioritized CORESET (e.g., CORESET#2 608) as a default beam for the reception of the aperiodic CSI-RS resource (e.g., resource 606). In some implementations, both the overlapped and non-overlapped portions of the symbols of the aperiodic CSI-RS in resource 606 may use the same QCL assumption. In some other implementations, only the overlapped portions of the aperiodic CSI-RS in resource 606 may use the same QCL assumption as the overlapped CORESET#2 608, and the non-overlapped portions of the aperiodic CSI-RS in resource 606 may keep using the original QCL configuration.

[00113] **DEPRIORITIZED PDSCH FOR NON-MONITORED CORESET(s)**

[00114] As described above, if the QCL assumption (e.g., QCL-TypeD) of the PDSCH DMRSs is different from that of the PDCCH DMRSs with which they overlap in at least one symbol in the time domain, the UE may be expected to prioritize the reception of the PDCCH associated with that CORESET over the PDSCH.

[00115] However, if that CORESET is not monitored by the UE (e.g., due to accidentally overlapping with other CORESETs), the UE's behavior may be unclear because the UE may not know whether to prioritize the QCL assumption for the non-monitored CORESET, as illustrated in Fig. 7.

[00116] Fig. 7 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. In the example implementation, the UE may receive DCI from CORESET#1 702 to schedule PDSCH 704 that

overlaps CORESET#2 706 in the time domain, where CORESET#2 706 and CORESEST#3 708 are overlapped in at least one symbol in the time domain with different QCL assumptions. In addition, CORESET#3 is monitored by the UE, and while CORESET#2 is not monitored. As described above, it may be unclear whether the reception of PDSCH 704 should change its QCL assumption for the non-monitored and overlapped CORESET#2 706.

[00117] In view of this issue, techniques for determining the QCL assumption for the PDSCH that overlaps CORESET(s) are described below.

[00118] **Case 4.1**

[00119] In this case, the PDSCH may have the same QCL assumption as the overlapped non-monitored CORESET. For example, in Fig. 7, the QCL assumption of PDSCH 704 may follow the QCL assumption of the overlapped non-monitored CORESET#2 706, if the scheduling offset 71 between the reception of the DCI and the corresponding PDSCH 704 is less than a threshold (e.g., Threshold-Sched-Offset). This case may also apply to the intra-band CA case (e.g., the PDSCH and the overlapped CORESET are in different CCs).

[00120] **Case 4.2**

[00121] Fig. 8 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. In the example implementation, the UE may receive DCI from CORESET#1 802 to schedule PDSCH 804 that overlaps CORESET#2 806 in the time domain. In addition, CORESET#2 806 is monitored by the UE.

[00122] In this case, if the scheduling offset 81 between the reception of the DCI and the corresponding PDSCH 804 is less than a threshold (e.g., Threshold-Sched-Offset), and the QCL assumption of the DMRSs of PDSCH 804 is different from the overlapped monitored PDCCH (in CORESET#2 806), the UE may be expected to prioritize the reception of monitored PDCCH associated with that CORESET (e.g., CORESET#2 806). This case may also apply to the intra-band CA case (e.g., the PDSCH and the CORESET are in different CCs).

[00123] Fig. 9 is a flowchart for a method of determining QCL assumptions in a wireless communication system, in accordance with an example implementation of the present disclosure. In action 902, a UE may monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot. In action 904, the UE may apply a QCL assumption of a CORESET to receive an aperiodic CSI-RS. The CORESET may be associated with a

monitored search space configured with the lowest CORESET ID among the monitored CORESET(s).

[00124] In some of the present implementations, the UE may monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot. In addition, the UE may receive DCI scheduling a PDSCH from a PDCCH and apply a QCL assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between an end of a last symbol of the PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold. The above-described PDCCH may be transmitted in one of a set of one or more monitored CORESETs, where this monitored CORESET (in which the PDCCH is transmitted) may be associated with a monitored search space configured with a lowest CORESET ID among the monitored CORESET(s).

[00125] Fig. 10 is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure. As shown in Fig. 10, a node 1000 may include a transceiver 1020, a processor 1028, a memory 1034, one or more presentation components 1038, and at least one antenna 1036. The node 1000 may also include an RF spectrum band module, a BS communications module, a network communications module, and a system communications management module, Input/Output (I/O) ports, I/O components, and power supply (not explicitly shown in Fig. 10). Each of these components may be in communication with each other, directly or indirectly, over one or more buses 1040. In one implementation, the node 1000 may be a UE or a BS that performs various functions described herein, for example, with reference to Figs. 1 through 9.

[00126] The transceiver 1020 having a transmitter 1022 (e.g., transmitting/transmission circuitry) and a receiver 1024 (e.g., receiving/reception circuitry) may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, the transceiver 1020 may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. The transceiver 1020 may be configured to receive data and control channels.

[00127] The node 1000 may include a variety of computer-readable media. Computer-readable media may be any available media that may be accessed by the node 1000 and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication

media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or data.

[00128] Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, Digital Versatile Disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

[00129] The memory 1034 may include computer-storage media in the form of volatile and/or non-volatile memory. The memory 1034 may be removable, non-removable, or a combination thereof. Example memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in Fig. 10, The memory 1034 may store computer-readable, computer-executable instructions 1032 (e.g., software codes) that are configured to, when executed, cause the processor 1028 to perform various functions described herein, for example, with reference to Figs. 1 through 9. Alternatively, the instructions 1032 may not be directly executable by the processor 1028 but be configured to cause the node 1000 (e.g., when compiled and executed) to perform various functions described herein.

[00130] The processor 1028 (e.g., having processing circuitry) may include an intelligent hardware device, e.g., a Central Processing Unit (CPU), a microcontroller, an ASIC, and etc. The processor 1028 may include memory. The processor 1028 may process the data 1030 and the instructions 1032 received from the memory 1034, and information through the transceiver 1020, the base band communications module, and/or the network communications module. The processor 1028 may also process information to be sent to the transceiver 1020 for transmission through the antenna 1036, to the network communications module for transmission to a core

network.

[00131] One or more presentation components 1038 presents data indications to a person or other device. Examples of presentation components 1038 may include a display device, speaker, printing component, vibrating component, etc.

[00132] From the above description, it is manifested that various techniques may be used for implementing the concepts described in the present application without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art may recognize that changes may be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present application is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

CLAIMS

WHAT IS CLAIMED IS:

1. A user equipment (UE) comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot; and

apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS);

wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

2. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

obtain, from the first CORESET, Downlink Control Information (DCI) scheduling the aperiodic CSI-RS, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the aperiodic CSI-RS is less than a threshold.

3. The UE of claim 1, wherein the first CORESET overlaps a second CORESET of the plurality of CORESETs in at least one symbol in a time domain, the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

4. The UE of claim 3, wherein the monitored search space associated with the first CORESET is configured with a first search space ID, the non-monitored search space associated with the second CORESET is configured with a second search space ID, and the first search space

ID is lower than the second search space ID.

5. The UE of claim 3, wherein the second CORESET is configured on one of:

a deactivated Bandwidth Part (BWP); and

a deactivated Secondary Cell (SCell).

6. The UE of claim 3, wherein the second CORESET further overlaps a third CORESET of the set of one or more monitored CORESETs in at least one symbol in the time domain.

7. The UE of claim 1, wherein the plurality of CORESETs and a resource carrying the aperiodic CSI-RS are provided in the time slot and the active BWP of the serving cell.

8. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

obtain DCI scheduling a Physical Downlink Shared Channel (PDSCH) from the first CORESET; and

apply a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold;

wherein the second CORESET overlaps the PDSCH in at least one symbol in a time domain.

9. The UE of claim 8, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

10. A user equipment (UE) comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot;

receive Downlink Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH) from a Physical Downlink Control Channel (PDCCH); and

apply a Quasi Co-Location (QCL) assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between an end of a last symbol of the PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold;

wherein the PDCCH is transmitted in one of a set of one or more monitored CORESETs, and the one of the set of one or more monitored CORESETs is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

11. A method of wireless communications, the method comprising:

monitoring, by a user equipment (UE), at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot; and

applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS);

wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among a set of one or more monitored CORESETs.

12. The method of claim 11, further comprising:

obtaining, by the UE, Downlink Control Information (DCI) scheduling the aperiodic CSI-RS from the first CORESET, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the aperiodic CSI-RS is less than a threshold.

13. The method of claim 11, wherein the first CORESET overlaps a second CORESET of the plurality of CORESETs in at least one symbol in a time domain, the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

14. The method of claim 13, wherein the monitored search space associated with the first CORESET is configured with a first search space ID, the non-monitored search space associated with the second CORESET is configured with a second search space ID, and the first search space ID is lower than the second search space ID.

15. The method of claim 13, wherein the second CORESET is configured on one of:

a deactivated Bandwidth Part (BWP); and

a deactivated Secondary Cell (SCell).

16. The method of claim 13, wherein the second CORESET further overlaps a third CORESET of the set of one or more monitored CORESETs in at least one symbol in the time domain.

17. The method of claim 11, wherein the plurality of CORESETs and a resource carrying the aperiodic CSI-RS are provided in the time slot and the active BWP of the serving cell.

18. The method of claim 11, further comprising:

obtaining, by the UE, DCI scheduling a Physical Downlink Shared Channel (PDSCH) from the first CORESET; and

applying, by the UE, a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold;

wherein the second CORESET overlaps the PDSCH in at least one symbol in a time domain.

19. The method of claim 18, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

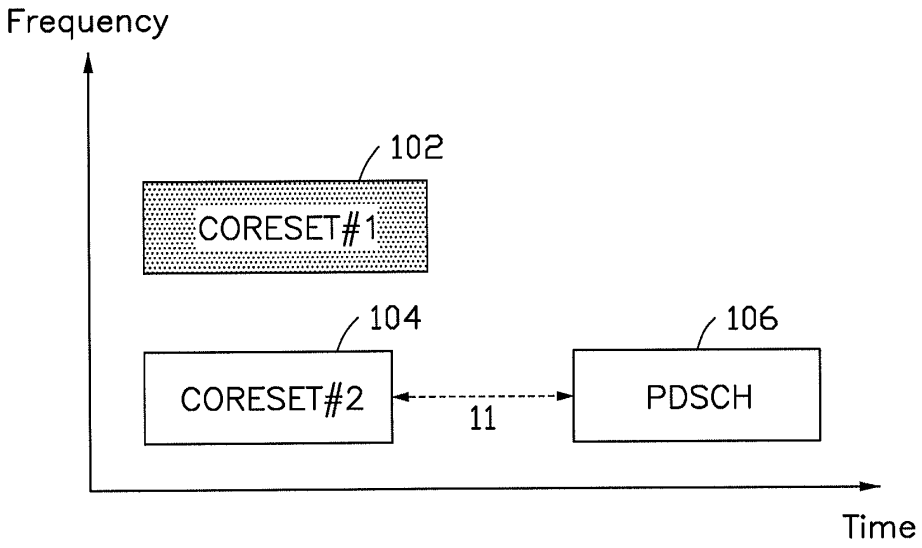

Frequency
102
CORESET#1
104
CORESET#2
11
106
PDSCH
Time

FIG. 1

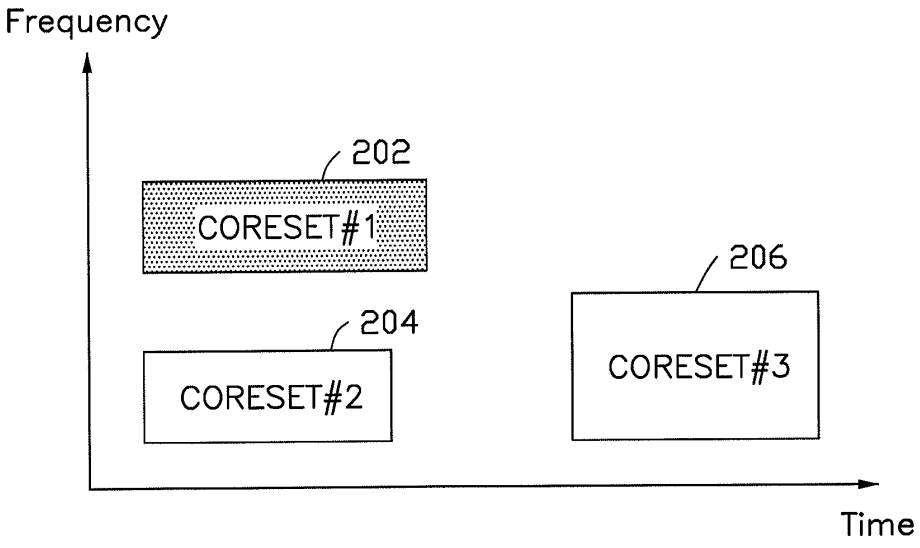

Frequency
202
CORESET#1
204
CORESET#2
206
CORESET#3
Time

FIG. 2

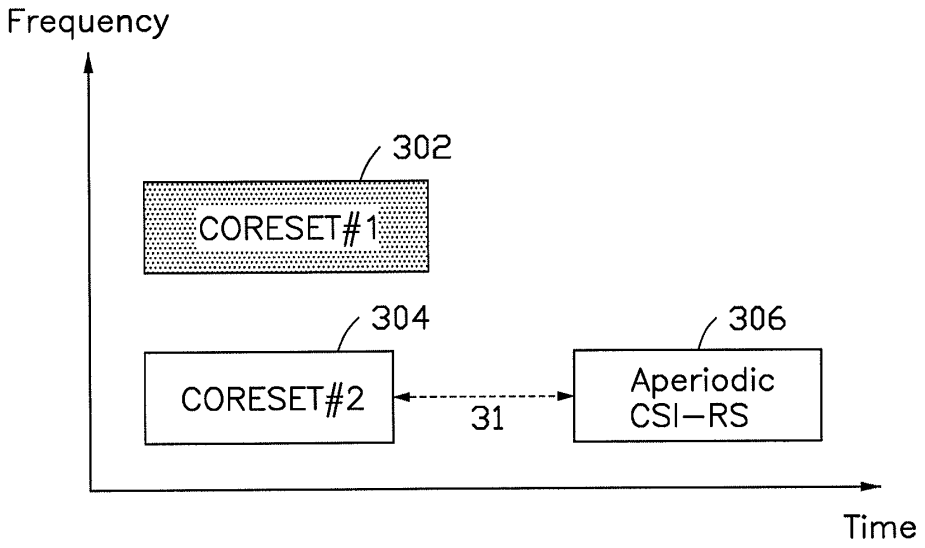

Frequency
302
CORESET#1
304
CORESET#2
306
Aperiodic CSI–RS
31
Time

FIG. 3

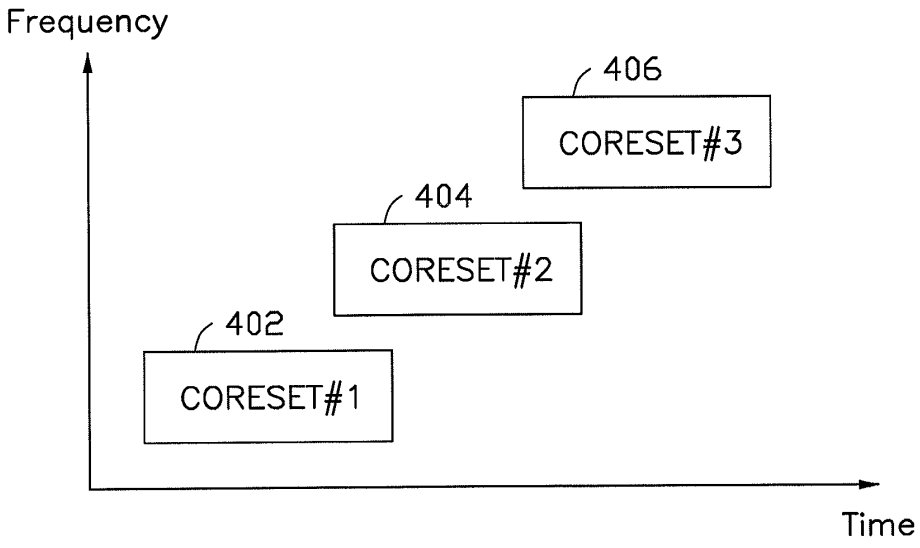

Frequency
406
CORESET#3
404
CORESET#2
402
CORESET#1
Time

FIG. 4

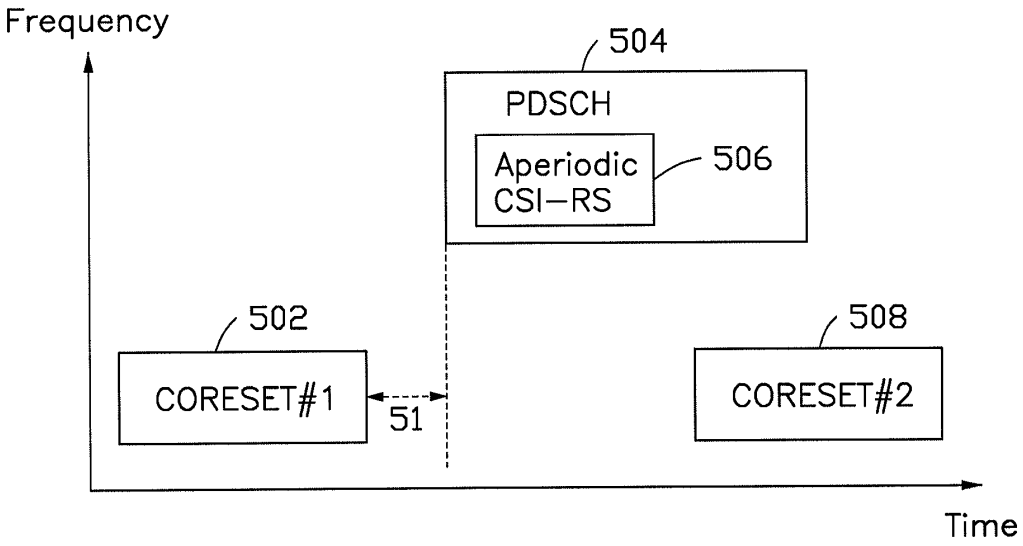

Frequency
504
PDSCH
Aperiodic CSI-RS
506
502
CORESET#1
51
508
CORESET#2
Time

FIG. 5

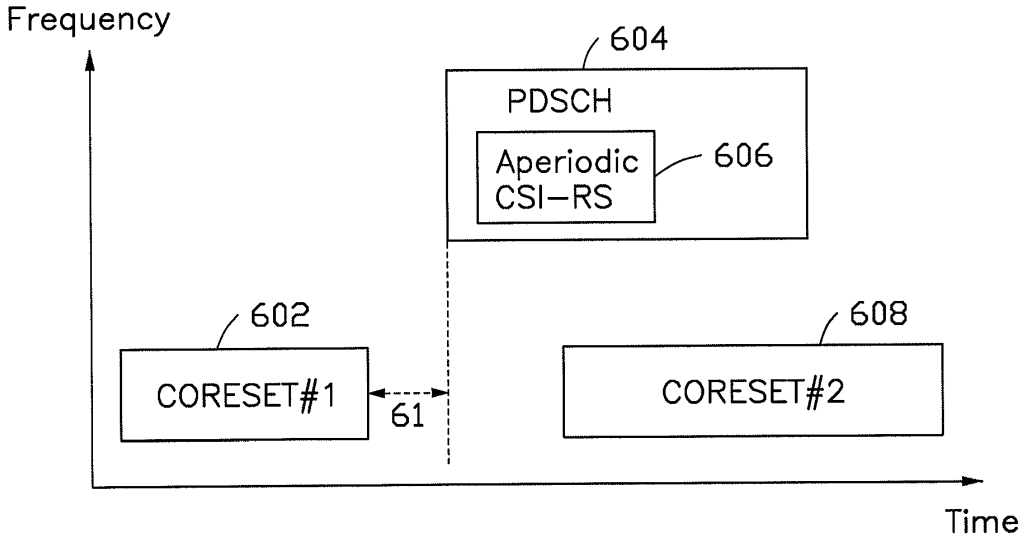

Frequency
604
PDSCH
Aperiodic CSI-RS
606
602
CORESET#1
61
608
CORESET#2
Time

FIG. 6

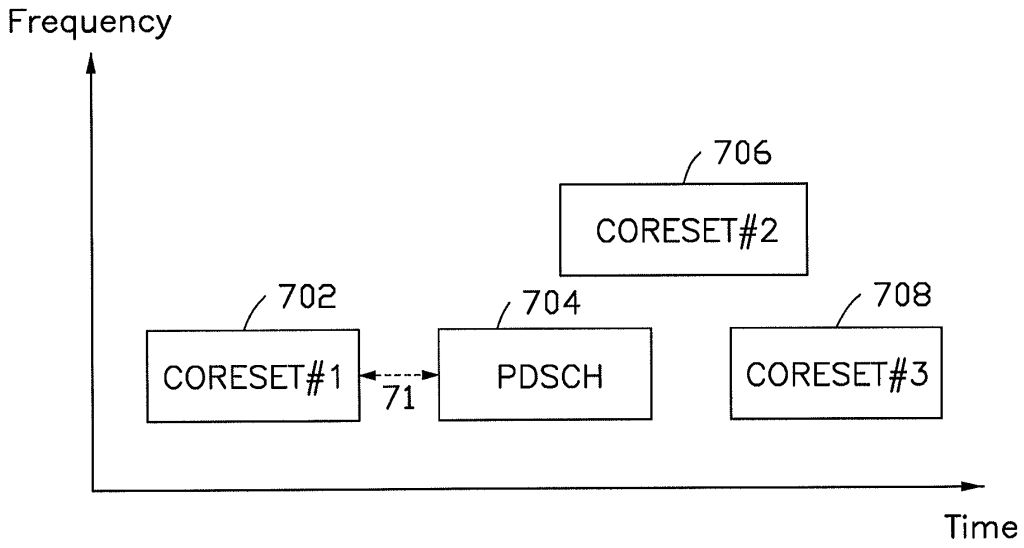

Frequency
706
CORESET#2
702
704
708
CORESET#1
71
PDSCH
CORESET#3
Time

FIG. 7

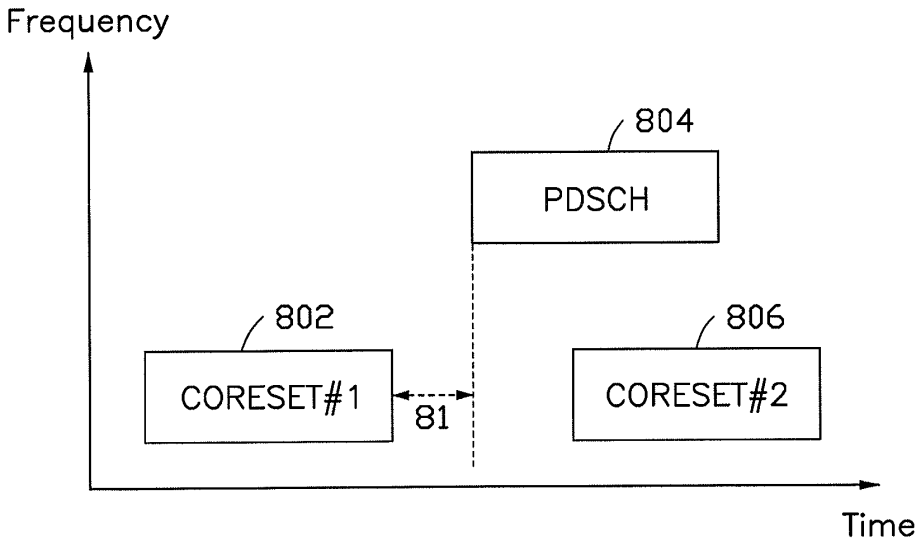

Frequency
804
PDSCH
802
806
CORESET#1
81
CORESET#2
Time

FIG. 8

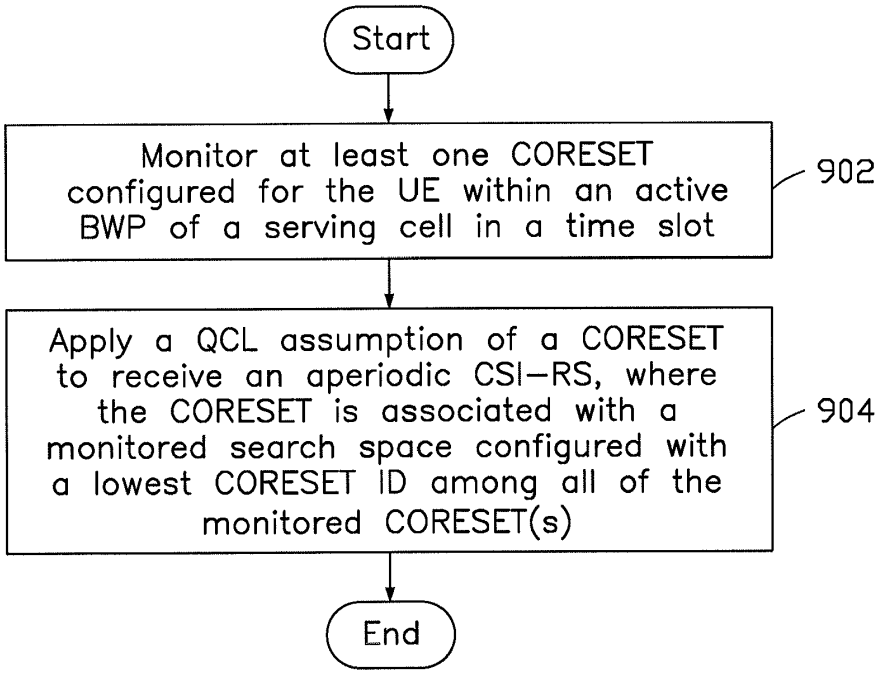

Start
Monitor at least one CORESET configured for the UE within an active BWP of a serving cell in a time slot
902
Apply a QCL assumption of a CORESET to receive an aperiodic CSI-RS, where the CORESET is associated with a monitored search space configured with a lowest CORESET ID among all of the monitored CORESET(s)
904
End

FIG. 9

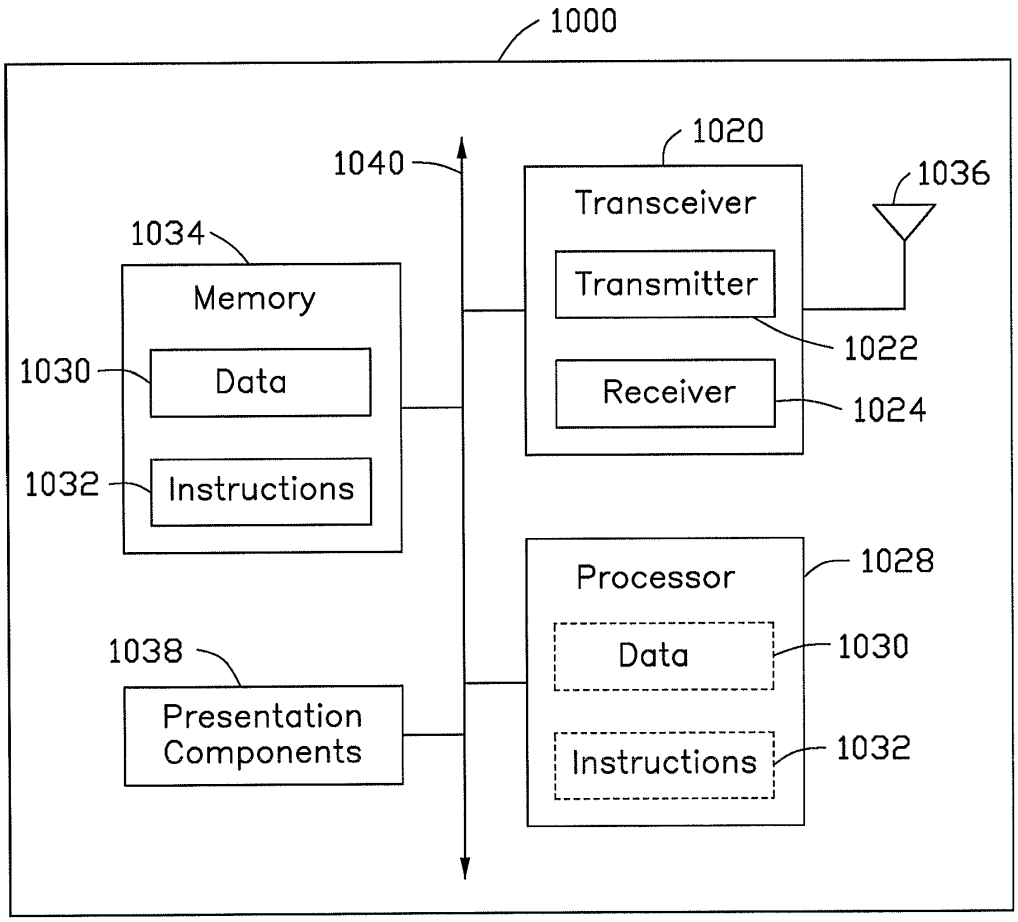

1000
1040
1020
Transceiver
1036
1034
Memory
Transmitter
1030
Data
1022
Receiver
1024
1032
Instructions
Processor
1028
1038
Data
1030
Presentation Components
Instructions
1032

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/112403

A. CLASSIFICATION OF SUBJECT MATTER

H04L 5/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04L; H04W; H04Q

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)

CNPAT,CNKI,WPI,EPODOC,3GPP: control resource sets, CORESET, quasi co-location, QCL, assumption, lowest, active, BWP, CSI,PDCCH,PDSCH, schedule, offset, threshold, search space

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ZTE. "Maintenance for beam management; R1-1808196" *3GPP TSG RAN WG1 Meeting #94,* 24 August 2018 (2018-08-24), sections 2-4	1-19
X	ZTE. "Simultaneous transmission and reception of different channels and reference signals; R1-1805830" *3GPP TSG RAN WG1 Meeting #93,* 25 May 2018 (2018-05-25), section 2	1-19
X	VIVO. "Maintenance for beam management; R1-1810366" *3GPP TSG RAN WG1 #94b,* 12 October 2018 (2018-10-12), sections 2-3	1-19
A	CN 108111286 A (ZTE CORPORATION) 01 June 2018 (2018-06-01) the whole document	1-19
A	WO 2018016907 A1 (LG ELECTRONICS INC.) 25 January 2018 (2018-01-25) the whole document	1-19

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 January 2020	**23 January 2020**
Name and mailing address of the ISA/CN **National Intellectual Property Administration, PRC** **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088** **China**	Authorized officer **JIN,Jing**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2019/112403

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 108111286 A	01 June 2018	WO 2019095723 A1	23 May 2019
WO 2018016907 A1	25 January 2018	US 2019306847 A1	03 October 2019
		CN 109565390 A	02 April 2019
		EP 3490184 A1	29 May 2019

1. IN202147019446 - METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

National Biblio. Data | Patent Family | Documents

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Priority Data
62/754165 01.11.2018 US

Title
(EN) METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

Abstract
(EN) A method of wireless communications is provided. The method includes monitoring, by a user equipment (UE), at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the monitored CORESET (s).

Related patent documents
WO/2020/088295 US20200145982 KR1020210076989 CN113039740 EP3874668 JP2022506048 US20210258946

FORM 2

THE PATENTS ACT, 1970
(39 of 1970)
AND
THE PATENTS RULES, 2003

COMPLETE SPECIFICATION

(See Section 10; rule 13)

TITLE OF THE INVENTION

"METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS"

APPLICANT

FG INNOVATION COMPANY LIMITED
of Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun New Territories, Hong Kong, China; Nationality: China

The following specification particularly describes
the invention and the manner in which
it is to be performed

METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] The present application claims the benefit of and priority to a provisional U.S. Patent Application Serial No. 62/754,165, filed on November 1, 2018, entitled "Method and Apparatus for Spatial QCL assumptions with Overlapped CORESETs," with Attorney Docket No. US75368 (hereinafter referred to as "US75368 application"). The disclosure of the US75368 application is hereby incorporated fully by reference into the present application.

FIELD

[0002] The present disclosure generally relates to wireless communications, and more particularly, to methods and apparatuses of determining Quasi Co-Location (QCL) assumptions for beam operations.

BACKGROUND

[0003] The next generation (e.g., Fifth Generation (5G) New Radio (NR)) wireless communication system may utilize beamforming technologies to provide directional communications. For example, a User Equipment (UE) may perform beam operations to switch its beam(s) to transmit or receive channels or resources. Each beam the UE applies may be considered as a spatial domain filter that is determined by a corresponding QCL assumption.

[0004] However, current specifications for the next generation wireless communication system may cause a UE to perform unfavorable beam switching when the UE is configured with multiple Control Resource Sets (CORESETs). In addition, although the next generation wireless communication system enables utilizing a flexible resource allocation scheme, a UE is likely unable to decide which QCL assumption to use due to the ambiguity of the current specifications for the next generation wireless communication system.

[0005] Therefore, there is a need in the art for methods and apparatuses of determining QCL assumptions for beam operations when multiple CORESETs are configured to a UE.

SUMMARY

[0006] The present disclosure is directed to methods and apparatuses for determining QCL

assumptions.

[0007] According to an aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, and apply a first QCL assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET may be associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

[0008] According to another aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, receive Downlink Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH) from a Physical Downlink Control Channel (PDCCH), and apply a QCL assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between a last symbol of the PDCCH carrying the DCI and a first symbol of the PDSCH is less than a threshold. The PDCCH may be transmitted in one of a set of one or more monitored CORESETs, and the one of the set of one or more monitored CORESETs may be associated with a monitored search space configured with a lowest CORESET ID among the set of one or more monitored CORESETs.

[0009] According to another aspect of the present disclosure, a method of wireless communications is provided. The method includes monitoring, by a UE, at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first QCL assumption of a first CORESET of the set of one or more monitored CORESETs to receive an aperiodic CSI-RS. The first CORESET may be associated with a monitored search space configured with a lowest CORESET ID among the set of one or more monitored CORESETs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Aspects of the present disclosure are best understood from the following detailed description when read with the accompanying figures. Various features are not drawn to scale. Dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

[0011] Fig. 1 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0012] Fig. 2 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0013] Fig. 3 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0014] Fig. 4 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0015] Fig. 5 is a schematic diagram illustrating a PDSCH overlapping a CORESET in the time domain, in accordance with an example implementation of the present disclosure.

[0016] Fig. 6 is a schematic diagram illustrating that an aperiodic CSI-RS, a PDSCH, and a CORESET are overlapped in the time domain, in accordance with an example implementation of the present disclosure.

[0017] Fig. 7 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0018] Fig. 8 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with an example implementation of the present disclosure.

[0019] Fig. 9 is a flowchart for a method of determining QCL assumptions in a wireless communication system, in accordance with an example implementation of the present disclosure.

[0020] Fig. 10 is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure.

DETAILED DESCRIPTION

[0021] The following description contains specific information pertaining to example implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely example implementations. However, the

present disclosure is not limited to merely these example implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale and are not intended to correspond to actual relative dimensions.

[0022] For the purpose of consistency and ease of understanding, like features may be identified (although, in some examples, not shown) by the same numerals in the example figures. However, the features in different implementations may be differed in other respects, and thus shall not be narrowly confined to what is shown in the figures.

[0023] The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent. The expression "at least one of A, B and C" or "at least one of the following: A, B and C" means "only A, or only B, or only C, or any combination of A, B and C."

[0024] Additionally, for the purposes of explanation and non-limitation, specific details, such as functional entities, techniques, protocols, standard, and the like are set forth for providing an understanding of the described technology. In other examples, detailed description of well-known methods, technologies, systems, architectures, and the like are omitted so as not to obscure the description with unnecessary details.

[0025] Persons skilled in the art will immediately recognize that any network function(s) or algorithm(s) described in the present disclosure may be implemented by hardware, software or a combination of software and hardware. Described functions may correspond to modules which may be software, hardware, firmware, or any combination thereof. The software implementation may comprise computer executable instructions stored on computer readable medium such as memory or other type of storage devices. For example, one or more microprocessors or general-purpose computers with communication processing capability may be programmed with corresponding executable instructions and carry out the described network function(s) or

algorithm(s). The microprocessors or general-purpose computers may be formed of Applications Specific Integrated Circuitry (ASIC), programmable logic arrays, and/or using one or more Digital Signal Processor (DSPs). Although some of the example implementations described in this specification are oriented to software installed and executing on computer hardware, nevertheless, alternative example implementations implemented as firmware or as hardware or combination of hardware and software are well within the scope of the present disclosure.

[0026] The computer readable medium includes but is not limited to Random Access Memory (RAM), Read Only Memory (ROM), Erasable Programmable Read-Only Memory (EPROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), flash memory, Compact Disc Read-Only Memory (CD-ROM), magnetic cassettes, magnetic tape, magnetic disk storage, or any other equivalent medium capable of storing computer-readable instructions.

[0027] A radio communication network architecture (e.g., a Long Term Evolution (LTE) system, an LTE-Advanced (LTE-A) system, an LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network (RAN)) typically includes at least one Base Station (BS), at least one User Equipment (UE), and one or more optional network elements that provide connection towards a network. The UE communicates with the network (e.g., a Core Network (CN), an Evolved Packet Core (EPC) network, an Evolved Universal Terrestrial Radio Access Network (E-UTRAN), a 5G Core (5GC), or an internet), through a RAN established by one or more BSs.

[0028] It should be noted that, in the present application, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, a vehicle, or a Personal Digital Assistant (PDA) with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

[0029] A BS may be configured to provide communication services according to at least one of the following Radio Access Technologies (RATs): Worldwide Interoperability for Microwave Access (WiMAX), Global System for Mobile communications (GSM, often referred to as 2G), GSM Enhanced Data rates for GSM Evolution (EDGE) Radio Access Network (GERAN), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS, often referred to as 3G) based on basic Wideband-Code Division Multiple Access (W-CDMA), High-Speed Packet Access (HSPA), LTE, LTE-A, eLTE (evolved LTE, e.g., LTE connected to 5GC),

NR (often referred to as 5G), and/or LTE-A Pro. However, the scope of the present application should not be limited to the above-mentioned protocols.

[0030] A BS may include, but is not limited to, a node B (NB) as in the UMTS, an evolved Node B (eNB) as in the LTE or LTE-A, a Radio Network Controller (RNC) as in the UMTS, a Base Station Controller (BSC) as in the GSM/GERAN, a ng-eNB as in an Evolved Universal Terrestrial Radio Access (E-UTRA) BS in connection with the 5GC, a next generation Node B (gNB) as in the 5G-RAN, and any other apparatus capable of controlling radio communication and managing radio resources within a cell. The BS may serve one or more UEs through a radio interface.

[0031] The BS is operable to provide radio coverage to a specific geographical area using a plurality of cells forming the radio access network. The BS supports the operations of the cells. Each cell is operable to provide services to at least one UE within its radio coverage. More specifically, each cell (often referred to as a serving cell) provides services to serve one or more UEs within its radio coverage (e.g., each cell schedules the Downlink (DL) and optionally uplink resources to at least one UE within its radio coverage for DL and optionally uplink packet transmissions). The BS can communicate with one or more UEs in the radio communication system through the plurality of cells. A cell may allocate Sidelink (SL) resources for supporting Proximity Service (ProSe) or Vehicle to Everything (V2X) service. Each cell may have overlapped coverage areas with other cells.

[0032] As discussed above, the frame structure for NR is to support flexible configurations for accommodating various next generation (e.g., 5G) communication requirements, such as Enhanced Mobile Broadband (eMBB), Massive Machine Type Communication (mMTC), Ultra-Reliable and Low-Latency Communication (URLLC), while fulfilling high reliability, high data rate and low latency requirements. The Orthogonal Frequency-Division Multiplexing (OFDM) technology as agreed in the 3rd Generation Partnership Project (3GPP) may serve as a baseline for NR waveform. The scalable OFDM numerology, such as the adaptive sub-carrier spacing, the channel bandwidth, and the Cyclic Prefix (CP) may also be used. Additionally, two coding schemes are considered for NR: (1) Low-Density Parity-Check (LDPC) code and (2) Polar Code. The coding scheme adaption may be configured based on the channel conditions and/or the service applications.

[0033] Moreover, it is also considered that in a transmission time interval TX of a single NR

frame, a DL transmission data, a guard period, and an Uplink (UL) transmission data should at least be included, where the respective portions of the DL transmission data, the guard period, the UL transmission data should also be configurable, for example, based on the network dynamics of NR. In addition, SL resources may also be provided in an NR frame to support ProSe services or V2X services.

[0034] In addition, the terms "system" and "network" herein may be used interchangeably. The term "and/or" herein is only an association relationship for describing associated objects, and represents that three relationships may exist. For example, A and/or B may indicate that: A exists alone, A and B exist at the same time, or B exists alone. In addition, the character "/" herein generally represents that the former and latter associated objects are in an "or" relationship.

[0035] In some implementations, a UE may perform the following processes to determine a default PDSCH beam when multiple search spaces are overlapped in the time domain:

> for a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with Carrier Aggregation (CA) in the same frequency band,
>
> > if the monitoring occasions of the search space are overlapped in the time domain and the search spaces are associated with different CORESETs having different Quasi Co-Location (QCL)-TypeD properties, the UE may monitor the search spaces associated with a given CORESET containing a Common Search Space (CSS) in the active DL BWP in the serving cell with the lowest serving cell index and any other CORESET associated with the same QCL-TypeD properties as the given CORESET,
> >
> > > if two or more CORESETs contain the CSS, the UE may select the CORESET containing the search space having the lowest search space ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index, and
> > >
> > > if none of the CORESETs contains the CSS, the UE may select the CORESET containing the search space having the lowest search space ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index.

[0036] For this purpose, the QCL assumption with respect to the Synchronization Signal

Block (SSB) and the QCL assumption with respect to the Channel Status Information-Reference Signal (CSI-RS) (or Tracking Reference Signal (TRS)) may be considered as two different QCL assumptions, even if the CSI-RS is sourced from the same SSB. The QCL assumption may be based on different parameters, such as the spatial-domain QCL parameters (e.g., QCL TypeD parameter), or the QCL parameters obtained based on at least one of the average delay, the delay spread, the Doppler shift, and the Doppler spread.

[0037] In addition, the UE may perform the process described below:

> if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH (e.g., which means a time interval between the last symbol of the PDCCH carrying the DCI and the first symbol of the PDSCH) is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the Demodulation-Reference Signal (DM-RS) ports of the PDSCH of a serving cell are quasi co-located with the RS(s) in the Transmission Configuration Indication (TCI) state with respect to the QCL assumption(s) used for the PDCCH QCL indication of the lowest CORESET ID in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE.

[0038] In this manner, if the QCL assumption of the DM-RSs of a PDSCH is different from that of the DM-RSs of a PDCCH overlapping the PDSCH in at least one symbol in the time domain, the UE may be expected to prioritize the reception of the PDCCH associated with that CORESET. This may also apply to the intra-band CA case (e.g., the PDSCH and the CORESET are in different Component Carriers (CCs)).

[0039] In some of the present implementations, a UE may be configured with multiple CORESETs, but not all of them may be monitored by the UE. For example, if a UE is configured with two CORESETs that overlap each other in at least one symbol (e.g., an OFDM symbol) in the time domain, the UE may select one of the CORESETs to monitor based on certain priority rule(s) or pre-configuration(s).

[0040] In some of the present implementations, the UE may prioritize and monitor a CORESET if the monitored CORESET is associated with a CSS and the lowest search space ID. By contrast, a non-monitored CORESET may be a CORESET that is associated with a non-monitored search space configuration, for example, due to QCL-TypeD conflicts. The non-

monitored CORESET may be configured on a deactivated BWP, on a deactivated Secondary Cell (SCell), or on the same active BWP of a serving cell as other monitored CORESET(s). In some other implementations, the non-monitored CORESET may contain a PDCCH that overlaps with at least one Resource Element (RE) corresponding to a Synchronization Signal (SS)/Physical Broadcast Channel (PBCH) block. In some other implementations, the non-monitored CORESET may be a CORESET configured for a UE that operates under a Discontinuous Reception (DRX) mode.

[0041] **NON-MONITORED CORESET FOR A DEFAULT PDSCH BEAM**

[0042] In some implementations, a non-monitored CORESET may be used for a beam indication for receiving a PDSCH when the non-monitored CORESET has the lowest CORESET ID among the configured CORESETs.

[0043] For example, if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the DM-RS ports of the PDSCH may be quasi co-located with the RS(s) in the TCI state with respect to the QCL assumption(s). The QCL assumption(s) may be used for a PDCCH QCL indication (e.g., CORESET) with the lowest CORESET ID in the latest slot, where one or more CORESETs, in the latest slot, within the active BWP of the serving cell are configured for the UE.

[0044] Fig. 1 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 1, the UE is configured with two CORESETs, CORESET#1 102 and CORESET#2 104, overlapping in at least one symbol in the time domain. The UE may receive DCI from CORESET#2 104 to schedule PDSCH 106. CORESET#1 102 may not be monitored by the UE due to, for example, priority rules (e.g., CORESET#1 102 is not configured with a CSS, and/or is associated with a non-monitored search space having the lowest search space ID). The non-monitored search space may have the lowest search space ID among those search spaces overlapping this non-monitored search space. For example, if CORESET#1 102 is associated with a non-monitored search space that is configured with a first search space ID, and CORESET#2 104 is associated with a monitored search space that is configured with a second search space ID, the first search space ID may be lower than the second search space ID.

[0045] Currently, assuming that CORESET#1 102 has the lowest CORESET ID, if the scheduling offset 11 between CORESET#2 104 and the corresponding PDSCH 106 is less than a

threshold (e.g., Threshold-Sched-Offset), an RX beam which is determined by the TCI state of CORESET#1 102 may be required to be used to receive PDSCH 106. In this case, the UE is forced to use different RX beams for CORESET#2 104 and PDSCH 106 in order to follow the 3GPP specification. This type of beam switching, however, is undesirable and needs to be prevented.

[0046] **Case 1.1**

[0047] In some of the present implementations, the CORESET having the lowest CORESET ID may not be taken as a non-monitored CORESET. In such a case, if the monitoring occasions of the search space are overlapped in the time domain and the search spaces are associated with different CORESETs having different QCL-TypeD properties, the UE may select the CORESET having the lowest CORESET ID in the monitoring occasions in the active DL BWP of a serving cell with the lowest serving cell index. Any overlapped search space(s) associated with the CORESET(s) having the same QCL-TypeD parameter may be monitored.

[0048] In some other implementations, the UE may select the following CORESETs to monitor according to a predefined priority order (from high priority to low priority):

1) CORESET associated with a CSS;
2) CORESET associated with a search space having the lowest search space ID; and
3) CORESET containing the lowest CORESET ID.

[0049] This priority rule may be used for determining the QCL assumptions of the RX beams when two or more CORESETs are overlapped in the time domain.

[0050] **Case 1.2**

[0051] In some of the present implementations, to avoid unfavourable beam switching, the non-monitored CORESETs may be transparent to the UE. For example, if the scheduling offset between the reception of the DL DCI and the corresponding PDSCH is less than a threshold (e.g., Threshold-Sched-Offset), the UE may assume that the DM-RS ports of the PDSCH are quasi co-located with the RS(s) in the TCI state with respect to the QCL assumption(s). The QCL assumption(s) may be used for a monitored PDCCH QCL indication with the lowest CORESET ID in the latest slot, where one or more CORESETs, in the latest slot, within the active BWP of the serving cell are configured for the UE.

[0052] In this case, the non-monitored PDCCH/CORESET may not be used for the QCL assumption for reception of the scheduled PDSCH.

[0053] In some of the present implementations, a PDCCH is a monitored PDCCH when a UE

prioritizes to monitor the search space(s) associated with a given CORESET (containing the monitored PDCCH) in an active DL BWP of a serving cell having the lowest serving cell index. This UE may be configured to monitor multiple search spaces associated with different CORESETs (e.g., for a single cell operation or for an operation with CA in the same frequency band).

[0054] **Case 1.3**

[0055] In some of the present implementations, a non-monitored CORESET may be treated as a non-configured CORESET by a UE. For example, an RRC configuration for a CORESET may not be used for other purposes when the UE does not monitor the CORESET, but the RRC configuration may still be stored by the UE and become valid again when there is no collision between two or more CORESETs in the subsequent time slots. An example of the UE's operation is described below:

> for a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and the search spaces are associated with different CORESETs having different QCL-TypeD properties, and the search spaces are not monitored by the UE,
> >
> > > the CORESETs that UE does not monitor are transparent to the UE, and treated as blank REs in the corresponding slots; or
> >
> > > at least, the CORESETs that the UE does not monitor may not be used for beam-indication or QCL-indication purposes.

[0056] In some of the present implementations, the UE may maintain and store the RRC configuration of the non-monitored CORESET(s). This RRC configuration may be updated via MAC-CE(s) and/or DCI.

[0057] In some other implementations, the UE may release the RRC configuration for the non-monitored CORESET(s). The released RRC configuration may not be updated or stored by the UE.

[0058] **Case 1.4**

[0059] Currently, there is no clear wording on a non-monitored CORESET whether its QCL

assumption should be maintained, be invalidated, or be overridden by the overlapped monitored CORESET. Example solutions for this issue are described below as different cases.

[0060] **Case 1.4.1**

[0061] In Case 1.4.1, the UE may store and maintain the QCL assumption of the non-monitored CORESET. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search spaces are not monitored by the UE,
> >
> > > the UE may store and maintain the QCL assumption for the non-monitored CORESET(s).

[0062] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be updated via a MAC-CE and/or the DCI.

[0063] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used if the UE supports multiple RX beams.

[0064] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used for the non-overlapped symbols of this CORESET in the time domain.

[0065] In some of the present implementations, the QCL assumption of the non-monitored CORESET may be used as a beam indication, a QCL indication, or being part of a QCL chain.

[0066] **Case 1.4.2**

[0067] In Case 1.4.2, the UE may release or suspend the QCL assumption of the non-monitored CORESET. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,
>
> > if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search space(s) are not monitored by the UE,
> >
> > > the UE may release the QCL assumption for the non-monitored CORESET(s) and for the non-overlapped CORESET(s) related to this search

space, or

> the UE may suspend the QCL assumption for the slots in which the CORESETs are overlapped and non-monitored by the UE, but keep the QCL assumption for the non-overlapped CORESETs in the same search space, or

> the UE may release or suspend the QCL assumption for the overlapped parts of the non-monitored CORESET(s), but keep using the configured QCL assumptions for the non-overlapped parts of the CORESETs (e.g., within one or two OFDM symbols).

[0068] **Option #3**

[0069] In this option, the UE may override the QCL assumption of the non-monitored CORESET by another QCL assumption. An example of the UE's operation is described below:

> For a UE that monitors multiple search spaces associated with different CORESETs, for a single cell operation or for an operation with CA in the same frequency band,

> if the monitoring occasions of the search spaces are overlapped in the time domain and one or more search spaces are not monitored by the UE,

> the UE may override the QCL assumption for the non-monitored CORESET(s) by the monitored CORESET.

[0070] In some of the present implementations, the QCL assumption of the non-monitored CORESET may only be overridden in the overlapped symbols of the non-monitored CORESET.

[0071] In some other implementations, the QCL assumption of the non-monitored CORESET(s) may be overridden in the whole-time interval of the non-monitored CORESET.

[0072] **NON-SELECTED CORESET FOR RADIO LINK MONITOR (RLM) RS SELECTION**

[0073] In some implementations, an RLM RS selection process for a UE is described as follows:

> the UE is not required to use an aperiodic or semi-persistent RS for radio link monitoring, and

> the UE selects N_{RLM} RS(s) provided for the active TCI states for a PDCCH reception in the CORESET(s) associated with the search space(s) with the shortest monitoring periodicity, and

> if multiple CORESETs are associated with the search space(s) with the same periodicity, the UE may select the CORESET(s) with the highest CORESET ID.

[0074] Fig. 2 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 2, the UE is configured with CORESET#1 202, CORESET#2 204, and CORESET#3 206, where CORESET#1 202 overlaps CORESET#2 204 in at least one symbol in the time domain.

[0075] Assuming that CORESET#1 202 has a higher CORESET ID than the overlapped CORESET#2 204, the above-described RLM RS selection process may be ambiguous in a case that CORESET#2 204 is not monitored by the UE.

[0076] In view of this issue, some of the present implementations provide methods to improve the UE's behavior for the RLM RS selection process.

[0077] **Case 2.1**

[0078] In this case, the UE may select the CORESET(s) with the lowest CORESET ID to monitor when there are multiple CORESETs configured to the UE. An example RLM RS selection process is described below:

> the UE is not required to use an aperiodic or semi-persistent RS for radio link monitoring, and

> the UE selects N_{RLM} RS provided for the active TCI states for a PDCCH reception in the CORESET(s) associated with the search space(s) with the shortest monitoring periodicity, and

> if multiple CORESETs are associated with the search space(s) with the same periodicity, the UE may select the CORESET(s) with the lowest CORESET ID containing an active TCI-state to monitor.

[0079] **Case 2.2**

[0080] In this case, to avoid a case that there are no TCI states (or TCI states are not valid) for

selection, the selected CORESET(s) may be monitored by the UE and be configured with TCI state(s) during the RLM RS selection process.

[0081] **NON-MONITORED CORESET FOR A DEFAULT APERIODIC CSI-RS BEAM**

[0082] In some implementations, if there is no PDSCH transmitted in the same symbols as the aperiodic CSI-RS, the default QCL assumption of the aperiodic CSI-RS may be derived from the CORESET with the lowest CORESET ID. An example process applied by a UE for determining a default QCL assumption is described below:

> after the UE successfully decodes the DCI scheduling a PDSCH, if there is only PDSCH(s) transmitted in the same symbols as the CSI-RS, the default QCL assumption of the aperiodic CSI-RS may follow the QCL assumption of the PDSCH (assuming that the scheduling offset between the reception of DCI and the PDSCH is larger than, or equal to, a threshold), and

> if there is no PDSCH transmitted in the same symbols as the CSI-RS, the default QCL assumption of the aperiodic CSI-RS may be derived from the CORESET with the lowest CORESET ID.

[0083] As described above, the CORESET with the lowest CORESET ID may be a non-monitored CORESET. If the non-monitored CORESET is used for a beam indication, an unfavourable beam switching may happen, as shown in Fig. 3.

[0084] Fig. 3 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As show in Fig. 3, the UE is configured with two CORESETs, CORESET#1 302 and CORESET#2 304, overlapping in at least one symbol in the time domain. In addition, the UE may receive DCI from CORESET#2 304 to transmit the aperiodic CSI-RS in resource 306.

[0085] Assuming that CORESET#1 302 has the lowest CORESET ID and is not monitored by the UE, based on the above-described process, CORESET#1 302 may be used for the beam indication (or QCL assumption) for receiving resource 306 carrying the aperiodic CSI-RS when the scheduling offset 31 between the reception of the DCI in CORESET#2 304 and the resource 306 is less than a threshold (e.g., Threshold-Sched-Offset), but this may result in an unfavourable beam switching.

[0086] In view of this issue, in some of the present implementations, the CORESET with the lowest CORESET ID may be expected to be monitored by the UE and contain at least one activated TCI state.

[0087] Fig. 4 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. As shown in Fig. 4, the UE is configured with CORESET#1 402, CORESET#2 404 and CORESET#3 406. CORESET#1 402 may overlap CORESET#2 404 in at least one symbol in the time domain, and CORESET#2 404 may further overlap CORESET#3 406 in at least one symbol in the time domain.

[0088] In this example implementation, the UE may monitor CORESET#1 402 only, or monitor both of CORESET#1 402 and CORESET#3 406 simultaneously. If the UE monitors CORESET#1 402 and CORESET#3 406, then CORESET#2 404 may be the only non-monitored CORESET, and its QCL assumption for the beam indication may follow the processes described in the present disclosure. By contrast, if the UE only monitors CORESET#1 402, then both CORESET#2 404 and CORESET#3 406 may become overlapped non-monitored CORESETs, and their QCL assumptions for the beam indication may either remain the same spatial QCLs, or be overridden by the non-monitored CORESET with the lowest CORESET ID.

[0089] **DEPRIORITIZED PDSCH**

[0090] In some implementations, the reception of a PDSCH may be deprioritized when the PDSCH overlaps one or more CORESETs in the time domain. This PDSCH may be referred to as a deprioritized PDSCH, which means that the level of priority for receiving this PDSCH may be reduced.

[0091] Fig. 5 is a schematic diagram illustrating a PDSCH overlapping a CORESET in the time domain, in accordance with example implementations of the present disclosure. As shown in Fig. 5, the UE may receive DCI in CORESET#1 502 to schedule PDSCH 504 that overlaps CORESET#2 508 in the time domain. In this example implementation, PDSCH 504 may contain resource 506 carrying an aperiodic CSI-RS that does not overlap CORESET#2 508 in the time domain. The location of resource 506 may be scheduled or determined by the DCI obtained from CORESET#1 502. The scheduling offset 51 may be a time interval between the end of the last symbol of the PDCCH carrying the DCI (in CORESET#1 502) and the beginning of the first symbol of PDSCH 504. In this example implementation, the scheduling offset 51 may be less than a threshold (e.g., Threshold-Sched-Offset).

[0092] In some of the present implementations, all CORESETs configured to the UE (e.g., CORESET#1 502 and CORESET#2 508) and the resource carrying the aperiodic CSI-RS (e.g., resource 506 in Fig. 5) may be provided in a time slot in an active BWP of a serving cell.

[0093] In some implementations of the present implementation, CORESET#2 508 may be a non-monitored CORESET associated with a non-monitored search space configured to the UE.

[0094] Techniques for determining the QCL assumption for PDSCH 504 or resource 506 carrying the aperiodic CSI-RS are described below.

[0095] **Case 3.1**

[0096] In this case, the QCL assumption of PDSCH 504 may follow the QCL assumption of CORESET#2 508 that overlaps PDSCH 504 in at least one symbol in the time domain. For example, the UE may assume that the DM-RS ports of PDSCH 504 are quasi co-located with the RS(s) indicated in the TCI state with respect to the QCL assumption(s) used for the PDCCH QCL indication (e.g., corresponding to CORESET#2 508) with the lowest CORESET ID in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE.

[0097] This case may also be applied to the intra-band CA case (in which the PDSCH and the CORESET are in different CCs).

[0098] **Case 3.2**

[0099] In this case, after a successful decoding of the DCI scheduling PDSCH 504, if only PDSCH 504 is transmitted in the same symbols as resource 506 having the aperiodic CSI-RS, the default QCL assumption for the aperiodic CSI-RS resource 506 may follow the QCL assumption of PDSCH 504, even if the reception of PDSCH 504 is deprioritized because of being overlapped with CORESET#2 508 in at least one OFDM symbol in the time domain.

[00100] In some of such implementations, if there are multiple QCL assumptions for a single PDSCH in the time domain over at least one OFDM symbol, the aperiodic CSI RS may follow the same QCL assumption(s) as the aligned PDSCH symbols.

[00101] **Case 3.3**

[00102] Currently, there is no clear wording on a deprioritized PDSCH whether its QCL assumption should be maintained, invalidated, or overridden by the overlapped CORESET. Example solutions for this issue are described below.

[00103] **Case 3.3.1**

[00104] In Case 3.3.1, the UE may store and maintain the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508 shown in Fig. 5) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET (e.g., CORESET#2 508). In some of the present implementations, the QCL assumption of the deprioritized PDSCH may still be used for this PDSCH if the UE supports multiple RX beams. In some other implementations, the QCL assumption of the deprioritized PDSCH may be used for the non-overlapped portion with CORESET#2 508. In some other implementations, the QCL assumption may be used for beam indication purposes or for building a QCL chain.

[00105] **Case 3.3.2**

[00106] In Case 3.3.2, the UE may release, or partially release, the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET (e.g., CORESET#2 508). For example, the UE may release the QCL assumption of PDSCH 504 only for the overlapped portion with CORESET#2 508 in the time domain, while maintaining this QCL assumption for the non-overlapped portion.

[00107] **Case 3.3.3**

[00108] In Case 3.3.3, the UE may override the QCL assumption of the deprioritized PDSCH (e.g., PDSCH 504) by an overlapped monitored CORESET (e.g., CORESET#1 502), if the QCL assumption (e.g., QCL-TypeD parameters) of the DMRSs of this PDSCH is different from the DMRSs of the PDCCH (e.g., in CORESET#2 508) overlapping the PDSCH in at least one symbol in the time domain. The UE may be expected to prioritize the reception of the PDCCH associated with that CORESET.

[00109] In some of the present implementations, if two or more CORESETs are chosen, the UE may select the CORESET with the lowest CORESET ID to override the QCL assumption of the deprioritized PDSCH. In some of the present implementations, the UE may overwrite the QCL assumption of the deprioritized PDSCH only for the overlapped portion with the CORESET(s) in the time domain while maintaining this QCL assumption for the non-overlapped portion.

[00110] DEPRIORITIZED PDSCH FOR OVERLAPPED APERIODIC CSI-RS AND CORESET

[00111] Fig. 6 is a schematic diagram illustrating that an aperiodic CSI-RS, a PDSCH, and a CORESET are overlapped in the time domain, in accordance with example implementations of the present disclosure. As shown in Fig. 6, the UE may receive DCI in CORESET#1 602 to schedule PDSCH 604 that overlaps CORESET#2 608 in the time domain. Similar to Fig. 5, PDSCH 604 may also contain resource 606 carrying an aperiodic CSI-RS, but resource 606 overlaps CORESET#2 608 in the time domain. In addition, the scheduling offset 61 may be a time interval between the end of last symbol of the PDCCH carrying the DCI (in CORESET#1 602) and the beginning of the first symbol of PDSCH 604. In this example implementation, the scheduling offset 61 may be less than a threshold (e.g., Threshold-Sched-Offset).

[00112] In some of the present implementations, the UE may apply the QCL assumption of the monitored and prioritized CORESET (e.g., CORESET#2 608) as a default beam for the reception of the aperiodic CSI-RS resource (e.g., resource 606). In some implementations, both the overlapped and non-overlapped portions of the symbols of the aperiodic CSI-RS in resource 606 may use the same QCL assumption. In some other implementations, only the overlapped portions of the aperiodic CSI-RS in resource 606 may use the same QCL assumption as the overlapped CORESET#2 608, and the non-overlapped portions of the aperiodic CSI-RS in resource 606 may keep using the original QCL configuration.

[00113] DEPRIORITIZED PDSCH FOR NON-MONITORED CORESET(s)

[00114] As described above, if the QCL assumption (e.g., QCL-TypeD) of the PDSCH DMRSs is different from that of the PDCCH DMRSs with which they overlap in at least one symbol in the time domain, the UE may be expected to prioritize the reception of the PDCCH associated with that CORESET over the PDSCH.

[00115] However, if that CORESET is not monitored by the UE (e.g., due to accidentally overlapping with other CORESETs), the UE's behavior may be unclear because the UE may not know whether to prioritize the QCL assumption for the non-monitored CORESET, as illustrated in Fig. 7.

[00116] Fig. 7 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. In the example implementation, the UE may receive DCI from CORESET#1 702 to schedule PDSCH 704 that

overlaps CORESET#2 706 in the time domain, where CORESET#2 706 and CORESEST#3 708 are overlapped in at least one symbol in the time domain with different QCL assumptions. In addition, CORESET#3 is monitored by the UE, and while CORESET#2 is not monitored. As described above, it may be unclear whether the reception of PDSCH 704 should change its QCL assumption for the non-monitored and overlapped CORESET#2 706.

[00117] In view of this issue, techniques for determining the QCL assumption for the PDSCH that overlaps CORESET(s) are described below.

[00118] **Case 4.1**

[00119] In this case, the PDSCH may have the same QCL assumption as the overlapped non-monitored CORESET. For example, in Fig. 7, the QCL assumption of PDSCH 704 may follow the QCL assumption of the overlapped non-monitored CORESET#2 706, if the scheduling offset 71 between the reception of the DCI and the corresponding PDSCH 704 is less than a threshold (e.g., Threshold-Sched-Offset). This case may also apply to the intra-band CA case (e.g., the PDSCH and the overlapped CORESET are in different CCs).

[00120] **Case 4.2**

[00121] Fig. 8 is a schematic diagram illustrating multiple CORESETs configured for a UE, in accordance with example implementations of the present disclosure. In the example implementation, the UE may receive DCI from CORESET#1 802 to schedule PDSCH 804 that overlaps CORESET#2 806 in the time domain. In addition, CORESET#2 806 is monitored by the UE.

[00122] In this case, if the scheduling offset 81 between the reception of the DCI and the corresponding PDSCH 804 is less than a threshold (e.g., Threshold-Sched-Offset), and the QCL assumption of the DMRSs of PDSCH 804 is different from the overlapped monitored PDCCH (in CORESET#2 806), the UE may be expected to prioritize the reception of monitored PDCCH associated with that CORESET (e.g., CORESET#2 806). This case may also apply to the intra-band CA case (e.g., the PDSCH and the CORESET are in different CCs).

[00123] Fig. 9 is a flowchart for a method of determining QCL assumptions in a wireless communication system, in accordance with an example implementation of the present disclosure. In action 902, a UE may monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot. In action 904, the UE may apply a QCL assumption of a CORESET to receive an aperiodic CSI-RS. The CORESET may be associated with a

monitored search space configured with the lowest CORESET ID among the monitored CORESET(s).

[00124] In some of the present implementations, the UE may monitor at least one of multiple CORESETs configured for the UE within an active BWP of a serving cell in a time slot. In addition, the UE may receive DCI scheduling a PDSCH from a PDCCH and apply a QCL assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between an end of a last symbol of the PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold. The above-described PDCCH may be transmitted in one of a set of one or more monitored CORESETs, where this monitored CORESET (in which the PDCCH is transmitted) may be associated with a monitored search space configured with a lowest CORESET ID among the monitored CORESET(s).

[00125] Fig. 10 is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure. As shown in Fig. 10, a node 1000 may include a transceiver 1020, a processor 1028, a memory 1034, one or more presentation components 1038, and at least one antenna 1036. The node 1000 may also include an RF spectrum band module, a BS communications module, a network communications module, and a system communications management module, Input/Output (I/O) ports, I/O components, and power supply (not explicitly shown in Fig. 10). Each of these components may be in communication with each other, directly or indirectly, over one or more buses 1040. In one implementation, the node 1000 may be a UE or a BS that performs various functions described herein, for example, with reference to Figs. 1 through 9.

[00126] The transceiver 1020 having a transmitter 1022 (e.g., transmitting/transmission circuitry) and a receiver 1024 (e.g., receiving/reception circuitry) may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, the transceiver 1020 may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. The transceiver 1020 may be configured to receive data and control channels.

[00127] The node 1000 may include a variety of computer-readable media. Computer-readable media may be any available media that may be accessed by the node 1000 and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication

media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or data.

[00128] Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, Digital Versatile Disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

[00129] The memory 1034 may include computer-storage media in the form of volatile and/or non-volatile memory. The memory 1034 may be removable, non-removable, or a combination thereof. Example memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in Fig. 10, The memory 1034 may store computer-readable, computer-executable instructions 1032 (e.g., software codes) that are configured to, when executed, cause the processor 1028 to perform various functions described herein, for example, with reference to Figs. 1 through 9. Alternatively, the instructions 1032 may not be directly executable by the processor 1028 but be configured to cause the node 1000 (e.g., when compiled and executed) to perform various functions described herein.

[00130] The processor 1028 (e.g., having processing circuitry) may include an intelligent hardware device, e.g., a Central Processing Unit (CPU), a microcontroller, an ASIC, and etc. The processor 1028 may include memory. The processor 1028 may process the data 1030 and the instructions 1032 received from the memory 1034, and information through the transceiver 1020, the base band communications module, and/or the network communications module. The processor 1028 may also process information to be sent to the transceiver 1020 for transmission through the antenna 1036, to the network communications module for transmission to a core

network.

[00131] One or more presentation components 1038 presents data indications to a person or other device. Examples of presentation components 1038 may include a display device, speaker, printing component, vibrating component, etc.

[00132] From the above description, it is manifested that various techniques may be used for implementing the concepts described in the present application without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art may recognize that changes may be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present application is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

We Claim:

1. A user equipment (UE) comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot; and

apply a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS);

wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

2. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

obtain, from the first CORESET, Downlink Control Information (DCI) scheduling the aperiodic CSI-RS, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the aperiodic CSI-RS is less than a threshold.

3. The UE of claim 1, wherein the first CORESET overlaps a second CORESET of the plurality of CORESETs in at least one symbol in a time domain, the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

4. The UE of claim 3, wherein the monitored search space associated with the first CORESET is configured with a first search space ID, the non-monitored search space associated with the second CORESET is configured with a second search space ID, and the first search space

ID is lower than the second search space ID.

5. The UE of claim 3, wherein the second CORESET is configured on one of:

a deactivated Bandwidth Part (BWP); and

a deactivated Secondary Cell (SCell).

6. The UE of claim 3, wherein the second CORESET further overlaps a third CORESET of the set of one or more monitored CORESETs in at least one symbol in the time domain.

7. The UE of claim 1, wherein the plurality of CORESETs and a resource carrying the aperiodic CSI-RS are provided in the time slot and the active BWP of the serving cell.

8. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

obtain DCI scheduling a Physical Downlink Shared Channel (PDSCH) from the first CORESET; and

apply a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold;

wherein the second CORESET overlaps the PDSCH in at least one symbol in a time domain.

9. The UE of claim 8, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

10. A user equipment (UE) comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

monitor at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active Bandwidth Part (BWP) of a serving cell in a time slot;

receive Downlink Control Information (DCI) scheduling a Physical Downlink Shared Channel (PDSCH) from a Physical Downlink Control Channel (PDCCH); and

apply a Quasi Co-Location (QCL) assumption for reception of the PDCCH to receive the PDSCH, when a scheduling offset between an end of a last symbol of the PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold;

wherein the PDCCH is transmitted in one of a set of one or more monitored CORESETs, and the one of the set of one or more monitored CORESETs is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the set of one or more monitored CORESETs.

11. A method of wireless communications, the method comprising:

monitoring, by a user equipment (UE), at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot; and

applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS);

wherein the first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among a set of one or more monitored CORESETs.

12. The method of claim 11, further comprising:

obtaining, by the UE, Downlink Control Information (DCI) scheduling the aperiodic CSI-RS from the first CORESET, wherein a scheduling offset between an end of a last symbol of a Physical Downlink Control Channel (PDCCH) carrying the DCI and a beginning of a first symbol of a resource carrying the aperiodic CSI-RS is less than a threshold.

13. The method of claim 11, wherein the first CORESET overlaps a second CORESET of the plurality of CORESETs in at least one symbol in a time domain, the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

14. The method of claim 13, wherein the monitored search space associated with the first CORESET is configured with a first search space ID, the non-monitored search space associated with the second CORESET is configured with a second search space ID, and the first search space ID is lower than the second search space ID.

15. The method of claim 13, wherein the second CORESET is configured on one of:

a deactivated Bandwidth Part (BWP); and

a deactivated Secondary Cell (SCell).

16. The method of claim 13, wherein the second CORESET further overlaps a third CORESET of the set of one or more monitored CORESETs in at least one symbol in the time domain.

17. The method of claim 11, wherein the plurality of CORESETs and a resource carrying the aperiodic CSI-RS are provided in the time slot and the active BWP of the serving cell.

18. The method of claim 11, further comprising:

obtaining, by the UE, DCI scheduling a Physical Downlink Shared Channel (PDSCH) from the first CORESET; and

applying, by the UE, a second QCL assumption of a second CORESET to receive the PDSCH when a scheduling offset between an end of a last symbol of a PDCCH carrying the DCI and a beginning of a first symbol of the PDSCH is less than a threshold;

wherein the second CORESET overlaps the PDSCH in at least one symbol in a time domain.

19. The method of claim 18, wherein the second CORESET is a non-monitored CORESET in the plurality of CORESETs, and the non-monitored CORESET is associated with a non-monitored search space configured to the UE.

Dated this 28 day of April 2021

~Digitally signed~

ABSTRACT

METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

A method of wireless communications is provided. The method includes monitoring, by a user equipment (UE), at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the monitored CORESET(s).

[FIGURE 9]

Samsung Exhibit 1032, Page 274 of 620

FORM 5
THE PATENTS ACT, 1970
(39 of 1970)
&
The Patents Rules, 2003
DECLARATION AS TO INVENTORSHIP
[Section 10(6), Rule 13(6)]

1. Name of Applicant(s)
FG INNOVATION COMPANY LIMITED of Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun New Territories, Hong Kong, China; Nationality: China

hereby declare that the true and first inventor(s) of the invention disclosed in the complete specification filed in pursuance of my/our application numbered ..... dated 28 April 2021 is/are:

2. INVENTOR(S)
CHENG, Chienchun of FACA 6F, No. 185, Jingye 1st Road, Zhongshan District, Taipei City, Taiwan 11492, China; a Taiwanese citizen,
TSAI, Tsunghua of 12F.-7, No. 135, Ciyun Rd., East Dist., Hsinchu City, Taiwan 30072, China; a Taiwanese citizen,
CHENG, Yuhsin of FACA, 5F-1, No. 5, Hsin-An Rd., Hsinchu Science-based Industrial Park, Hsinchu City, Taiwan 300, China; a Taiwanese citizen,
LIN, Wanchen of No. 130, Zhuangjing Rd., Hualien City, Taiwan 970 , China; a Taiwanese citizen

3. Declaration to be given when the application in India is filed by the applicant(s) in the convention country: -
We the applicant(s) in the convention country hereby declare that our right to apply for a patent in India is by way of assignment from the true and first inventor(s).

Dated this 28 day of April 2021

FG INNOVATION COMPANY LIMITED
By their Agent & Attorney

~Digitally signed~

(Arindam Paul)
REG. No. IN/PA-174
Of De Penning & De Penning

~~**4. Statement (**to be signed by the additional inventor(s) not mentioned in the application form)~~

~~I/We assent to the invention referred to in the above declaration, being included in the complete specification filed in pursuance of the stated application.~~

~~Dated this 28 day of April 2021 .~~

~~Signature of the additional inventor(s)~~
~~Name:~~

To
The Controller of Patents
The Patent office, Chennai

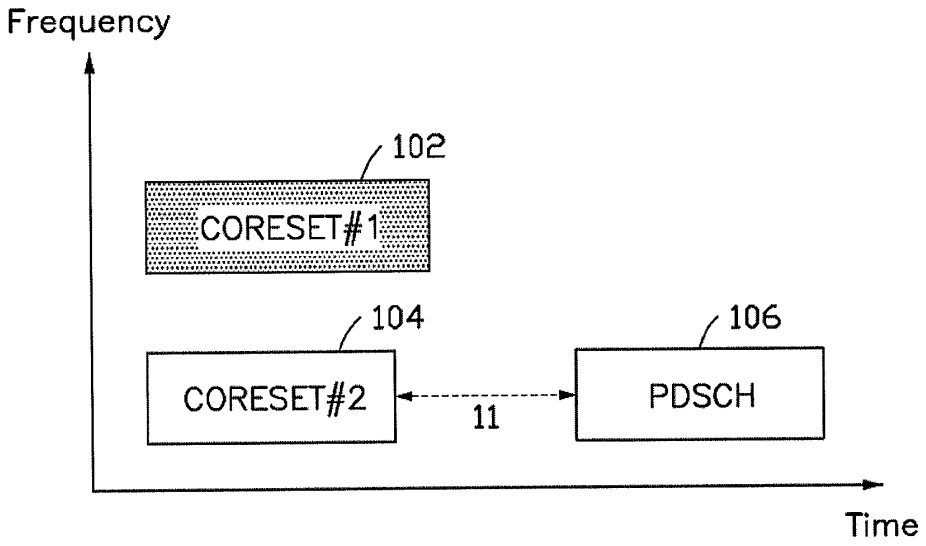

Frequency
102
CORESET#1
104
CORESET#2
11
106
PDSCH
Time

FIG. 1

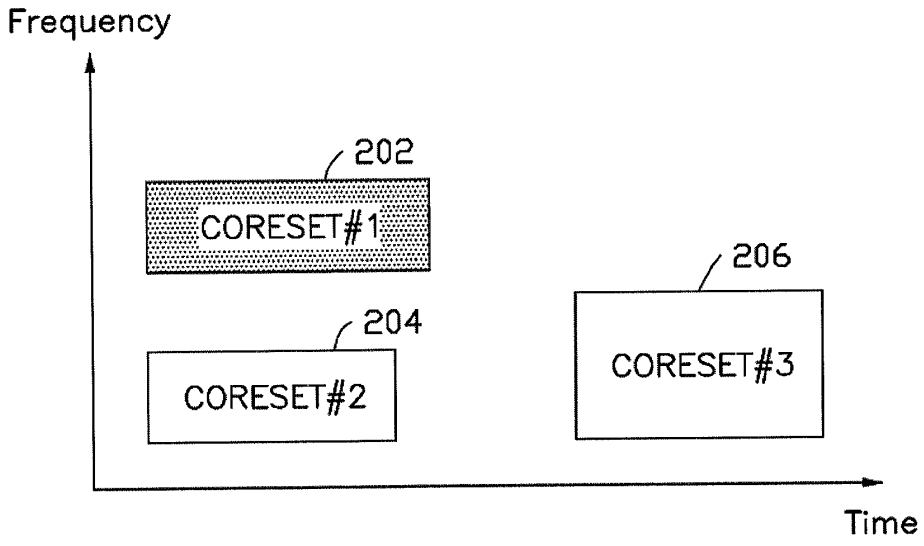

Frequency
202
CORESET#1
204
CORESET#2
206
CORESET#3
Time

FIG. 2

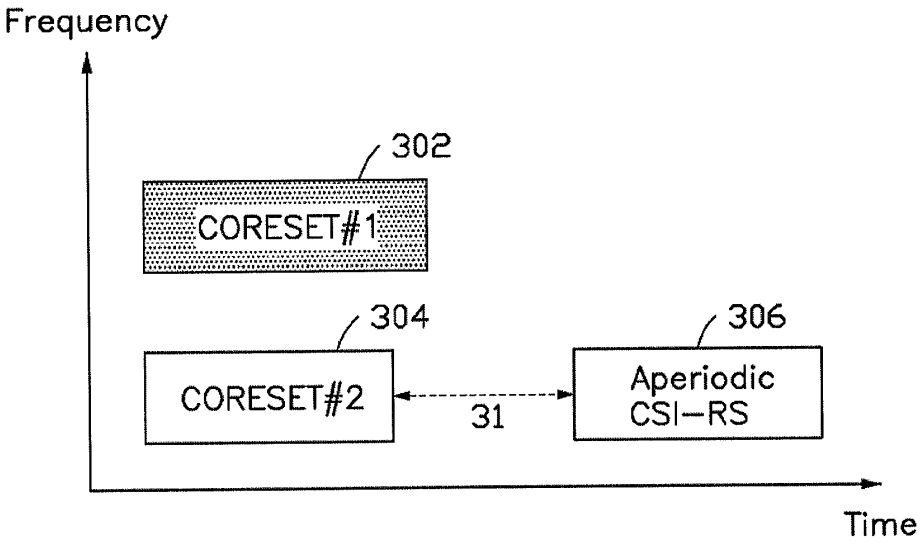

Frequency
302
CORESET#1
304
CORESET#2
31
306
Aperiodic
CSI-RS
Time

FIG. 3

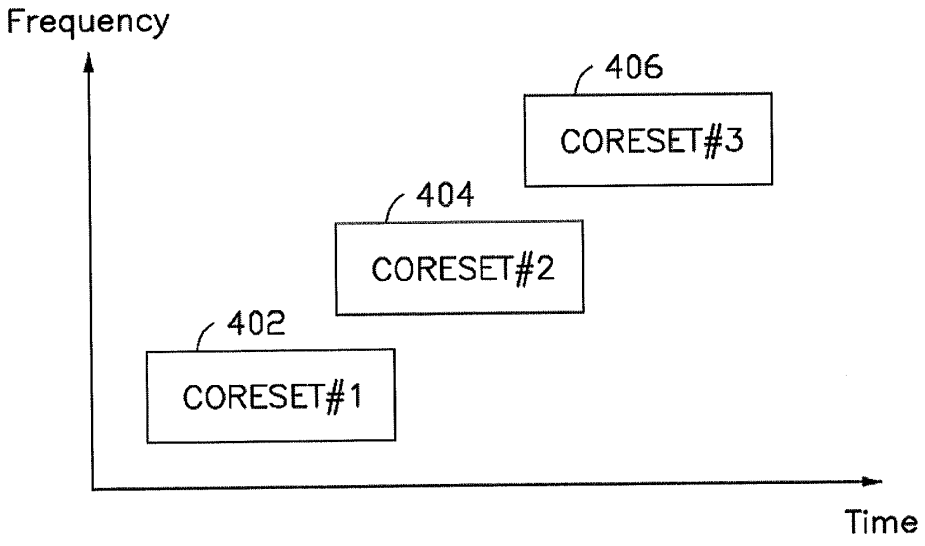

Frequency
406
CORESET#3
404
CORESET#2
402
CORESET#1
Time

FIG. 4

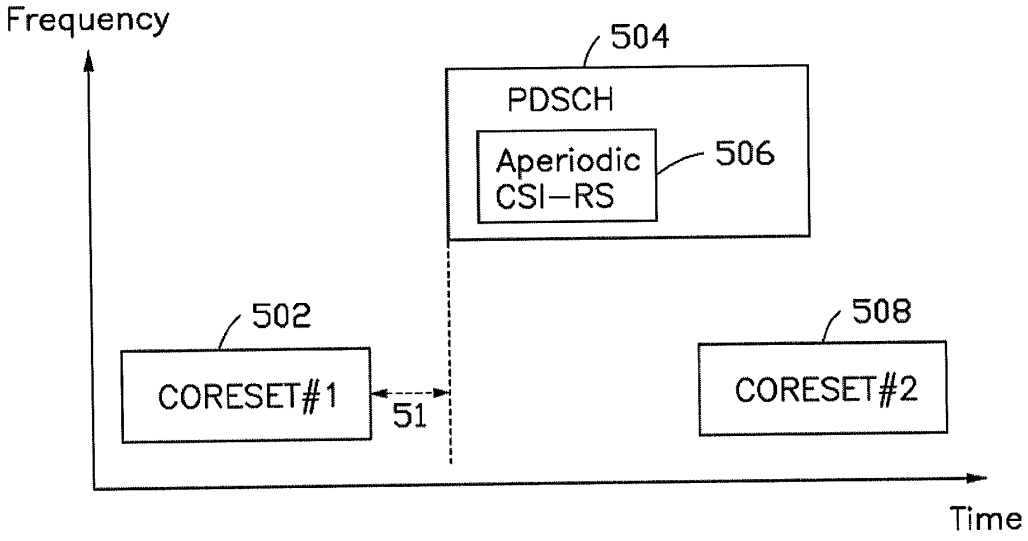

Frequency
504
PDSCH
Aperiodic CSI-RS
506
502
CORESET#1
51
508
CORESET#2
Time

FIG. 5

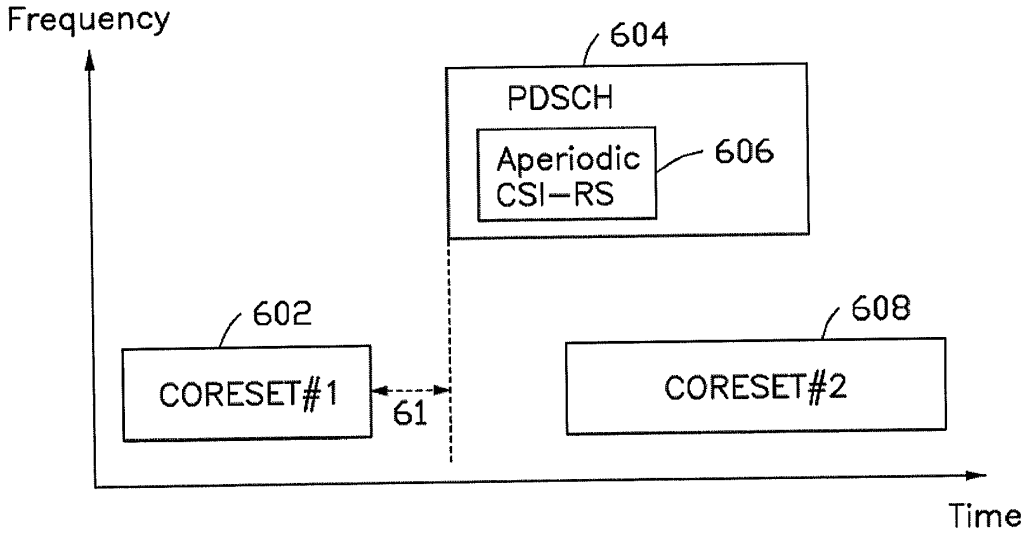

Frequency
604
PDSCH
Aperiodic CSI-RS
606
602
CORESET#1
61
608
CORESET#2
Time

FIG. 6

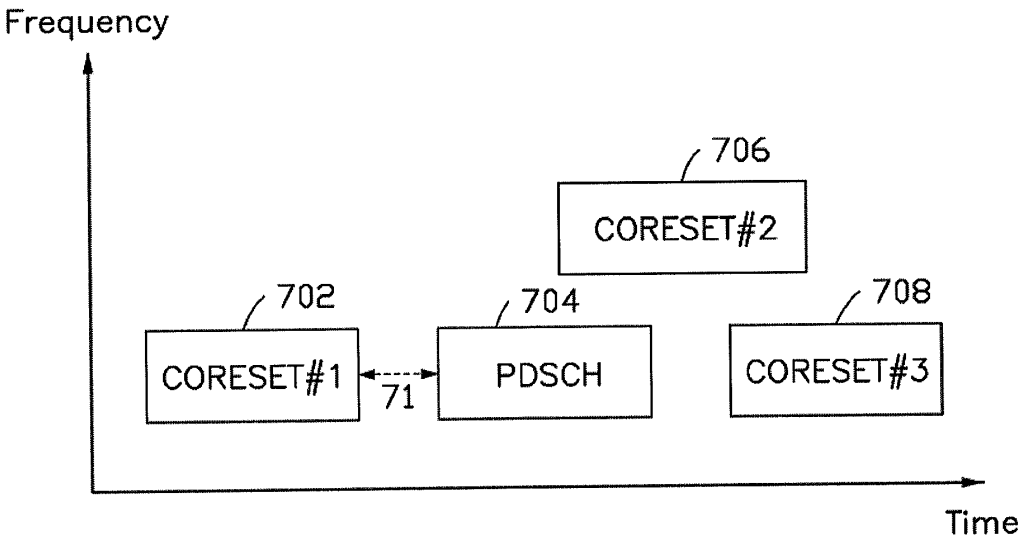

Frequency
706
CORESET#2
702
704
708
CORESET#1
71
PDSCH
CORESET#3
Time

FIG. 7

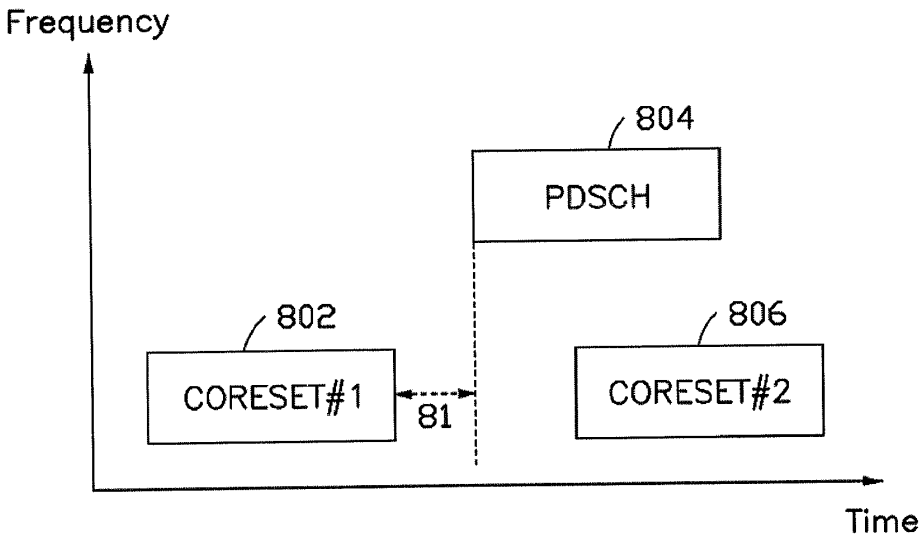

Frequency
804
PDSCH
802
806
CORESET#1
81
CORESET#2
Time

FIG. 8

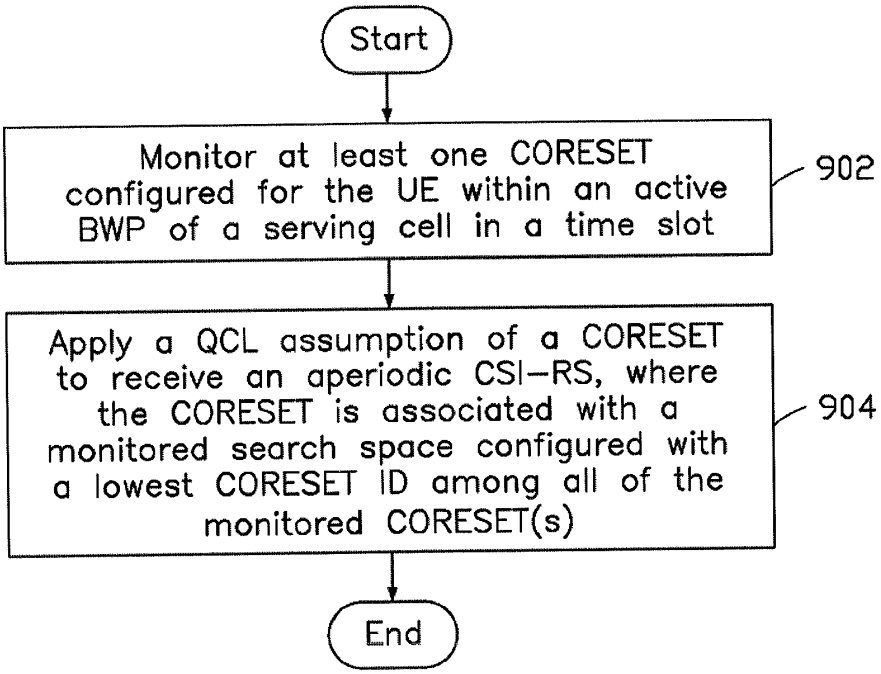

Start
Monitor at least one CORESET configured for the UE within an active BWP of a serving cell in a time slot
902
Apply a QCL assumption of a CORESET to receive an aperiodic CSI-RS, where the CORESET is associated with a monitored search space configured with a lowest CORESET ID among all of the monitored CORESET(s)
904
End

FIG. 9

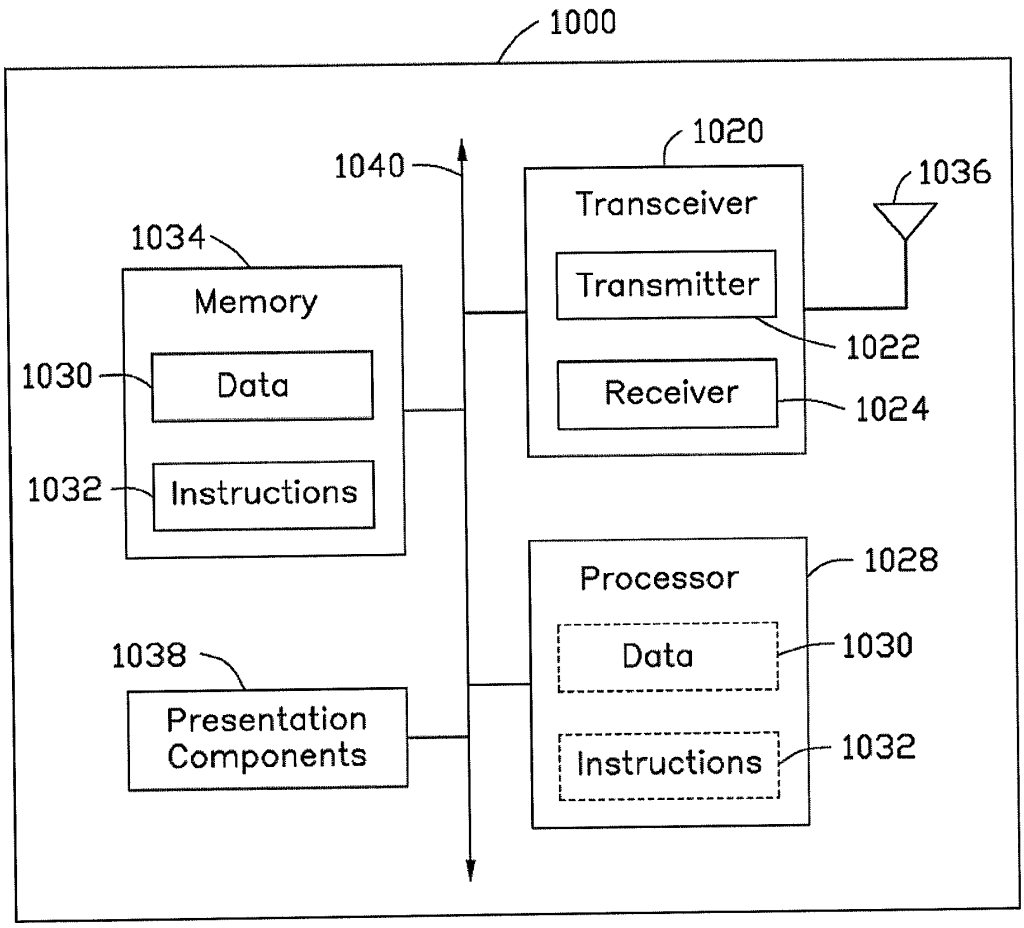

1000
1040
1020
Transceiver
1036
1034
Memory
Transmitter
1022
1030
Data
Receiver
1024
1032
Instructions
Processor
1028
1038
Data
1030
Presentation Components
Instructions
1032

FIG. 10

DE PENNING & DE PENNING
PATENTS - TRADEMARKS - DESIGNS - COPYRIGHT
SINCE 1856

Our Reference : 1239-2021/AP/amp Date 28 April 2021

The Controller of Patents
The Patent Office
Chennai

No. MAS-2021/

Dear Sirs,

Entry into national phase in INDIA
International Application No. : PCT/CN2019/112403
International filing date : 22 October 2019
Date of Entry : 28 April 2021
Applicant : **FG INNOVATION COMPANY LIMITED**

We submit herewith a request for entry into the national phase in India along with a request for examination of the International Patent Application No.PCT/CN2019/112403 for the grant of a Patent.

To this end, we submit herewith the following documents:

1. Duly Executed Form-1
2. Complete Specification
3. Drawings 6 sheets
4. Form 3
5. Form 5
6. Form 18
7. Copy of GPA with Stamp Paper
8. Copy of Form PCT/IB/304
9. Copy of Form PCT/IB/306

We also confirm that the official fees of Rs.26,400/- + Rs.20,000/- = Rs.46,400/- has been paid via e-filing module.

We request you to issue the Application Filing Receipt as soon as possible.

Yours faithfully
De Penning & De Penning

~Digitally signed~

(Arindam Paul)
REG. No.: IN/PA-174

Enclosures: as above

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FORM 1 THE PATENTS ACT 1970 (39 of 1970) and The Patents Rules, 2003 APPLICATION FOR GRANT OF PATENT (See section 7, 54 & 135 and sub-rule (1) of rule 20)		(FOR OFFICE USE ONLY)
	Application No. :	
	Filing Date :	
	Amount of Fee Paid :	
	CBR No. :	
	Signature :	
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)		

2. TYPE OF APPLICATION [Please tick(✓) at the appropriate category]					
Ordinary()		Convention()		PCT-NP (✓)	
Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()

3A. APPLICANT(S)			
Name in Full	Nationality	Country of Residence	Address of the Applicant
FG INNOVATION COMPANY LIMITED	China	China	Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun New Territories, Hong Kong, China

3B. CATEGORY OF APPLICANT [Please tick(✓) at the appropriate category]			
Natural Person ( )	Other than Natural Person		
	Small Entity ( )	Startup ( )	Others (✓)

4. INVENTOR(S) [Please tick(✓) at the appropriate category]		
Are all the inventor(s) same as the applicant(s) name above?	Yes ( )	No (✓)

If "No", furnish the details of the inventor(s)

Name in Full	Nationality	Country of Residence	Address of the Inventor
CHENG, Chienchun	a Taiwanese citizen	China	FACA 6F, No. 185, Jingye 1st Road, Zhongshan District, Taipei City, Taiwan 11492, China
TSAI, Tsunghua	a Taiwanese citizen	China	12F.-7, No. 135, Ciyun Rd., East Dist., Hsinchu City, Taiwan 30072, China
CHENG, Yuhsin	a Taiwanese citizen	China	FACA, 5F-1, No. 5, Hsin-An Rd., Hsinchu Science-based Industrial Park, Hsinchu City, Taiwan 300, China
LIN, Wanchen	a Taiwanese citizen	China	No. 130, Zhuangjing Rd., Hualien City, Taiwan 970 , China

5. TITLE OF THE INVENTION
METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

6. AUTHORISED REGISTERED PATENT AGENT(S)	IN/PA No.	**IN/PA-174**
	Name	**Arindam Paul**
	Mobile No.	8939824355
7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA	Name	**De Penning & De Penning**
	Postal Address	**120 Velachery Main Road, Guindy , Chennai 600 032**
	Telephone No.	**9144 - 42213444**
	Mobile No.	8939824355
	Fax No.	**9144 - 42213402**
	Email ID	**patent@depenning.com**

8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION

Country	Application No.	Filing Date	Name of the Applicant	Title of the Invention	IPC (as classified in the convention country)
USA	62/754,165	01/11/2018	**CHENG, Chienchun ; TSAI, Tsunghua ; CHENG, Yuhsin ; LIN, Wanchen**	METHOD AND APPARATUS FOR SPATIAL QCL ASSUMPTIONS WITH OVERLAPPED CORESETS	

9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)

International Application Number	International Filing Date
PCT/CN2019/112403	**22 October 2019**

~~**10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION**~~

~~Original (First) Application No.~~	~~Date of Filing of Original (First) Application~~

~~**11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT**~~

~~Main Application / Patent No.~~	~~Date of Filing of Main Application~~

12. DECLARATIONS

(i) Declaration by the inventor(s)

(In case the applicant is an assignee: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

~~I~~/We, the above named inventor(s) is/are the true & first inventor(s) for this invention and declare that the applicant(s) herein is/are my/our assignee ~~or legal representative~~.

Name	Signature	Date
CHENG, Chienchun	Chienchun	23-APRIL-2021
TSAI, Tsunghua	Tsai, Tsung-Hua	23-April-2021
CHENG, Yuhsin	Cheng Yu Hsin	23. April. 2021
LIN, Wanchen	WanchenLin	23-April-2021

~~(ii) Declaration by the applicant(s) in the convention country~~

~~(In case the applicant in India is different than the applicant in the convention country:~~ ~~the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).~~

~~I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.~~

~~(a) Date~~

~~(b) Signature(s)~~

~~(c) Name(s) of the signatory~~

(iii) Declaration by the applicant(s)

~~I~~/We, the applicant(s) hereby declare(s) that:-

☑ ~~I am~~/We are in possession of the above mentioned invention.

☑ The ~~provisional~~ / complete specification relating to the invention is filed with this application.

☒ The Invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me / us before the grant of patent to me/us

☑ There is no lawful ground of objections to the grant of the Patent to ~~me~~/us.

☒ ~~I am~~ / We are the true & first inventor(s).

☑ ~~I am~~ / We are the assignee ~~or legal representative~~ of true & first inventor(s).

☑ The application or each of the applications, particulars of which are given in Para 8 was the first application in convention country/countries in respect of ~~my~~/our invention(s).

☑ ~~I~~ / We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by ~~me~~/us or by any person from which ~~I~~/we derive the title.

☑ ~~My~~/Our application in India is based on International application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.

☒ The application is divided out of my/our application particulars of which is given in Paragraph-10 and pray that this application may be treated as deemed to have been filed on.....under sec.16 of the Act.

☒ The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph – 11.

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

a) Form 2

Item	Details	Fee	Remarks
Complete/~~provisional~~ specification #	No. of pages 24		Sequence Listing 0 Pages
No. of Claim(s)	No. of Claims 19 and No. of Pages 4		
Abstract	No. of Pages 1		
No. of Drawing(s)	No. of Drawings 10 and No. of Pages 6		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule13(4), the no. of such pages filed with the provisional specification are required to be mentioned here.

(b) complete specification (in conformation with the international application)/ ~~as amended before the International Preliminary Examination Authority (IPEA)~~, as applicable (2 copies)
(c) ~~Sequence listing in electronic form~~
(d) Drawings (in conformation with the international application)/ ~~as amended before the International Preliminary Examination Authority (IPEA)~~, as applicable (2 copies)
~~(e) Priority document(s) or a request to retrieve the priority documents from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.~~
~~(f) Translation of priority document / specification / international search report / international preliminary report on patentability~~
(g) statement and undertaking on Form 3
(h) Declaration of Inventorship on Form 5
(i) Request for Examination on Form 18
(j) Copy of GPA with Stamp Paper
(k) Copy of Form PCT/IB/304
(l) Copy of Form PCT/IB/306

Total Fee Rs.26,400/- + Rs.20,000/- = Rs.46,400/- is paid by e-filing module.

I / We hereby declare that to the best of my/our knowledge, information and belief the fact and matters stated herein are correct and I/we request that a patent may be granted to me/us for the said invention.

Dated this 28 day of April 2021

Signature :

Name : Arindam Paul
Reg No. IN/PA-174
Of De Penning & De Penning
Agent for the Applicants

To,
The Controller of Patents
The Patent Office, at Chennai

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92*bis*.1 and Administrative Instructions, Section 422)

To:

SHENZHEN SCIENBIZIP INTELLECTUAL PROPERTY AGENCY CO., LTD.
9F, Rongqun Building,
No. 83 Longguan East Rd., Longhua New Dist.,
Shenzhen, Guangdong 518109
Chine

Date of mailing *(day/month/year)*
15 April 2021 (15.04.2021)

Applicant's or agent's file reference
WO41218

IMPORTANT NOTIFICATION

International application No.
PCT/CN2019/112403

International filing date *(day/month/year)*
22 October 2019 (22.10.2019)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address
FG INNOVATION COMPANY LIMITED
CHIE-MING CHOU
Flat 2623, 26/F Tuen Mun Central Square,
22 Hoi Wing Road, Tuen Mun, New Territories,
Tuen Mun, Hong Kong
China

State of Nationality: CN
State of Residence: CN
Telephone No.:
Facsimile No.:
E-mail address:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address
FG INNOVATION COMPANY LIMITED
Flat 2623, 26/F Tuen Mun Central Square,
22 Hoi Wing Road, Tuen Mun, New Territories,
Hong Kong
China

State of Nationality: CN
State of Residence: CN
Telephone No.:
Facsimile No.:
E-mail address:
☐ Notifications by e-mail authorized

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the Authority(ies) specified for supplementary search
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO
34, chemin des Colombettes

Authorized officer

ADVANCE E-MAIL

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION, OBTENTION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

SHENZHEN SCIENBIZIP INTELLECTUAL PROPERTY AGENCY CO., LTD.
9F, Rongqun Building,
No. 83 Longguan East Rd., Longhua New Dist.,
Shenzhen, Guangdong 518109
CHINE

Date of mailing *(day/month/year)* 15 November 2019 (15.11.2019)	
Applicant's or agent's file reference WO41218	**IMPORTANT NOTIFICATION**
International application No. PCT/CN2019/112403	International filing date *(day/month/year)* 22 October 2019 (22.10.2019)
International publication date *(day/month/year)* **Not yet published**	Priority date *(day/month/year)* 01 November 2018 (01.11.2018)
Applicant FG INNOVATION COMPANY LIMITED	

The applicant is hereby notified of the date of receipt (or of obtaining by the International Bureau) of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to the date of receipt, **the priority document concerned was submitted or transmitted to or obtained by the International Bureau in compliance with Rule 17.1(a), (b) or (b-*bis*)**. This Form replaces any previously issued notification concerning submission, transmittal or obtaining of priority documents.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
01 November 2018 (01.11.2018)	62/754,165	US	10 November 2019 (10.11.2019)

The letters "NR" denote a priority document which, on the date of mailing of this Form, had not yet been received or obtained by the International Bureau in compliance with Rule 17.1(a), (b) or (b-*bis*). Where the applicant has failed to either submit, request to prepare and transmit, or to request the International Bureau to obtain the priority document within the applicable time limit under that Rule, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

An asterisk "*" next to a date of receipt, denotes a priority document submitted or transmitted to or obtained by the International Bureau but not in compliance with Rule 17.1(a), (b) or (b-*bis*) (the priority document was received after the time limit prescribed in Rule 17.1(a); the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b) or the request to the International Bureau to obtain the priority document was made after the applicable time limit under Rule 17.1(b-*bis*)). Even though the priority document was not furnished in compliance with Rule 17.1(a), (b) or (b-*bis*), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Xiaofan Tang

FORM 1 THE PATENTS ACT 1970 (39 of 1970) and The Patents Rules, 2003 APPLICATION FOR GRANT OF PATENT (See section 7, 54 & 135 and sub-rule (1) of rule 20)		(FOR OFFICE USE ONLY)
	Application No. :	
	Filing Date :	
	Amount of Fee Paid :	
	CBR No. :	
	Signature :	
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)		

2. TYPE OF APPLICATION [Please tick(✓) at the appropriate category]

Ordinary()		Convention()		PCT-NP (✓)	
Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()

3A. APPLICANT(S)

Name in Full	Nationality	Country of Residence	Address of the Applicant
FG INNOVATION COMPANY LIMITED	China	China	Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun New Territories, Hong Kong, China

3B. CATEGORY OF APPLICANT [Please tick(✓) at the appropriate category]

Natural Person ( )	Other than Natural Person		
	Small Entity ( )	Startup ( )	Others (✓)

4. INVENTOR(S) [Please tick(✓) at the appropriate category]

Are all the inventor(s) same as the applicant(s) name above?	Yes ( )	No (✓)

If "No", furnish the details of the inventor(s)

Name in Full	Nationality	Country of Residence	Address of the Inventor
CHENG, Chienchun	a Taiwanese citizen	China	FACA 6F, No. 185, Jingye 1st Road, Zhongshan District, Taipei City, Taiwan 11492, China
TSAI, Tsunghua	a Taiwanese citizen	China	12F.-7, No. 135, Ciyun Rd., East Dist., Hsinchu City, Taiwan 30072, China
CHENG, Yuhsin	a Taiwanese citizen	China	FACA, 5F-1, No. 5, Hsin-An Rd., Hsinchu Science-based Industrial Park, Hsinchu City, Taiwan 300, China
LIN, Wanchen	a Taiwanese citizen	China	No. 130, Zhuangjing Rd., Hualien City, Taiwan 970 , China

5. TITLE OF THE INVENTION

METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

6. AUTHORISED REGISTERED PATENT AGENT(S)	IN/PA No.	**IN/PA-174**
	Name	**Arindam Paul**
	Mobile No.	8939824355
7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA	Name	**De Penning & De Penning**
	Postal Address	**120 Velachery Main Road, Guindy , Chennai 600 032**
	Telephone No.	**9144 - 42213444**
	Mobile No.	8939824355
	Fax No.	**9144 - 42213402**
	Email ID	**patent@depenning.com**

8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION

Country	Application No.	Filing Date	Name of the Applicant	Title of the Invention	IPC (as classified in the convention country)
USA	62/754,165	01/11/2018	**CHENG, Chienchun ; TSAI, Tsunghua ; CHENG, Yuhsin ; LIN, Wanchen**	METHOD AND APPARATUS FOR SPATIAL QCL ASSUMPTIONS WITH OVERLAPPED CORESETS	

9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)

International Application Number	International Filing Date
PCT/CN2019/112403	**22 October 2019**

~~**10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION**~~

~~Original (First) Application No.~~	~~Date of Filing of Original (First) Application~~

~~**11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT**~~

~~Main Application / Patent No.~~	~~Date of Filing of Main Application~~

12. DECLARATIONS

(i) Declaration by the inventor(s)

(In case the applicant is an assignee: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

~~I~~/We, the above named inventor(s) is/are the true & first inventor(s) for this invention and declare that the applicant(s) herein is/are my/our assignee ~~or legal representative~~.

Name	Signature	Date
CHENG, Chienchun	Chienchun	23-APRIL-2021
TSAI, Tsunghua	Tsai, Tsung-Hua	23-April-2021
CHENG, Yuhsin	Cheng Yu Hsin	23.April.2021
LIN, Wanchen	WanchenLin	23-April-2021

~~**(ii) Declaration by the applicant(s) in the convention country**~~

~~**(In case the applicant in India is different than the applicant in the convention country:** the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).~~

~~I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.~~

~~(a) Date~~

~~(b) Signature(s)~~

~~(c) Name(s) of the signatory~~

(iii) Declaration by the applicant(s)

~~I~~/We, the applicant(s) hereby declare(s) that:-

☑ ~~I am~~/We are in possession of the above mentioned invention.

☑ The ~~provisional~~ / complete specification relating to the invention is filed with this application.

☒ The Invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me / us before the grant of patent to me/us

☑ There is no lawful ground of objections to the grant of the Patent to ~~me~~/us.

☒ ~~I am~~ / We are the true & first inventor(s).

☑ ~~I am~~ / We are the assignee ~~or legal representative~~ of true & first inventor(s).

☑ The application or each of the applications, particulars of which are given in Para 8 was the first application in convention country/countries in respect of ~~my~~/our invention(s).

☑ ~~I~~ / We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by ~~me~~/us or by any person from which ~~I~~/we derive the title.

☑ ~~My~~/Our application in India is based on International application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.

☒ The application is divided out of my/our application particulars of which is given in Paragraph-10 and pray that this application may be treated as deemed to have been filed on.....under sec.16 of the Act.

☒ The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph – 11.

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

a) Form 2

Item	Details	Fee	Remarks
Complete/~~provisional~~ specification #	No. of pages 24		Sequence Listing 0 Pages
No. of Claim(s)	No. of Claims 19 and No. of Pages 4		
Abstract	No. of Pages 1		
No. of Drawing(s)	No. of Drawings 10 and No. of Pages 6		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule13(4), the no. of such pages filed with the provisional specification are required to be mentioned here.

(b) complete specification (in conformation with the international application)/ ~~as amended before the International Preliminary Examination Authority (IPEA)~~, as applicable (2 copies)
(c) ~~Sequence listing in electronic form~~
(d) Drawings (in conformation with the international application)/ ~~as amended before the International Preliminary Examination Authority (IPEA)~~, as applicable (2 copies)
~~(e) Priority document(s) or a request to retrieve the priority documents from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.~~
~~(f) Translation of priority document / specification / international search report / international preliminary report on patentability~~
(g) statement and undertaking on Form 3
(h) Declaration of Inventorship on Form 5
(i) Request for Examination on Form 18
(j) Copy of GPA with Stamp Paper
(k) Copy of Form PCT/IB/304
(l) Copy of Form PCT/IB/306

Total Fee Rs.26,400/- + Rs.20,000/- = Rs.46,400/- is paid by e-filing module.

~~I~~ / We hereby declare that to the best of my/our knowledge, information and belief the fact and matters stated herein are correct and ~~I~~/we request that a patent may be granted to me/us for the said invention.

Dated this 28 day of April 2021

Signature :

Name : Arindam Paul
Reg No. IN/PA-174
Of De Penning & De Penning
Agent for the Applicants

To,
The Controller of Patents
The Patent Office, at Chennai

FORM 18 **THE PATENTS ACT, 1970** **(39 OF 1970)** **&** **The Patents Rules, 2003** **REQUEST FOR EXAMINATION OF APPLICATION FOR PATENT** **[See section 11B and rule 20(4)(ii), 24B(1)(i)]**	**(FOR OFFICE USE ONLY)** **RQ. No :** **Filing Date :** **Amount of fees paid :** **CBR No. :** **Signature :**

1. **Applicant FG INNOVATION COMPANY LIMITED of Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun New Territories, Hong Kong, China; Nationality: China**

   date of publication of the application under section 11A

2. Statement in case of request for examination made by the applicant(s)

   I/We hereby request that my/our application for Patent No filed on 28 April 2021 for the invention titled "METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS" shall be examined under sections 12 and 13 of the Act.

   Or

   ~~I/We hereby make an express request that my application for Patent No. filed on 28 April 2021 based on Patent Cooperation Treaty (PCT) shall be examined under sections 12 and 13 of the Act, immediately without waiting for the expiry of 31 months as specified in Rule 20(4)(ii).~~

3. STATEMENT IN CASE OF REQUEST FOR EXAMINATION MADE BY ANY OTHER INTERESTED PERSON

   ~~I the interested person request for the examination of the application No. dated filed by the applicant titled under sections 12 and 13 of the Act.~~

   ~~As an evidence of my interest in the application for patent following documents are submitted.~~

   ~~(a) .....~~
   ~~(b) .....~~

4. Address for service

De Penning & De Penning
120 Velachery Main Road
Guindy Chennai 600 032
Phone:9144 - 42213444
Fax:9144 - 42213402
E-mail:patent@depenning.com

Dated this 28 day of April 2021

FG INNOVATION COMPANY LIMITED
By their Agent & Attorney

~Digitally signed~

(Arindam Paul)
REG. No.: IN/PA-174
of De Penning & De Penning

To
The Controller of Patents
The Patent Office, Chennai

FORM 3
THE PATENTS ACT, 1970
(39 of 1970)
and
THE PATENTS RULES, 2003
STATEMENT AND UNDERTAKING UNDER SECTION 8
(See section 8; rule 12)

1. Name of the applicant(s).	**I/We FG INNOVATION COMPANY LIMITED of Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun New Territories, Hong Kong, China; Nationality: China** hereby declare:
2. Name, address and nationality of the joint applicant	~~(i) that I/We have not made any application for the same/substantially the same invention outside India.~~ ~~Or~~ (ii) that I/We who have made this application No..... dated 28 April 2021 alone/~~jointly with~~, made for the same/ substantially same invention, application(s) for patent in the other countries, the particulars of which are given below:-

Name of the country	Date of application	Application No.	Status of the application	Publication No.	Date of Publication	Grant No.	Date of grant
USA	01/11/2018	62/754,165	EXPIRED				
PCT	22/10/2019	PCT/CN2019/ 112403	PUBLISHED	WO 2020/ 088295 A1	07/05/ 2020		

3. Name and address of the assignee	(iii) that the rights in the application(s) has/have been assigned to us that I/We undertake that upto the date of grant of the patent by the Controller, I/We would keep him informed in writing the details regarding corresponding applications for patents filed outside India within six months from the date of filing of such application. Dated this 28 day of April 2021
4. To be signed by the applicant or his authorized registered patent agent 5. Name of the natural person who has signed.	**~Digitally signed~** (Arindam Paul) REG. No.: IN/PA-174 Of De Penning & De Penning Agent for the Applicants
	To The Controller of Patents, The Patent Office, at Chennai

Note.- Strike out whichever is not applicable;

Espacenet

Bibliographic data: JP2022506048 (A) — 2022-01-17

METHODS AND APPARATUSES OF DETERMINING QUASI CO-LOCATION (QCL) ASSUMPTIONS FOR BEAM OPERATIONS

Inventor(s): チェン, チエンチュン, ; ツァイ, ツンファ, ; チェン, ユシン, ; リン, ワンチェン

Applicant(s): 鴻穎創新有限公司

Classification: - international: ***H04W16/28; H04W72/04; H04W72/12***
- cooperative: **H04L5/0007 (KR)**; **H04L5/0023 (EP)**; **H04L5/0032 (KR, US)**; **H04L5/0044 (EP)**; **H04L5/005 (EP, KR, US)**; **H04L5/0053 (EP, KR)**; **H04L5/0098 (KR)**; **H04W72/042 (KR, US)**; **H04W72/044 (KR, US)**; **H04W72/048 (KR, US)**; H04L5/0007 (EP); H04L5/0098 (EP)

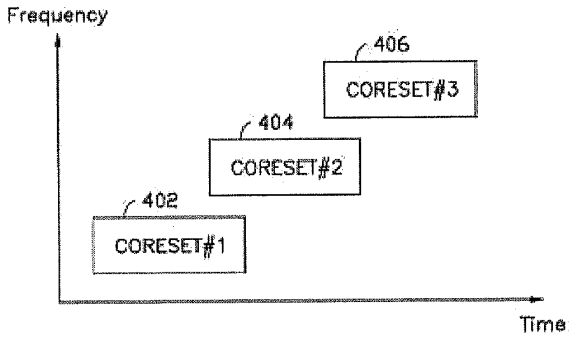
Application number: JP20210523200 20191022 Global Dossier

Priority number(s): US201862754165P 20181101 ; WO2019CN112403 20191022

Also published as: CN113039740 (A) EP3874668 (A1) KR20210076989 (A) US11057896 (B2) US2020145982 (A1) more

Abstract not available for JP2022506048 (A)
Abstract of corresponding document: US2020145982 (A1)

A method of wireless communications is provided. The method includes monitoring, by a user equipment (UE), at least one of a plurality of Control Resource Sets (CORESETs) configured for the UE within an active BWP of a serving cell in a time slot, and applying, by the UE, a first Quasi Co-Location (QCL) assumption of a first CORESET of a set of one or more monitored CORESETs to receive an aperiodic Channel Status Information-Reference Signal (CSI-RS). The first CORESET is associated with a monitored search space configured with a lowest CORESET Identity (ID) among the monitored CORESET(s).



Samsung Exhibit 1032, Page 296 of 620

(19)日本国特許庁(JP)　(12)公表特許公報(A)　(11)特許出願公表番号

特表2022-506048
(P2022-506048A)

(43)公表日　令和4年1月17日(2022.1.17)

(51)Int.Cl.			F I			テーマコード(参考)
H04W	*72/04*	*(2009.01)*	H04W	72/04	136	5K067
H04W	*72/12*	*(2009.01)*	H04W	72/12	130	
H04W	*16/28*	*(2009.01)*	H04W	72/04	132	
			H04W	16/28		

審査請求 有　予備審査請求 未請求　(全 34 頁)

(21)出願番号　特願2021-523200(P2021-523200)
(86)(22)出願日　令和1年10月22日(2019.10.22)
(85)翻訳文提出日　令和3年4月27日(2021.4.27)
(86)国際出願番号　PCT/CN2019/112403
(87)国際公開番号　WO2020/088295
(87)国際公開日　令和2年5月7日(2020.5.7)
(31)優先権主張番号　62/754,165
(32)優先日　平成30年11月1日(2018.11.1)
(33)優先権主張国・地域又は機関
米国(US)

(71)出願人　518446879
鴻穎創新有限公司
FG INNOVATION COMPANY LIMITED
中華人民共和国香港新界屯門海榮路２２號
屯門中央廣場２６樓２６２３室
Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun, New Territories, The Hong Kong Special Administrative Region of the People's Republic of China

最終頁に続く

(54)【発明の名称】ビーム動作のための擬似コロケーション（ＱＣＬ）想定を決定する方法及び装置

(57)【要約】
無線通信の方法を提供する。本方法は、ユーザ機器（ＵＥ）によって、時間スロットにおけるサービングセルのアクティブＢＷＰ内でＵＥのために構成された複数の制御リソースセット（ＣＯＲＥＳＥＴ）の内の少なくとも一つをモニターする工程と、ＵＥが、一つ以上のモニターされたＣＯＲＥＳＥＴの集合における第１のＣＯＲＥＳＥＴの第１の擬似コロケーション（ＱＣＬ）想定を適用することによって、非周期的チャンネルステータス情報－参照信号（ＣＳＩ－ＲＳ）を受信する工程と、を含む。第１のＣＯＲＥＳＥＴは、モニターされたＣＯＲＥＳＥＴ（複数可）のうちの最小のＣＯＲＥＳＥＴ識別子（ＩＤ）を用いて構成されモニターされるサーチスペースに関連付けられる。

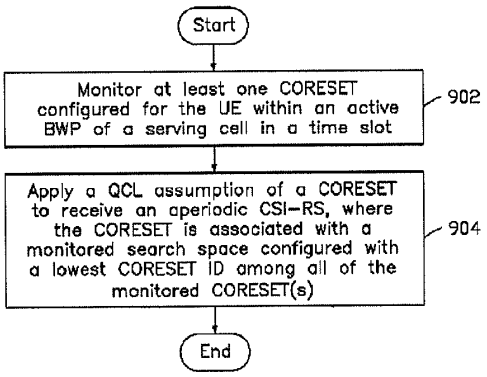


FIG. 9

【特許請求の範囲】
【請求項１】
ユーザ機器（ＵＥ：user equipment）であって、
コンピュータ実行可能命令が実装された一つ以上の非一時的なコンピュータ読み取り可能媒体と、
前記一つ以上の非一時的なコンピュータ読み取り可能媒体に結合された少なくとも一つのプロセッサと、を備え、
前記少なくとも一つのプロセッサは、
時間スロットにおけるサービングセルのアクティブＢＷＰ内において、前記ＵＥのために構成された複数の制御リソースセット（ＣＯＲＥＳＥＴ：Control Resource Sets）の内の少なくとも一つをモニターし、
一つ以上のモニターされたＣＯＲＥＳＥＴの集合における第１のＣＯＲＥＳＥＴの第１の擬似コロケーション（ＱＣＬ：Quasi Co－Location）想定を適用することによって、非周期的チャンネルステータス情報－参照信号（ＣＳＩ－ＲＳ：Channel Status Information－Reference Signal）を受信するように、前記コンピュータ実行可能命令を実行するように構成され、
前記第１のＣＯＲＥＳＥＴは、一つ以上のモニターされたＣＯＲＥＳＥＴの前記集合のうちの最小のＣＯＲＥＳＥＴ識別子（ＩＤ）を用いて構成されてモニターされたサーチスペースに関連付けられている、
ＵＥ。
【請求項２】
前記少なくとも一つのプロセッサは、
前記第１のＣＯＲＥＳＥＴから、前記非周期的ＣＳＩ－ＲＳをスケジュールするダウンリンク制御情報（ＤＣＩ：Downlink Control Information）を取得するように、前記コンピュータ実行可能命令を更に実行するように構成され、
前記ＤＣＩを搬送する物理ダウンリンク制御チャンネル（ＰＤＣＣＨ：Physical Downlink Control Channel）の最後のシンボルの終端と前記非周期的ＣＳＩ－ＲＳを搬送するリソースの最初のシンボルの起点の間にあるスケジューリングオフセットが閾値未満である、
請求項１に記載のＵＥ。
【請求項３】
前記第１のＣＯＲＥＳＥＴは、時間領域における少なくとも一つのシンボルにおいて、前記複数のＣＯＲＥＳＥＴのうちの第２のＣＯＲＥＳＥＴと重複し、前記第２のＣＯＲＥＳＥＴは、前記複数のＣＯＲＥＳＥＴのうちのモニターされないＣＯＲＥＳＥＴであり、前記モニターされないＣＯＲＥＳＥＴは、前記ＵＥに構成されるモニターされないサーチスペースに関連付けられている、請求項１に記載のＵＥ。
【請求項４】
前記第１のＣＯＲＥＳＥＴに関連付けられた前記モニターされたサーチスペースは、第１のサーチスペースＩＤを用いて構成され、前記第２のＣＯＲＥＳＥＴに関連付けられた前記モニターされないサーチスペースは、第２のサーチスペースＩＤを用いて構成され、前記第１のサーチスペースＩＤは、前記第２のサーチスペースＩＤよりも小さい、請求項３に記載のＵＥ。
【請求項５】
前記第２のＣＯＲＥＳＥＴは、非アクティブ化されたバンド幅部分（ＢＷＰ）、及び、非アクティブ化されたセカンダリーセル（ＳＣｅｌｌ）のうちの一方において構成される、請求項３に記載のＵＥ。
【請求項６】
前記第２のＣＯＲＥＳＥＴは、前記時間領域における少なくとも一つのシンボルにおいて、一つ以上のモニターされたＣＯＲＥＳＥＴの前記集合における第３のＣＯＲＥＳＥＴと更に重複する、請求項３に記載のＵＥ。

【請求項７】
前記複数のＣＯＲＥＳＥＴ及び前記非周期的ＣＳＩ－ＲＳを搬送するリソースは、前記時間スロット及び前記サービングセルの前記アクティブＢＷＰにおいて提供される、請求項１に記載のＵＥ。
【請求項８】
前記少なくとも一つのプロセッサは、
前記第１のＣＯＲＥＳＥＴから、物理ダウンリンク共有チャンネル（ＰＤＳＣＨ）をスケジュールするＤＣＩを取得し、
前記ＤＣＩを搬送するＰＤＣＣＨの最後のシンボルの終端と前記ＰＤＳＣＨの最初のシンボルの起点の間にあるスケジューリングオフセットが閾値未満のとき、第２のＣＯＲＥＳＥＴの第２のＱＣＬ想定を適用することによって、前記ＰＤＳＣＨを受信するように、前記コンピュータ実行可能命令を実行するように更に構成され、
前記第２のＣＯＲＥＳＥＴは、時間領域における少なくとも一つのシンボルにおいて、前記ＰＤＳＣＨと重複する、
請求項１に記載のＵＥ。
【請求項９】
前記第２のＣＯＲＥＳＥＴは、前記複数のＣＯＲＥＳＥＴのうちモニターされないＣＯＲＥＳＥＴであり、前記モニターされないＣＯＲＥＳＥＴは、前記ＵＥに構成されたモニターされないサーチスペースに関連付けられている、
請求項８に記載のＵＥ。
【請求項１０】
ユーザ機器（ＵＥ）であって、
コンピュータ実行可能命令が実装された一つ以上の非一時的なコンピュータ読み取り可能媒体と、
前記一つ以上の非一時的なコンピュータ読み取り可能媒体に結合された少なくとも一つのプロセッサと、を備え、
前記少なくとも一つのプロセッサは、
時間スロットにおけるサービングセルのアクティブバンド幅部分（ＢＷＰ）において、前記ＵＥのために構成された複数の制御リソースセット（ＣＯＲＥＳＥＴ）の内の少なくとも一つをモニターし、
物理ダウンリンク制御チャンネル（ＰＤＣＣＨ）から、物理ダウンリンク共有チャンネル（ＰＤＳＣＨ）をスケジュールするダウンリンク制御情報（ＤＣＩ）を受信し、
前記ＤＣＩを搬送する前記ＰＤＣＣＨの最後のシンボルの終端と前記ＰＤＳＣＨの最初のシンボルの起点の間にあるスケジューリングオフセットが閾値未満のとき、前記ＰＤＣＣＨを受信するための擬似コロケーション（ＱＣＬ）想定を適用することによって、前記ＰＤＳＣＨを受信するように、前記コンピュータ実行可能命令を実行するように構成され、
前記ＰＤＣＣＨは、一つ以上のモニターされたＣＯＲＥＳＥＴの集合における一つのＣＯＲＥＳＥＴにおいて送信され、一つ以上のモニターされたＣＯＲＥＳＥＴの前記集合における前記一つのＣＯＲＥＳＥＴは、一つ以上のモニターされたＣＯＲＥＳＥＴの前記集合のうちの最小のＣＯＲＥＳＥＴ識別子（ＩＤ）を用いて構成されてモニターされたサーチスペースに関連付けられている、
ＵＥ。
【請求項１１】
無線通信の方法であって、
ユーザ機器（ＵＥ）が、時間スロットにおけるサービングセルのアクティブＢＷＰ内において、前記ＵＥに構成された複数の制御リソースセット（ＣＯＲＥＳＥＴ）の内の少なくとも一つをモニターする工程と、
前記ＵＥが、一つ以上のモニターされたＣＯＲＥＳＥＴの集合における第１のＣＯＲＥＳＥＴの第１の擬似コロケーション（ＱＣＬ）想定を適用することによって、非周期的チャンネルステータス情報－参照信号（ＣＳＩ－ＲＳ）を受信する工程と、を含み、

前記第１のＣＯＲＥＳＥＴは、一つ以上のモニターされたＣＯＲＥＳＥＴの集合のうちの最小のＣＯＲＥＳＥＴ識別子（ＩＤ）を用いて構成されてモニターされたサーチスペースに関連付けられている、
方法。
【請求項１２】
前記ＵＥが、前記第１のＣＯＲＥＳＥＴから、前記非周期的ＣＳＩ－ＲＳをスケジュールするダウンリンク制御情報（ＤＣＩ）を取得する工程を更に含み、前記ＤＣＩを搬送する物理ダウンリンク制御チャンネル（ＰＤＣＣＨ）の最後のシンボルの終端と前記非周期的ＣＳＩ－ＲＳを搬送するリソースの最初のシンボルの起点の間にあるスケジューリングオフセットは、閾値未満である、請求項１１に記載の方法。
【請求項１３】
前記第１のＣＯＲＥＳＥＴは、時間領域における少なくとも一つのシンボルにおいて、前記複数のＣＯＲＥＳＥＴのうちの第２のＣＯＲＥＳＥＴと重複し、前記第２のＣＯＲＥＳＥＴは、前記複数のＣＯＲＥＳＥＴのうちのモニターされないＣＯＲＥＳＥＴであり、前記モニターされないＣＯＲＥＳＥＴは、前記ＵＥに構成されたモニターされないサーチスペースに関連付けられている、請求項１１に記載の方法。
【請求項１４】
前記第１のＣＯＲＥＳＥＴに関連付けられた前記モニターされたサーチスペースは、第１のサーチスペースＩＤを用いて構成され、前記第２のＣＯＲＥＳＥＴに関連付けられた前記モニターされないサーチスペースは、第２のサーチスペースＩＤを用いて構成され、前記第１のサーチスペースＩＤは、前記第２のサーチスペースＩＤよりも小さい、請求項１３に記載の方法。
【請求項１５】
前記第２のＣＯＲＥＳＥＴは、非アクティブ化されたバンド幅部分（ＢＷＰ）、及び、非アクティブ化されたセカンダリーセル（ＳＣｅｌｌ）のうちの一方において構成される、請求項１３に記載の方法。
【請求項１６】
前記第２のＣＯＲＥＳＥＴは、前記時間領域における少なくとも一つのシンボルにおいて、一つ以上のモニターされたＣＯＲＥＳＥＴの前記集合における第３のＣＯＲＥＳＥＴと更に重複する、請求項１３に記載の方法。
【請求項１７】
前記複数のＣＯＲＥＳＥＴ及び前記非周期的ＣＳＩ－ＲＳを搬送するリソースは、前記時間スロット及び前記サービングセルの前記アクティブＢＷＰにおいて提供される、請求項１１に記載の方法。
【請求項１８】
前記ＵＥが、前記第１のＣＯＲＥＳＥＴから、物理ダウンリンク共有チャンネル（ＰＤＳＣＨ）をスケジュールするＤＣＩを取得する工程と、
前記ＤＣＩを搬送するＰＤＣＣＨの最後のシンボルの終端と前記ＰＤＳＣＨの最初のシンボルの起点の間にあるスケジューリングオフセットが閾値未満のとき、前記ＵＥが、第２のＣＯＲＥＳＥＴの第２のＱＣＬ想定を適用することによって、前記ＰＤＳＣＨを受信する工程と、を含み、
前記第２のＣＯＲＥＳＥＴは、時間領域における少なくとも一つのシンボルにおいて、前記ＰＤＳＣＨと重複する、
請求項１１に記載の方法。
【請求項１９】
前記第２のＣＯＲＥＳＥＴは、前記複数のＣＯＲＥＳＥＴのうちモニターされないＣＯＲＥＳＥＴであり、前記モニターされないＣＯＲＥＳＥＴは、前記ＵＥに構成されたモニターされないサーチスペースに関連付けられている、請求項１８に記載の方法。
【発明の詳細な説明】
【発明の詳細な説明】

【０００１】
〔関連出願の相互参照〕
本出願は、代理人整理番号ＵＳ７５３６８（以下、「ＵＳ７５３６８出願」と称する）を有する、「Ｍｅｔｈｏｄ ａｎｄ Ａｐｐａｒａｔｕｓ ｆｏｒ Ｓｐａｔｉａｌ ＱＣＬ ａｓｓｕｍｐｔｉｏｎｓ ｗｉｔｈ Ｏｖｅｒｌａｐｐｅｄ ＣＯＲＥＳＥＴｓ」と題する、２０１８年１１月１日に出願された米国特許仮出願第６２／７５４，１６５号の利益および優先権を主張する。ＵＳ７５３６８出願の開示は、参照により本出願に完全に組み込まれる。
【０００２】
〔分野〕
本開示は一般に、無線通信に関し、より詳細には、ビーム動作のための擬似コロケーション（ＱＣＬ）想定を決定する方法及び装置に関する。
【０００３】
〔背景〕
次世代（例えば、５世代（５Ｇ）新無線（ＮＲ））無線通信システムは、指向性通信を提供するためにビームフォーミング技術を利用することができる。例えばユーザ機器（ＵＥ）は、チャンネル又はリソースを送信又は受信するためにそのビーム（複数可）を切り替えるためにビーム動作を実行することができる。ＵＥが適用する各ビームは、対応するＱＣＬ想定によって決定される空間領域フィルタとみなすことができる。
【０００４】
しかしながら、次世代無線通信システムの現在の仕様は、ＵＥが複数の制御リソースセット（ＣＯＲＥＳＥＴ）を用いて構成されるとき、不都合なビーム切り替えをＵＥに実行させる可能性がある。その上、次世代無線通信システムは、柔軟なリソース割り当て方式を利用することができるが、ＵＥは、次世代無線通信システムの現在の仕様の曖昧さのために、どのＱＣＬ想定を使用するかを決定することができない可能性が高い。
【０００５】
したがって、当技術分野では、複数のＣＯＲＥＳＥＴがＵＥに構成されるとき、ビーム動作のためのＱＣＬ想定を決定する方法および装置が必要とされている。
【０００６】
〔概要〕
本開示は、ＱＣＬ想定を決定するための方法および装置を対象とする。
【０００７】
本開示の一態様によれば、ＵＥが提供される。ＵＥは、コンピュータ実行可能命令が実装された一つ以上の非一時的なコンピュータ読み取り可能媒体、及び一つ以上の非一時的なコンピュータ読み取り可能媒体に結合された少なくとも一つのプロセッサを含む。少なくとも一つのプロセッサは、時間スロットにおけるサービングセルのアクティブＢＷＰ内のＵＥのために構成された複数のＣＯＲＥＳＥＴの内の少なくとも一つをモニターし、一つ以上のモニターされたＣＯＲＥＳＥＴの集合における第１のＣＯＲＥＳＥＴの第１のＱＣＬ想定を適用することによって、非周期的チャンネルステータス情報－参照信号（ＣＳＩ－ＲＳ：Ｃｈａｎｎｅｌ Ｓｔａｔｕｓ Ｉｎｆｏｒｍａｔｉｏｎ－Ｒｅｆｅｒｅｎｃｅ Ｓｉｇｎａｌ）を受信するように、コンピュータ実行可能命令を実行するように構成される。第１のＣＯＲＥＳＥＴは、サーチスペースに関連付けられていてもよい。当該サーチスペースは、一つ以上のモニターされるＣＯＲＥＳＥＴの集合のうちの最小のＣＯＲＥＳＥＴ識別子（ＩＤ）を用いて構成されてモニターされるサーチスペースである。
【０００８】
本開示の別の態様によれば、ＵＥが提供される。ＵＥは、コンピュータ実行可能命令が実装された一つ以上の非一時的なコンピュータ読み取り可能媒体、及び少なくとも一つ以上の非一時的なコンピュータ読み取り可能媒体に結合された少なくとも一つのプロセッサを含む。少なくとも一つのプロセッサは、時間スロットにおけるサービングセルのアクティブＢＷＰ内にあるＵＥのために構成された複数のＣＯＲＥＳＥＴの内の少なくとも一つを

モニターし、物理ダウンリンク制御チャンネル（ＰＤＣＣＨ）から、物理ダウンリンク共有チャンネル（ＰＤＳＣＨ）をスケジュールするダウンリンク制御情報（ＤＣＩ）を受信し、及びＤＣＩを搬送するＰＤＣＣＨの最後のシンボルとＰＤＳＣＨの最初のシンボルの間にあるスケジューリングオフセットが閾値未満のとき、ＰＤＣＣＨを受信するためにＱＣＬ想定を適用することによって、ＰＤＳＣＨを受信するように、コンピュータ実行可能命令を実行するように構成される。ＰＤＣＣＨは、一つ以上のモニターされたＣＯＲＥＳＥＴの集合における一つのＣＯＲＥＳＥＴ内で送信されてもよい。一つ以上のモニターされるＣＯＲＥＳＥＴの集合における一つのＣＯＲＥＳＥＴは、サーチスペースに関連づけられていてもよい。当該サーチスペースは、一つ以上のモニターされるＣＯＲＥＳＥＴの集合のうちの最小のＣＯＲＥＳＥＴ識別子（ＩＤ）を用いて構成されモニターされるサーチスペースである。

【０００９】

本開示の別の態様によれば、無線通信の方法が提供される。本方法は、ＵＥによって、時間スロットにおけるサービングセルのアクティブＢＷＰ内において、ＵＥに構成された複数のＣＯＲＥＳＥＴの内の少なくとも一つをモニターする工程と、ＵＥが、一つ以上のモニターされたＣＯＲＥＳＥＴの集合における第１のＣＯＲＥＳＥＴの第１のＱＣＬ想定を適用することによって、ＣＳＩ－ＲＳを受信する工程と、を含む。第１のＣＯＲＥＳＥＴは、サーチスペースに関連づけられていてもよい。当該サーチスペースは、一つ以上のモニターされるＣＯＲＥＳＥＴの集合のうちの最小のＣＯＲＥＳＥＴ　ＩＤを用いて構成されモニターされるサーチスペースである。

【００１０】

〔図面の簡単な説明〕

例示的な開示の態様は、添付の図面と共に読まれるとき、以下の詳細な説明から最も良く理解される。様々な特徴は、一定の縮尺で描かれておらず、様々な特徴の寸法は、議論を明確にするために任意に増減されてもよい。

【００１１】

図１は、本開示の一例としての実装形態による、ＵＥのために構成された複数のＣＯＲＥＳＥＴを示す概略図である。

【００１２】

図２は、本開示の一例としての実装形態による、ＵＥのために構成された複数のＣＯＲＥＳＥＴを示す概略図である。

【００１３】

図３は、本開示の一例としての実装形態による、ＵＥのために構成された複数のＣＯＲＥＳＥＴを示す概略図である。

【００１４】

図４は、本開示の一例としての実装形態による、ＵＥのために構成された複数のＣＯＲＥＳＥＴを示す概略図である。

【００１５】

図５は、本開示の一例としての実装形態による、時間領域におけるＣＯＲＥＳＥＴと重複するＰＤＳＣＨを示す概略図である。

【００１６】

図６は、本開示の一例としての実装形態による、非周期的ＣＳＩ－ＲＳ、ＰＤＳＣＨ、及びＣＯＲＥＳＥＴが時間領域において重複されることを示す概略図である。

【００１７】

図７は、本開示の一例としての実装形態による、ＵＥのために構成された複数のＣＯＲＥＳＥＴを示す概略図である。

【００１８】

図８は、本開示の一例としての実装形態による、ＵＥのために構成された複数のＣＯＲＥＳＥＴを示す概略図である。

【００１９】

図９は、本開示の一例としての実装形態による、無線通信システムにおけるＱＣＬ想定を決定する方法のフローチャートである。

【００２０】

図１０は、本開示の様々な態様による、無線通信のためのノードを示すブロック図である。

【００２１】

〔詳細な説明〕

以下の説明は、本開示における一例としての実装形態に関連する特定の情報を含む。本開示における図面及びそれらの添付の詳細な説明は、単に例としての実装形態を対象としている。しかし、本開示は、これらの例としての実装形態のみに限定されるものではない。本開示の他の変形例及び実装形態は、当業者には想起されるであろう。特に断らない限り、複数の図中の同様の又は対応する要素は、同様の又は対応する参照番号によって示され得る。更に、本開示における図面及び図示は、ほとんどの場合、一定の縮尺ではなく、実際の相対的な寸法に対応することを意図していない。

【００２２】

一貫性及び理解を容易にするために、同様の特徴は、例としての図において同じ数字によって識別され得る（ただし、いくつかの例において、図示されていない）。しかしながら、異なる実装形態における特徴は、他の点で異なっていてもよく、従って、図面に示されるものに狭く限定されるものではない。

【００２３】

本説明は、「一つの実装形態において」又は「いくつかの実装形態において」という語句を使用し、それぞれが同じ又は異なる実装形態の一つ以上を指してもよい。「結合された」というタームは、直接的又は間接的に介在する構成要素を介して接続されたものとして定義され、必ずしも物理的接続に限定されるものではない。「備える（ｃｏｍｐｒｉｓｉｎｇ）」というタームは、「必ずしも限定されるものではないが、含む」を意味する。それは、そのように説明された組み合わせ、グループ、シリーズ、及び等価物におけるオープンエンドの包含又はメンバーシップを特に示す。「Ａ、Ｂ、及びＣの内の少なくとも一つ」又は「Ａ、Ｂ、及びＣの内の少なくとも一つ」という表現は、「Ａのみ、又はＢのみ、又はＣのみ、又はＡ、Ｂ及びＣに任意の組み合わせ」を意味する。

【００２４】

更に、説明及び非限定の目的のために、機能エンティティ、技法、プロトコル、規格などの具体的な詳細が、説明される技術の理解を実現するために記載される。他の例において、不必要な詳細で説明を不明瞭にしないように、周知の方法、技術、システム、アーキテクチャなどの詳細な説明は、省略される。

【００２５】

当業者は、本開示に記載されている任意のネットワーク機能（複数可）又はアルゴリズム（複数可）が、ハードウェア、ソフトウェア、又はソフトウェアとハードウェアの組み合わせによって実装されてもよいことを直ちに理解するだろう。説明される機能は、ソフトウェア、ハードウェア、ファームウェア、又はそれらの任意の組み合わせであり得るモジュールに対応し得る。ソフトウェアの実装形態は、メモリ又は他の種類の記憶装置などのコンピュータ読み取り可能媒体に記憶されたコンピュータ実行可能命令を備えてもよい。例えば、通信処理能力を有する一つ以上のマイクロプロセッサ又は汎用コンピュータを、対応する実行可能命令を用いてプログラムし、記述されたネットワーク機能（複数種類可）又はアルゴリズム（複数種類可）を実行することができる。マイクロプロセッサ又は汎用コンピュータは、特定用途向け集積回路（ＡＳＩＣ）、プログラマブルロジックアレイ、及び／又は一つ以上のデジタル信号プロセッサ（ＤＳＰ）を使用して形成することができる。本明細書に記載されている例としての実装形態のいくつかは、コンピュータハードウェア上にインストールされ実行されるソフトウェアを指向しているが、それにもかかわらず、ファームウェアとして、又はハードウェアとして、又はハードウェアとソフトウェアの組合せとして実装される代替の実施例は、本開示の範囲内に十分にある。

【００２６】
コンピュータ読み取り可能な媒体は、ランダムアクセスメモリ（ＲＡＭ：Ｒａｎｄｏｍ Ａｃｃｅｓｓ Ｍｅｍｏｒｙ）、読み取り専用メモリ（ＲＯＭ：Ｒｅａｄ Ｏｎｌｙ Ｍｅｍｏｒｙ）、消去可能プログラマブル読み取り専用メモリ（ＥＰＲＯＭ：Ｅｒａｓａｂｌｅ Ｐｒｏｇｒａｍｍａｂｌｅ Ｒｅａｄ－Ｏｎｌｙ Ｍｅｍｏｒｙ）、電気的消去可能プログラマブル読み取り専用メモリ（ＥＥＰＲＯＭ：Ｅｌｅｃｔｒｉｃａｌｌｙ Ｅｒａｓａｂｌｅ Ｐｒｏｇｒａｍｍａｂｌｅ Ｒｅａｄ－Ｏｎｌｙ Ｍｅｍｏｒｙ）、フラッシュメモリ、コンパクトディスク読み取り専用メモリ（ＣＤ－ＲＯＭ：Ｃｏｍｐａｃｔ Ｄｉｓｃ Ｒｅａｄ－Ｏｎｌｙ Ｍｅｍｏｒｙ）、磁気カセット、磁気テープ、磁気ディスク記憶装置、又はコンピュータ読み取り可能命令を記憶可能な他の任意の同等の媒体を含むが、これらに限定されない。

【００２７】
無線通信ネットワークアーキテクチャ（例えばロングタームエボリューション（ＬＴＥ：Ｌｏｎｇ Ｔｅｒｍ Ｅｖｏｌｕｔｉｏｎ）システム、ＬＴＥ－Ａｄｖａｎｃｅｄ（ＬＴＥ－Ａ）システム、ＬＴＥ－Ａｄｖａｎｃｅｄ Ｐｒｏシステム、又は５Ｇ 新無線（ＮＲ）無線アクセスネットワーク（ＲＡＮ））は、通常、少なくとも一つの基地局（ＢＳ）、少なくとも一つのユーザ機器（ＵＥ）、及びネットワークへの接続を提供する一つ以上のオプションのネットワーク要素を含む。ＵＥは、一つ以上のＢＳによって確立されたＲＡＮを介して、ネットワーク（例えばコアネットワーク（ＣＮ）、エボルブドパケットコア（ＥＰＣ：Ｅｖｏｌｖｅｄ Ｐａｃｋｅｔ Ｃｏｒｅ）ネットワーク、エボルブドユニバーサルテレストリアル無線アクセスネットワーク（Ｅ－ＵＴＲＡＮ：Ｅｖｏｌｖｅｄ Ｕｎｉｖｅｒｓａｌ Ｔｅｒｒｅｓｔｒｉａｌ Ｒａｄｉｏ Ａｃｃｅｓｓ ｎｅｔｗｏｒｋ）、５Ｇコア（５ＧＣ）、又はインターネット）と通信する。

【００２８】
なお、本出願において、ＵＥとしては移動局、携帯端末又は携帯機器、ユーザ通信無線端末が挙げられるが、これらに限定されない。例えばＵＥは、携帯無線機器であってもよく、携帯電話、タブレット、ウェアラブルデバイス、センサ、車両、又は無線通信能力を有する携帯情報端末（ＰＤＡ）を含むが、これらに限定されない。上記ＵＥは、無線アクセスネットワークにおける一つ以上のセルに、エアーインターフェース上で、信号を送受信するよう構成されている。

【００２９】
ＢＳは、以下の無線アクセス技術（ＲＡＴｓ：Ｒａｄｉｏ Ａｃｃｅｓｓ Ｔｅｃｈｎｏｌｏｇｉｅｓ）の内の少なくとも一つに従った通信サービスを提供するように構成されてよい。マイクロ波アクセスのためのワールドワイド相互運用（ＷｉＭＡＸ：Ｗｏｒｌｄｗｉｄｅ Ｉｎｔｅｒｏｐｅｒａｂｉｌｉｔｙ ｆｏｒ Ｍｉｃｒｏｗａｖｅ Ａｃｃｅｓｓ）、モバイル通信のためのグローバルシステム（ＧＳＭ：Ｇｌｏｂａｌ Ｓｙｓｔｅｍ ｆｏｒ Ｍｏｂｉｌｅ、しばしば２Ｇとして呼ばれる）、ＧＳＭ ＥＤＧＥ無線アクセスネットワーク（ＧＥＲＡＮ：ＧＳＭ ＥＤＧＥ Ｒａｄｉｏ Ａｃｃｅｓｓ Ｎｅｔｗｏｒｋ）、汎用パケット無線サービス（ＧＲＰＳ：Ｇｅｎｅｒａｌ Ｐａｃｋｅｔ Ｒａｄｉｏ Ｓｅｒｖｉｃｅ）、基本広帯域コード分割多元アクセス（Ｗ－ＣＤＭＡ：Ｗｉｄｅｂａｎｄ－Ｃｏｄｅ Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅ Ａｃｃｅｓｓ）に基づいたユニバーサルモバイル通信システム（ＵＭＴＳ：Ｕｎｉｖｅｒｓａｌ Ｍｏｂｉｌｅ Ｔｅｌｅｃｏｍｍｕｎｉｃａｔｉｏｎ Ｓｙｓｔｅｍ、しばしば３Ｇとして呼ばれる）、高速パケットアクセス（ＨＳＰＡ：Ｈｉｇｈ－Ｓｐｅｅｄ Ｐａｃｋｅｔ Ａｃｃｅｓｓ）、ＬＴＥ、ＬＴＥ－Ａ、ｅＬＴＥ（進化型ＬＴＥ、例えば５ＧＣに接続したＬＴＥ）、ＮＲ（しばしば５Ｇとして呼ばれる）、及び／又はＬＴＥ－Ａ Ｐｒｏ。しかしながら本出願の範囲は、上記のプロトコルに限定されるべきではない。

【００３０】
基地局は、ＵＭＴＳにおけるノードＢ（ＮＢ：ｎｏｄｅ Ｂ）、ＬＴＥ又はＬＴＥ－Ａにおける進化型ノードＢ（ｅＮＢ：ｅｖｏｌｖｅｄ ｎｏｄｅ Ｂ）、ＵＭＴＳにおける無

線ネットワークコントローラ（ＲＮＣ：Ｒａｄｉｏ Ｎｅｔｗｏｒｋ Ｃｏｎｔｒｏｌｌｅｒ）、ＧＳＭ／ＧＥＲＡＮにおける基地局コントローラ（ＢＳＣ：Ｂａｓｅ Ｓｔａｔｉｏｎ Ｃｏｎｔｒｏｌｌｅｒ）、５ＧＣに接続したＥ－ＵＴＲＡ（Ｅ－ＵＴＲＡ：Ｅｖｏｌｖｅｄ Ｕｎｉｖｅｒｓａｌ Ｔｅｒｒｅｓｔｒｉａｌ Ｒａｄｉｏ Ａｃｃｅｓｓ）ＢＳにおけるｎｇ－ｅＮＢ、５Ｇ－ＲＡＮにおける次世代ノードＢ（ｇＮＢ：ｇｅｎｅｒａｔｉｏｎ Ｎｏｄｅ Ｂ）、及びセル内の無線通信を制御し、無線リソースを管理することができる任意の他の装置を含むことができるが、これらに限定されない。ＢＳは、ネットワークへの無線インターフェースによって、一つ以上のＵＥにサービスを提供するように接続し得る。

【００３１】

ＢＳは、無線アクセスネットワークを形成する複数のセルを使用して、特定の地理的エリアに無線カバレッジを提供するように動作可能である。ＢＳは、セルの動作をサポートする。各セルは、その無線カバレッジ内の少なくとも一つのＵＥにサービスを提供するように動作可能である。より具体的には、各セル（しばしばサービングセルと呼ばれる）は、その無線カバレッジ内の一つ以上のＵＥを提供するサービスを提供する（例えば各セルは、ダウンリンク（ＤＬ：Ｄｏｗｎｌｉｎｋ）をスケジュールし、任意で、ＤＬ及び任意でアップリンクパケット送信のために、その無線カバレッジ内の少なくとも一つのＵＥにアップリンクリソースをスケジュールする）。ＢＳは、複数のセルによって、無線通信システム内の一つ以上のＵＥと通信することができる。セルは、近接サービス（ＰｒｏＳｅ：Ｐｒｏｘｉｍｉｔｙ Ｓｅｒｖｉｃｅ）又はビークル・トゥ・エブリシング（Ｖ２Ｘ：Ｖｅｈｉｃｌｅ ｔｏ Ｅｖｅｒｙｔｈｉｎｇ）サービスをサポートするためにサイドリンク（ＳＬ：Ｓｉｄｅｌｉｎｋ）リソースを割り当ててよい。各セルは、他のセルと重複するカバレッジ領域を有してもよい。

【００３２】

上述したように、ＮＲのためのフレーム構造は、高信頼性、高データ速度、及び低遅延性の要件を満たしながら、拡張モバイルブロードバンド（ｅＭＢＢ：Ｅｎｈａｎｃｅｄ Ｍｏｂｉｌｅ Ｂｒｏａｄｂａｎｄ）、大容量マシンタイプ通信（ｍＭＴＣ：Ｍａｓｓｉｖｅ Ｍａｃｈｉｎｅ Ｔｙｐｅ Ｃｏｍｍｕｎｉｃａｔｉｏｎ）、超高信頼性及び低遅延性通信（ＵＲＬＬＣ：Ｕｌｔｒａ－Ｒｅｌｉａｂｌｅ ａｎｄ Ｌｏｗ－Ｌａｔｅｎｃｙ Ｃｏｍｍｕｎｉｃａｔｉｏｎ）といった様々な次世代（例えば５Ｇ）通信要件に対応するための柔軟な構成をサポートすることである。３ＧＰＰにおいて合意された直交周波数分割多重（ＯＦＤＭ：Ｏｒｔｈｏｇｏｎａｌ Ｆｒｅｑｕｅｎｃｙ－Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅｘｉｎｇ）技術は、ＮＲ波形のための基準として提供してよい。適応サブキャリア間隔、チャンネル帯域幅、及びサイクリックプレフィックス（ＣＰ：Ｃｙｃｌｉｃ Ｐｒｅｆｉｘ）といったスケーラブルなＯＦＤＭニューメロロジーは、使用されてもよい。更に、ＮＲには（１）低密度パリティ検査（ＬＤＰＣ：Ｌｏｗ－Ｄｅｎｓｉｔｙ Ｐａｒｉｔｙ－Ｃｈｅｃｋ）符号及び（２）ポーラ符号の２つの符号化方法が考えられる。符号化方法の適応は、チャンネル条件及び／又はサービスアプリケーションに基づいて構成されてもよい。

【００３３】

更に、単一のＮＲフレームの送信時間間隔ＴＸにおいて、ＤＬ送信データ、ガード期間、及びアップリンク（ＵＬ：Ｕｐｌｉｎｋ）送信データは、少なくとも含まれるべきであり、ＤＬ送信データ、ガード期間、及びガード期間のそれぞれの部分において、ＵＬ送信データはまた、例えばＮＲのネットワークダイナミクスに基づいて設定可能であるべきであることも考慮される。更に、サイドリンクリソースは、ＰｒｏＳｅサービス又はＶ２Ｘサービスをサポートするために、ＮＲフレームにおいて提供されてもよい。

【００３４】

更に、本明細書中のターム「システム」及び「ネットワーク」は、互換的に使用されてよい。本明細書中のターム「及び／又は」は、関連するオブジェクトを記述するための関連する関係のみであり、三つの関係が存在してもよいことを表す。例えばＡ及び／又はＢは

、Ａが単独で存在し、Ａ及びＢが同時に存在し、Ｂが単独で存在することを示してもよい。加えて、本明細書中の文字「／」は、前者及び後者の関連するオブジェクトが「又は」関係にあることを一般的に表す。

【００３５】

いくつかの実装形態において、複数のサーチスペースが時間領域において重複するとき、ＵＥは、デフォルトＰＤＳＣＨビームを決定するために、以下のプロセスを実行することができる：

【００３６】

【表１】

＞異なるＣＯＲＥＳＥＴに関連付けられた複数のサーチスペースをモニターするＵＥに関し、単一セルの動作、又は、同じ周波数帯におけるキャリアアグリゲーション（ＣＡ）を用いる動作について ＞サーチスペースのモニタリング期間が時間領域において重複する、及びサーチスペースが擬似コロケーション（ＱＣＬ）－タイプＤ特性を有する異なるＣＯＲＥＳＥＴに関連付けられている場合、ＵＥは、最小のサービングセルインデックスを有するサービングセル中のアクティブＤＬ　ＢＷＰにおける共通サーチスペース（ＣＳＳ）を記憶する所与のＣＯＲＥＳＥＴに関連付けられたサーチスペース、及び所与のＣＯＲＥＳＥＴのように同じＱＣＬ－タイプＤに関連付けられた他のＣＯＲＥＳＥＴをモニターすることができる、 ＞二つ以上のＣＯＲＥＳＥＴがＣＳＳを記憶する場合、ＵＥは、最小のサービングセルインデックスを用いて、サービングセルのアクティブＤＬ　ＢＷＰのモニタリング期間のうちの最小のサーチスペースＩＤを有するサーチスペースを記憶するＣＯＲＥＳＥＴを選択する、及び ＞全てのＣＯＲＥＳＥＴがＣＳＳを記憶しない場合、ＵＥは、最小のサービングセルインデックスを用いて、サービングセルのアクティブＤＬ　ＢＷＰのモニタリング期間のうちの最小のサーチスペースＩＤを有するサーチスペースを記憶するＣＯＲＥＳＥＴを選択する。

【００３７】

この目的のために、チャンネルステータス情報－参照信号（ＣＳＩ－ＲＳ：Ｃｈａｎｎｅｌ　Ｓｔａｔｕｓ　Ｉｎｆｏｒｍａｔｉｏｎ－Ｒｅｆｅｒｅｎｃｅ　Ｓｉｇｎａｌ）が同

期信号ブロック（ＳＳＢ：Ｓｙｎｃｈｒｏｎｉｚａｔｉｏｎ　Ｓｉｇｎａｌ　Ｂｌｏｃｋ）から提供される場合であっても、当該ＳＳＢに関するＱＣＬ想定とＣＳＩ－ＲＳ（又は追従参照信号（ＴＲＳ：Ｔｒａｃｋｉｎｇ　Ｒｅｆｅｒｅｎｃｅ　Ｓｉｇｎａｌ））に関するＱＣＬ想定は、２つの異なるＱＣＬ想定として考えることができる。ＱＣＬ想定は、空間領域ＱＣＬパラメータ（例えば、ＱＣＬタイプＤパラメータ）、又は平均遅延、遅延拡散、ドップラーシフト、及びドップラー拡散の内の少なくとも一つに基づいて取得されたＱＣＬパラメータといった異なるパラメータに基づいてもよい。

【００３８】

さらに、ＵＥは、以下に説明するプロセスを実行することができる：

【００３９】

【表２】

＞ＤＬ　ＤＣＩの受信及び対応するＰＤＳＣＨ（例えば、ＤＣＩを搬送するＰＤＣＣＨの最後のシンボル及びＰＤＳＣＨの最初のシンボルの間の時間間隔を意味する）の間のスケジューリングオフセットが閾値（例えば、Ｔｈｒｅｓｈｏｌｄ－Ｓｃｈｅｄ－Ｏｆｆｓｅｔ）未満である場合、ＵＥは、サービングセルのＰＤＳＣＨの復調参照信号（ＤＭ－ＲＳ）ポートが、サービングセルのアクティブＢＷＰ内の一つ以上のＣＯＲＥＳＥＴがＵＥのために構成されており、最後のスロットにおける最小のＣＯＲＥＳＥＴ　ＩＤのＰＤＣＣＨ　ＱＣＬインディケーションのために使用されるＱＣＬ想定（複数可）に関する、送信構成インディケーション（ＴＣＩ）状態におけるＲＳ（複数可）を用いて、擬似コロケーションされている、と想定することができる。

【００４０】

このようにして、ＰＤＳＣＨのＤＭ－ＲＳ群のＱＣＬ想定が時間領域において少なくとも一つのシンボルにおけるＰＤＳＣＨと重複するＰＤＣＣＨのＤＭ－ＲＳ群のＱＣＬ想定と異なる場合、ＵＥは、そのＣＯＲＥＳＥＴに関連付けられたＰＤＣＣＨの受信を優先することが期待され得る。これは、帯域内ＣＡの場合にも適用することができる（例えば、ＰＤＳＣＨとＣＯＲＥＳＥＴは、異なるコンポーネントキャリア（ＣＣ：Ｃｏｍｐｏｎｅｎｔ　Ｃａｒｒｉｅｒｓ）内にある）。

【００４１】

本実装形態のいくつかにおいて、ＵＥは、複数のＣＯＲＥＳＥＴを用いて構成されてもよい。しかしながら、それらの全てがＵＥによってモニターされるわけではなくてもよい。例えば、ＵＥが時間領域における少なくとも一つのシンボル（例えば、ＯＦＤＭシンボル）において互いに重複する二つのＣＯＲＥＳＥＴを用いて構成される場合、ＵＥは、特定の優先順位ルール（複数可）又は事前構成（複数可）に基づいて、モニターする一つのＣＯＲＥＳＥＴを複数のＣＯＲＥＳＥＴの内から選択することができる。

【００４２】

本実装形態のいくつかにおいて、モニターされるＣＯＲＥＳＥＴがＣＳＳ及び最小のサーチスペースＩＤに関連付けられている場合、ＵＥは、そのＣＯＲＥＳＥＴに優先してモニターすることができる。対照的に、モニターされないＣＯＲＥＳＥＴは、ＱＣＬ－タイプ