PTO/SB/39 (11-15)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

AUTHORIZATION OR RESCISSION OF AUTHORIZATION TO PERMIT ACCESS TO APPLICATION-AS-FILED BY PARTICIPATING OFFICES

Send completed form to: Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450

Application Number (if known):	Filing Date:
First Named Inventor: CHIEN-CHUN CHENG	Attorney Docket Number: US75368

Title (Required): Method and apparatus for spatial QCL assumptions with overlapped CORESETs

Check either box 1 or 2 below, but **not** both:

1. ☒ By checking this box, 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).

2. ☐ By checking this box, the undersigned hereby **rescinds the previous authority granted to the USPTO** to provide the EPO, JPO, KIPO, SIPO, WIPO or any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement access to the documents and information identified in paragraph 1 above.

This rescission of the previous authorization will not be effective unless and until an appropriate USPTO official recognizes and acts on the rescission.

However, 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.

NOTE: This form must be signed by an authorized party in accordance with 37 CFR 1.14(c). Please see 37 CFR 1.4(d) for the form of the signature. If necessary, submit multiple forms for more than one signature, see below.*

Signature /Alvin Koan/	Date 2018-11-01
Name (Print/Typed) Alvin Koan	Practitioner Registration Number (If applicable) 68468
Name of Assignee (if applicable)	Title (if applicable)

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.14(h). 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 6 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.

Title: Method and apparatus for spatial QCL assumptions with overlapped CORESETs

1 Introduction

In RAN1#94bis, the following agreements were made in control and MIMO sections for issues of overlapped search space and default PDSCH beam.

Agreements in RAN1#94b

- For a UE monitors multiple search spaces associated with different CORESETs, for single cell operation or for operation with carrier aggregation in the same frequency band,
  - ✓ If the monitoring occasions of the search space are overlapped in time and the search spaces are associated with different CORESETs having different QCL-TypeD properties, the UE monitors search spaces associated with a given CORESET containing a 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 are respectively containing CSS, the UE selects the CORESET containing the search space having the lowest ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index.
    - Any overlapped search space(s) associated with CORESET(s) having the same QCL-TypeD are monitored.
  - ✓ If none of the CORESETs contains CSS, the UE selects the CORESET containing the search space having the lowest ID in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index.
    - Any overlapped search space(s) associated with CORESET(s) having the same QCL-TypeD are monitored.
  - ✓ For this purpose, QCL TypeD with respect to an SSB and QCL TypeD with respect to a CSI-RS (or TRS) are considered as different QCL TypeD, even if the CSI-RS is sourced from the same SSB.

Agreement in RAN1#94b

Text proposal for TS38.214:

- If the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold Threshold-Sched-Offset, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location 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. In this case, if the QCL type D of the PDSCH DMRS is different from those of the PDCCH DMRS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET. This also applies to the intra-band CA case (PDSCH and CORESET are in different CCs).

In this provisional, we aim for specifying UE behaviour on the following two new features:

1) whether a non-selected CORESET can be used for beam indication;
2) whether a deprioritized PDSCH can be used for beam indication.

2 Technical scope

3 NON-SELECTED CORESETS

3.1 NON-SELECTED CORESET FOR A DEFAULT PDSCH BEAM

3.1.1 ALTERNATIVE #1: REWRITE THE PRIORITY RULES FOR OVERLAPPED SEARCH SPACES

3 Non-selected CORESETs

After RAN1#94b, UE can be configured a CORESET that is not selected due to priority selection[*] when CORESETs which are configured to the UE and may be possible to receive downlink control information are overlapped at least one of them in at least one OFDM symbol of the time domain. We name this type of CORESETs as non-selected CORESETs. Non-selected CORESET means a specific CORESET that is associated with non-monitored search space sets due to QCL-TypeD conflicts. Until right now, the UE behaviour is unclear whether a non-selected CORESET is transparent to the UE or not; whether UE shall take no action for a non-selected CORESET, maintain configuration fields that are stored, or take specified behaviour.

Note[*]: UE may prioritize and monitor the CORESET based on common search space (SS) and lowest SS ID.

3.1 Non-selected CORESET for a default PDSCH beam

Non-selected CORESETs can be used for beam indication for PDSCH when it contains the lowest CORESET ID among the configured CORESETs, which can be found in the current spec.

TS38.214-f30

If the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold Threshold-Sched-Offset, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location 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.

However, using non-selected CORESETs for beam indication could result in unfavourable beam switching. That means a beam switch happens in a short period for no purpose and no performance improvement, simply to obey specification.

The following figure is that CORESET#2 including the DCI to schedule the PDSCH is overlapped with CORESET#1 and CORESET#1 is not monitored by UE because there is no CSS configured in CORESET#1 or no the lowest ID of SS with CSS, meanwhile according to the current specification PDSCH is scheduled with a limited time offset that it requires to use the RX beam from the TCI-state of a CORESET with the lowest CORESET ID (which is CORESET#1 in the figure). In this case, the UE must use different beams for CORESET#2 and PDSCH for a reason of obeying the current spec. This type of beam switching is undesirable and can be avoided by putting constraints in the current specifications.

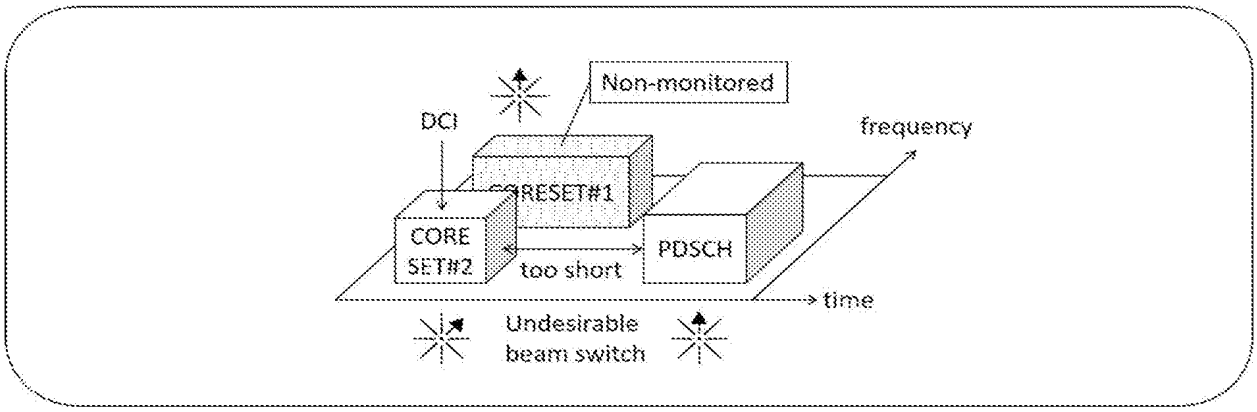

Figure 1. UE behaviour on the PDSCH beam with a non-selected CORESET.

3.1.1 Alternative #1: rewrite the priority rules for overlapped search spaces

To fundamentally solve this issue, we need to modify the agreement made in RAN1#94b. Our proposal is given below:

- For a UE monitors multiple search spaces associated with different CORESETs, for single cell operation or for operation with carrier aggregation in the same frequency band,
  - ✓ If the monitoring occasions of the search space are overlapped in time and the search spaces are associated with different CORESETs having different QCL-TypeD properties, **the UE selects the CORESET containing the lowest CORESET ID** in the monitoring occasions in the active DL BWP in the serving cell with the lowest serving cell index.
    - Any overlapped search space(s) associated with CORESET(s) having the same QCL-TypeD are monitored.

In another alternative, we could also modify the previous agreements made in both MIMO and control sections. One option is to change the priority rule on a CORESET with the lowest CORESET ID by the priority of the following order:

1) CORESET with CSS
2) CORESET with lowest SS ID
3) CORESET with the lowest CORESET ID

This priority rule shall be used for the QCL indication when more than one CORESETs are overlapped in time.

3.1.2 Alternative #2: add constraints for a PDSCH beam selection

To avoid unfavourable beam switching, non-selected CORESETs should be transparent to UE. Thus, we propose.

- If the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold Threshold-Sched-Offset, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for **a monitored** PDCCH quasi co-location 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. **In this case, a non-selected PDCCH cannot be used for QCL indication or beam indication.**
    - ✓ The monitored PDCCH means UE prioritizes to monitor search spaces associated with a given CORESET in the active DL BWP in the serving cell with the lowest serving cell index, for a UE monitors multiple search spaces associated with different CORESETs, for single cell operation or for operation with carrier aggregation in the same frequency band

3.1.3 Alternative #3: specify UE behaviour for non-selected CORESETs

To generalize and avoid potential issues, non-selected CORESETs shall be treated as a non-configured CORESETs. The configuration cannot be used for other purposes when UE does not monitor the corresponding CORESETs, but this configuration is still stored by the UE in case that there is no collision in the following slots and the configuration shall be valid again. As a result, we have the following proposal:

- For a UE monitors multiple search spaces associated with different CORESETs, for single cell operation or for operation with carrier aggregation in the same frequency band,
    - ✓ If the monitoring occasions of the search space are overlapped in time 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 shall be transparent to UE and shall be treated as blank REs in the corresponding slots;**
        - **at least, the CORESETs that UE does not monitor shall not be used for beam indication or QCL indication purposes;**
    - ✓ **when CORESETs are not monitored by UE, then**
        - **Option #1: UE still maintains and stores the RRC configuration for the non-selected CORESETs; the RRC configuration can be updated via MAC-CE and DCI, or**
        - **Option #2: UE release the RRC configuration for non-selected CORESETs; the RRC configuration cannot be updated and shall not be stored by UE.**

3.1.4 Alternative #4: specify QCL assumption for non-selected CORESETs

To avoid ambiguity, there is no clear wording on non-selected CORESETs whether its spatial QCL assumption, i.e., QCL-typeD, should be maintained, be invalid, or be overwritten by the overlapped and monitored CORESET. Thus, we have the following proposal:

3.1.4.1 Option #1: maintain its spatial QCL

- For a UE monitors multiple search spaces associated with different CORESETs, for single cell operation or for operation with carrier aggregation in the same frequency band,
    - ✓ If the monitoring occasions of the search space are overlapped in time **and the search spaces are not monitored by the UE**,
        - **UE stores and maintains the QCL assumption for non-selected CORESETs**
            - **The QCL can be updated via MAC-CE and/or DCI;**
            - **The QCL can be used if UE supports multiple RX beams;**
            - **The QCL can be used for non-selected CORESETs on the non-overlapped OFDM symbols in time;**
            - **The QCL can be used for beam indication, QCL indication, or being part of a QCL chain.**

3.1.4.2 Option #2: release or suspend its spatial QCL

- For a UE monitors multiple search spaces associated with different CORESETs, for single cell operation or for operation with carrier aggregation in the same frequency band,
  - ✓ If the monitoring occasions of the search space are overlapped in time **and the search spaces are not monitored by the UE**,
    - **UE release the spatial QCL assumption for non-selected CORESETs and for the non-overlapped CORESETs related to this search space, or**
    - **UE suspends the spatial QCL assumption for the slots that CORESETs are overlapped and non-selected by the UE, but for non-overlapped CORESETs in the same search space, the spatial QCL assumption remains, or**
    - **UE release or suspends the spatial QCL assumption for overlapped parts of non-selected CORESETs, and for the non-overlapped parts of CORESETs, may only with 1 or 2 OFDM symbols, UE remains using the configured QCL assumptions.**

3.1.4.3 Option #3: overwrite its spatial QCL

- For a UE monitors multiple search spaces associated with different CORESETs, for single cell operation or for operation with carrier aggregation in the same frequency band,
  - ✓ If the monitoring occasions of the search space are overlapped in time **and the search spaces are not monitored by the UE**,
    - **UE overwrites the spatial QCL assumption for non-selected CORESETs by the monitored CORESET;**
      - **The spatial QCL assumption of non-selected CORESETs could be overwritten in the overlapped symbols, or**
      - **The spatial QCL assumption of non-selected CORESETs could be overwritten in the whole-time interval of this CORESET.**

3.2 Non-selected CORESET for N_{RLM} RS selection

In RAN1#94b, NRLM RS can be selected based on TCI states in a CORESET, shown as below:

Agreement in RAN1#94b

- Adopt the following proposal to Section 5 of 38.213
  - ✓ the UE is not required to use for radio link monitoring an aperiodic or semi-persistent RS
  - ✓ For L = 4, the UE selects the N_{RLM} RS provided for active TCI states for PDCCH reception in the CORESETs associated with the search spaces with shortest monitoring periodicity. If more than one CORESETs are associated with search spaces with the same periodicity, the UE selects **the CORESETs with the highest CORESET ID.**

However, this CORESETs with the highest CORESET ID could be a non-selected CORESET, thus UE behaviour needs to be defined. An illustration is given in the following figure.

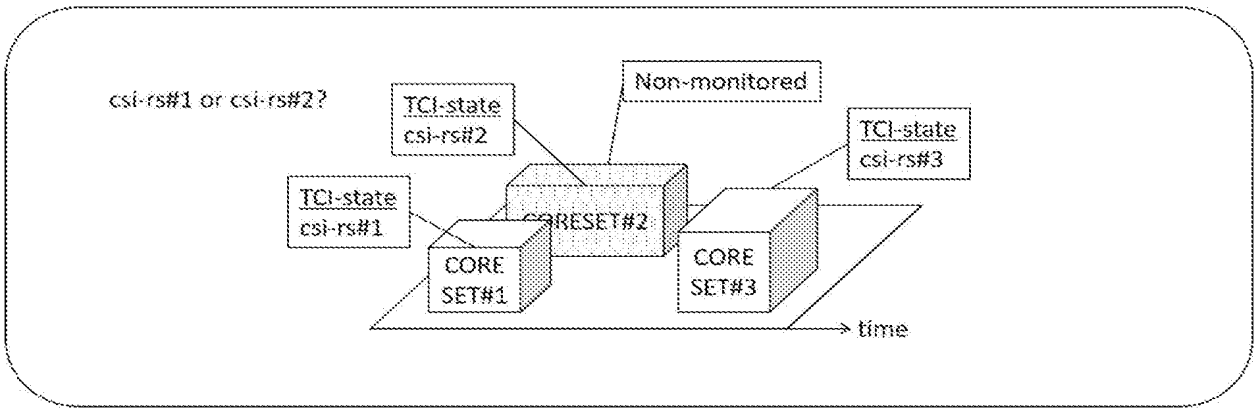

Figure 2. UE behaviour on NRLM RS selection with a non-selected CORESET.

3.2.1 Alternative #1: rewrite the priority rules for NRLM RS selection

To align with MIMO and control sections, we propose to change the highest CORESET ID to the lowest CORESET ID:

- Adopt the following proposal to Section 5 of 38.213
  - ✓ the UE is not required to use for radio link monitoring an aperiodic or semi-persistent RS
  - ✓ For L = 4, the UE selects the NRLM RS provided for active TCI states for PDCCH reception in the CORESETs associated with the search spaces with shortest monitoring periodicity. If more than one CORESETs are associated with search spaces with the same periodicity, the UE selects **the CORESETs with the lowest CORESET ID containing an active TCI-state.**

3.2.2 Alternative #2: add constraints for NRLM RS selection

To avoid a case that there are no TCI states or TCI states are not valid for selection. We thus propose:

- Adopt the following proposal to Section 5 of 38.213
  - ✓ the UE is not required to use for radio link monitoring an aperiodic or semi-persistent RS
  - ✓ For L = 4, the UE selects the NRLM RS provided for active TCI states for PDCCH reception in the CORESETs associated with the search spaces with shortest monitoring periodicity. If more than one CORESETs are associated with search spaces with the same periodicity, the UE selects the CORESETs with the highest CORESET ID. **In this case, the CORESET shall be monitored and be configured with TCI states.**

3.3 Non-selected CORESET for a default AP CSI-RS beam

It was agreed that if there is no PDSCH transmitted in the same symbols as the AP CSI-RS, the default QCL assumption of AP CSI-RS is derived from CORESET with lowest CORESET Id. We show the agreement below:

Agreement in RAN1#94b
- The default QCL assumption the UE applies in case the scheduling delay is smaller than a threshold:
  - ✓ After successful decoding of DCI scheduling the PDSCH, if there is only PDSCH transmitted in the same symbols as the CSI-RS, the default QCL assumption of AP CSI-RS follows **the QCL assumption of the PDSCH**.
    - Note: Scheduling offset of the PDSCH is larger than or equal to the threshold in this case
  - ✓ If there is no PDSCH transmitted in the same symbols as the CSI-RS, the default QCL assumption of AP CSI-RS is derived from **CORESET with lowest CORESET Id.**
    - FFS: When there is another downlink signal in the same symbols as the CSI-RS

However, the CORESET with the lowest CORESET ID could be a non-selected CORESET. An illustration is shown in the following figure that if the non-selected CORESET can be used for beam indication, then an unfavourable beam switching happens.

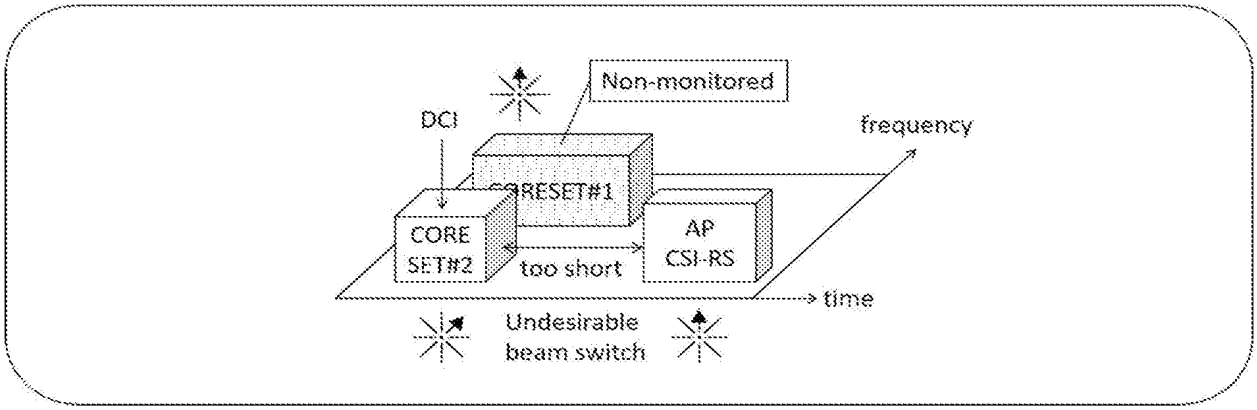

Figure 3. UE behaviour on NRLM RS selection with a non-selected CORESET.

3.3.1 Alternative #1: add constraints for a default AP CSI-RS beam

To avoid a case that there is no TCI state for RS selection. We thus propose:

- The default QCL assumption the UE applies in case the scheduling delay is smaller than a threshold:
  - ✓ If there is no PDSCH transmitted in the same symbols as the CSI-RS, the default QCL assumption of AP CSI-RS is derived from CORESET with lowest CORESET Id. **The CORESET shall be monitored and shall contain an activated TCI state.**

3.4 Scenarios for non-selected CORESETs

Non-selected CORESETs can also be found in the following cases:

- ✓ PDCCH on deactivated BWPs;
- ✓ PDCCH on deactivated SCells;
- ✓ PDCCH overlaps with at least one RE corresponding to an SS/PBCH block
- ✓ Under discontinuous reception (DRX) mode

UE behaviour on these non-selected CORESETs follows the same UE behaviour proposed in this disclosure.

3.5 Others: three CORESESTs are overlapped each other

It could happen that three CORESETs have overlap; Each two of them have overlap, but not three of them have overlap at a time. According to the current spec, there is a UE ambiguity for monitoring one CORESET or two CORESETs when these three CORESETs have different spatial QCL. In principle, UE shall maximize the number of CORESETs that can be monitored.

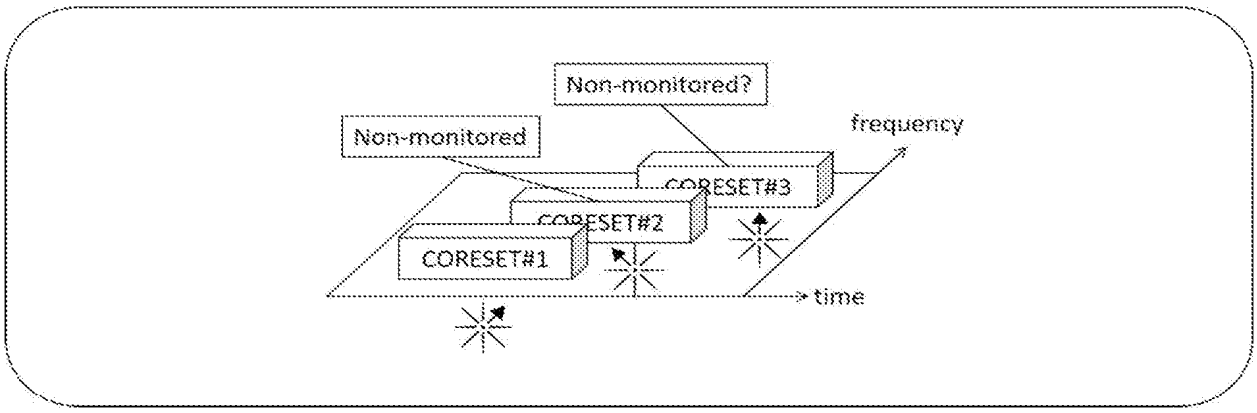

Figure 4. UE behaviour when three CORESETs have overlap, but three of them have no overlap.

In the figure above, UE could monitor CORESET#1 or monitor both CORESET#1 and CORESET#3 simultaneously. This is based on how to interpret the current agreement, and this leads to a UE ambiguity. More specific background settings, we assume CORESET#1 is the only one containing CSS and CORESET#2 has the lowest SS search space ID.

- ✓ If UE monitors CORESET#1 and CORESET#3, then CORESET#2 will be the only non-selected CORESET, and its QCL assumption for QCL indication will follow our disclosure above.
- ✓ If UE monitors simply CORESET#1, then CORESET#2 and CORESET#3 will be overlapped and non-selected CORESETs. Their QCL assumption for QCL indication may be either
  - Remaining the same spatial QCLs
  - Overwritten by the non-selected CORESET with the lowest CORESET ID

4 Deprioritized PDSCH

After RAN1#94b, UE can be configured a PDSCH that is deprioritized on its reception when this PDSCH is overlapped with CORESETs in time. We name this new type of PDSCHs as deprioritized PDSCHs. Until right now, the UE behaviour is unclear for a deprioritized PDSCH whether the spatial QCL assumption of a deprioritized PDSCH can be used for beam indication purpose.

4.1 Deprioritized PDSCH for a default AP CSI-RS beam

It was agreed that if there is only PDSCH transmitted in the same symbols as the AP CSI-RS, the default QCL assumption of AP CSI-RS follows the QCL assumption of the PDSCH. However, UE behaviour is unclear when PDSCH is overlapped with CORESETs and the reception of PDSCH is deprioritized.

An illustration is shown in the following figure. The QCL assumption of this AP CSI-RS follows the QCL assumption of the PDSCH, but PDSCH is deprioritized because of being overlapped with CORESET#2. In this case, UE behaviour is unclear that the QCL assumption of the AP CSI-RS should follow the PDSCH, CORESET#2, or CORESET#1.

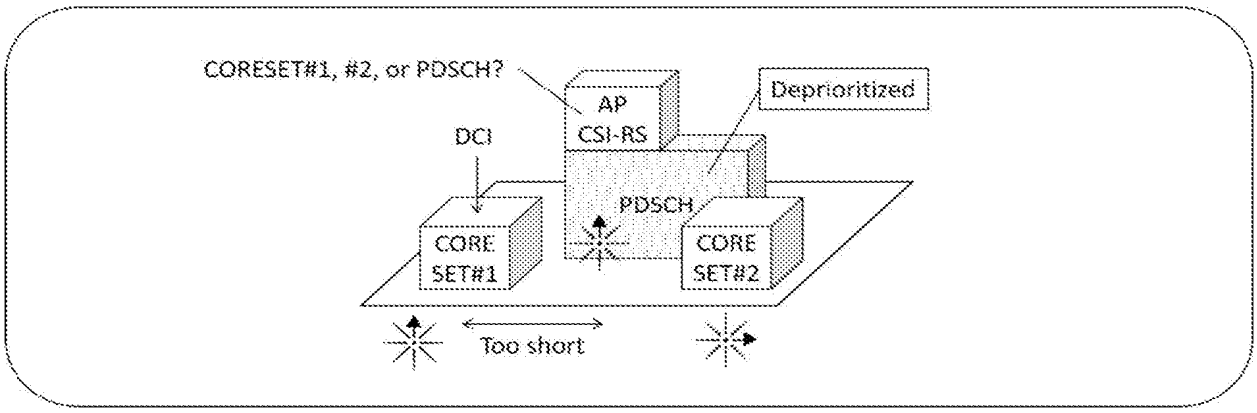

Figure 5. UE behaviour on AP CSI-RS beam when deprioritized PDSCH is overlapped with CORESETs

4.1.1 Alternative #1: rewrite the priority rule for PDSCH

To fundamentally solve this issue, we need to modify the agreement made in RAN1#94b. Our proposal is given below:

- If the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold Threshold-Sched-Offset, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location 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. In this case, if the QCL type D of the PDSCH DMRS is different from those of the PDCCH DMRS with which they overlap in at least one symbol, **the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for the overlapped PDCCH quasi co-location indication**. This also applies to the intra-band CA case (PDSCH and CORESET are in different CCs).

4.1.2 Alternative #2: add constraints for a default AP CSI-RS beam

To avoid this corner case, we then propose.

- After successful decoding of DCI scheduling the PDSCH, if there is only PDSCH transmitted in the same symbols as the AP CSI-RS, the default QCL assumption of AP CSI-RS follows the QCL assumption of the PDSCH. **In this case, the default QCL assumption of AP CSI-RS follows the QCL assumption of the PDSCH, even if the PDSCH is deprioritized because of being overlapped with CORESETs at least one OFDM symbol.**
    - **In case that there are multiple QCL assumptions within the PDSCH in time among OFDM symbols, AP-CSI RS follows the same QCL assumptions according to the aligned PDSCH symbols**.

4.1.3 Alternative #3: specify QCL assumption for deprioritized PDSCHs

In the current specification, there is no clear wording on deprioritized PDSCHs whether its spatial QCL assumption, i.e., QCL-typeD, should be maintained, be invalid, or be overwritten by the overlapped CORESET. Thus, we have the following proposal:

4.1.3.1 Option #1: maintain its spatial QCL

- If the QCL type D of the PDSCH DMRS is different from those of the PDCCH DMRS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET.
    - ✓ **UE stores and maintains the QCL assumption for deprioritized PDSCHs;**
    - ✓ **The spatial QCL assumption of deprioritized PDSCHs could be used for the PDSCH if UE supports multiple RX beams;**

- ✓ **The spatial QCL assumption of deprioritized PDSCHs could be used for the PDSCH for the non-overlapped part with CORESETs in time;**
- ✓ **The spatial QCL assumption could be used for beam indication purposes or for building a QCL chain.**

4.1.3.2 Option #2: release or partially release its spatial QCL

- If the QCL type D of the PDSCH DMRS is different from those of the PDCCH DMRS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET.
  - ✓ **UE release the spatial QCL assumption for deprioritized PDSCHs**
  - ✓ **UE release only for the overlapped part of OFDM symbols in the time domain and maintain the QCL for the non-overlapped part.**

4.1.3.3 Option #3: overwrite its spatial QCL

- If the QCL type D of the PDSCH DMRS is different from those of the PDCCH DMRS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET.
  - ✓ **UE overwrite the spatial QCL assumption for deprioritized PDSCHs by the overlapped and monitored CORESET. In this case, if more than one CORESETs can be chosen, then UE selects the CORESET with the lowest CORESET ID.**
  - ✓ **UE overwrite only for the overlapped part of OFDM symbols in the time domain and maintain the QCL for the non-overlapped part.**

4.2 Deprioritized PDSCH for overlapped AP CSI-RS and a CORESET

Like the previous case, but now a CORESET, PDSCH, and AP CSI-RS have overlap in time. In this case, UE shall apply the monitored and prioritized CORESET as a default beam for the reception of AP CSI-RS. This can be done by

1. Overlapped and non-overlapped parts of the symbols use the same QCL assumption;
2. Only Overlapped parts use the same QCL assumption; the non-overlapped parts remain the configuration.

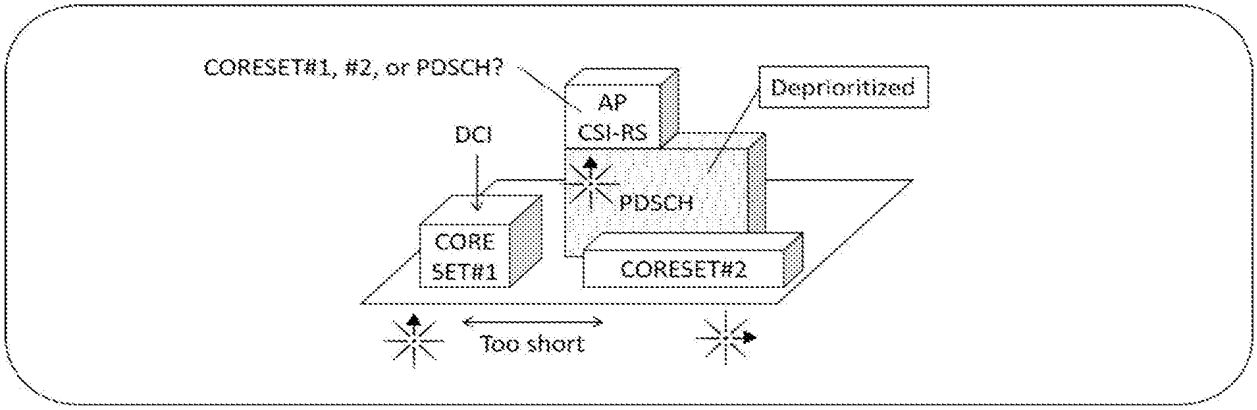

Figure 6. UE behaviour when AP CSI-RS, deprioritized PDSCH, and CORESET are overlapped in time

4.3 Deprioritized PDSCH for non-selected CORESETs

When the QCL type D of the PDSCH DMRS is different from those of the PDCCH DMRS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET. However, if that CORESET is not monitored by the UE due to accidentally overlapping with other CORESETs, UE behaviour is unclear. That said, whether the UE is expected to prioritize the non-selected CORESET or not.

As shown in the figure below, assume that CORESET#2 and CORESEST#3 are overlapped in time with the different QCL-D assumption, CORESET#3 is monitored, and CORESET#2 is not monitored by UE. In this case, it is unclear whether the reception of PDSCH shall change its QCL assumption for the non-selected CORESET#2.

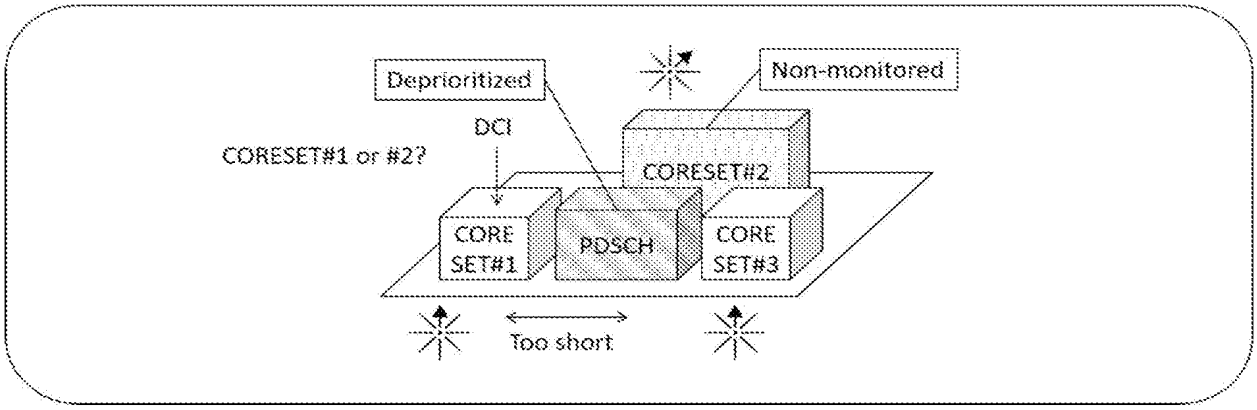

Figure 7. UE behaviour when deprioritized PDSCH and non-selected CORESETs are overlapped in time

4.3.1 Alternative #1: prioritize the non-selected CORESETs

To minimize spec change, we thus propose that

- If the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold Threshold-Sched-Offset, [...] In this case, if the QCL type D of the PDSCH DMRS is different from those of the PDCCH DMRS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET. This also applies to the intra-band CA case (PDSCH and CORESET are in different CCs). **In this case, even if the CORESET are not monitored by the UE, then the QCL type D of the PDSCH is the same as the QCL assumption of the non-selected CORESET.**

4.3.2 Alternative #2: add constraints on deprioritized PDSCH

To avoid this corner case, we thus propose that

- If the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold Threshold-Sched-Offset, [...] In this case, if the QCL type D of the PDSCH DMRS is different from those of the **monitored** PDCCH DMRS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of **monitored** PDCCH associated with that CORESET. This also applies to the intra-band CA case (PDSCH and CORESET are in different CCs).

  –

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Method and Apparatus for Spatial QCL Assumptions with Overlapped CORESETs
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Filer:	Alvin Sean Koan
Attorney Docket Number:	US75368

Filed as Large Entity

Filing Fees for Provisional

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
PROVISIONAL APPLICATION FILING	1005	1	280	280
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**280**

Electronic Acknowledgement Receipt

EFS ID:	34186468
Application Number:	62754165
International Application Number:	
Confirmation Number:	6903
Title of Invention:	Method and Apparatus for Spatial QCL Assumptions with Overlapped CORESETs
First Named Inventor/Applicant Name:	CHIEN-CHUN CHENG
Customer Number:	54000
Filer:	Alvin Sean Koan
Filer Authorized By:	
Attorney Docket Number:	US75368
Receipt Date:	01-NOV-2018
Filing Date:	
Time Stamp:	14:56:15
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$280
RAM confirmation Number	110218INTEFSW00001237505142
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	Provisional Cover Sheet (SB16)	US75368_SB16.pdf	2032305 efba2af8d814b3b2ab2a3f449a58ade66e5947d6	no	4
Warnings:					
Information:					
2	Auth or Resc of Auth to Access Appl by DAS/PDX Office	US75368_SB39.pdf	129395 3357a35b75572a36a19e0bbf04e90916a91892ef	no	2
Warnings:					
Information:					
3	Specification	US75368_SPEC.pdf	3074682 652af35b4cfbff1802c8739a0806092e4b6fb070	no	11
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30118 6fd42d313e6b3e21d37c501c4ac153c1c7789368	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	5266500		

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.

Doc Code: **TR.PROV**
Document Description: Provisional Cover Sheet (SB16)

PTO/SB/16 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

Inventor 1 — Remove

Given Name	Middle Name	Family Name	City	State	Country
CHIEN-CHUN		CHENG	Taipei		TW

Inventor 2 — Remove

Given Name	Middle Name	Family Name	City	State	Country
TSUNG-HUA		TSAI	HSINCHU		TW

Inventor 3 — Remove

Given Name	Middle Name	Family Name	City	State	Country
YU-HSIN		CHENG	HSINCHU		TW

Inventor 4 — Remove

Given Name	Middle Name	Family Name	City	State	Country
WAN-CHEN		LIN	Hualien		TW

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

Title of Invention	Method and Apparatus for Spatial QCL Assumptions with Overlapped CORESETs
Attorney Docket Number (if applicable)	US75368

Correspondence Address

Direct all correspondence to (select one):

◉ The address corresponding to Customer Number	○ Firm or Individual Name
Customer Number	54000

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

- ● No.
- Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:
- Yes, the invention was under a contract with an agency of the United States Government. The name of the U.S. Government agency and Government contract number are:

Doc Code: **TR.PROV**
Document Description: Provisional Cover Sheet (SB16)

PTO/SB/16 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

Entity Status
Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29

○	Applicant asserts small entity status under 37 CFR 1.27
○	Applicant certifies micro entity status under 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
◉	No

Warning

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Alvin Koan/			Date (YYYY-MM-DD)	2018-11-01
First Name	Alvin	Last Name	Koan	Registration Number (If appropriate)	68468

This collection of information is required by 37 CFR 1.51. 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 8 hours 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. **This form can only be used when in conjunction with EFS-Web. If this form is mailed to the USPTO, it may cause delays in handling the provisional application.**

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 paten. 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, t o a n other 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
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
62/754,165	11/01/2018		280	US75368		

CONFIRMATION NO. 6903

FILING RECEIPT

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

OC000000103850575

Date Mailed: 11/07/2018

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, 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 Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections 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**

Inventor(s)

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

Applicant(s)

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

Power of Attorney:
Alvin Koan--68468

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: 11/06/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 62/754,165**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No
Title

Method and Apparatus for Spatial QCL Assumptions with Overlapped CORESETs

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.