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UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF CALIFORNIA

SPEIR TECHNOLOGIES LTD., Plaintiff, v. GOOGLE LLC, Defendant.	Case No. '22CV0371 GPC BGS **COMPLAINT FOR PATENT INFRINGEMENT AGAINST GOOGLE LLC** **JURY TRIAL DEMANDED**

This is an action for patent infringement arising under the Patent Laws of the United States of America, 35 U.S.C. § 1 *et seq.*, in which Plaintiff Speir Technologies Limited ("Plaintiff" or "Speir") makes the following allegations against Defendant Google LLC ("Defendant" or "Google"):

INTRODUCTION

1. This complaint arises from Google's unlawful infringement of the following United States patents owned by Plaintiff, which relate to improvements in

mobile communications systems: United States Patent No. 8,345,780 ("the '780 Patent").

PARTIES

2. Plaintiff Speir Technologies Limited is a limited liability company organized and existing under the law of Ireland, with its principal place of business at The Hyde Building, Suite 23, The Park, Carrickmines, Dublin 18, Ireland. Speir is the sole owner by assignment of all rights, title, and interest in the Asserted Patents, including the right to recover damages for past, present, and future infringement.

3. On information and belief, Defendant Google LLC is a wholly-owned subsidiary of Alphabet, Inc. and a Delaware limited liability company with a principal place of business at 1600 Amphitheatre Parkway, Mountain View, California 94043. Google may be served with process through its registered agent, Kevin Silva – 1111 California Street, San Francisco, CA 94108.

JURISDICTION AND VENUE

4. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has original subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

5. This Court has personal jurisdiction over Google in this action because Google has committed acts within this District giving rise to this action and has established minimum contacts with this forum such that the exercise of jurisdiction over Google would not offend traditional notions of fair play and substantial justice. Google, directly and through subsidiaries or intermediaries, has committed and continues to commit acts of infringement in this District by, among other things, making, using, importing, offering to sell, and selling products that infringe the Asserted Patents.

6. Venue is proper in this District under 28 U.S.C. §§ 1391 and 1400(b). Venue is proper in this District under 28 U.S.C. §§ 1391 and 1400(b). Google is

registered to do business in California, and upon information and belief, Google has transacted business in this District and has committed acts of direct and indirect infringement in this District by, among other things, making, using, offering to sell, selling, and importing products that infringe the Asserted Patents. Google has regular and established place of business in this District, including at 6420 Sequence Dr., San Diego, CA 92121. Google currently has, as of March 2022, over 170 job postings for San Diego, CA, including for jobs concerning the accused 5G technology.[1]

THE ASSERTED PATENTS

7. On January 1, 2013, the United States Patent and Trademark Office issued U.S. Patent No. 8,345,780 ("the '780 Patent"), entitled "Wireless communication system compensating for interference and related methods," after full and fair examination. Plaintiff is the assignee of all rights, title, and interest in and to the '780 Patent and possesses all rights of recovery under the '780 Patent, including the right to recover damages for past, present, and future infringement. The '780 Patent is valid and enforceable. A true and correct copy of the '780 Patent is attached hereto as Exhibit 1.

GOOGLE'S INFRINGEMENT

8. The allegations provided below are exemplary and without prejudice to Plaintiff's infringement contentions provided pursuant to the Court's scheduling order and local rules. Plaintiff's claim construction contentions regarding the meaning and scope of the claim terms will be provided under the Court's scheduling order and local rules. As detailed below, each element of at least one claim of each

[1] *See, e.g.*, https://careers.google.com/locations/san-diego/; https://careers.google.com/jobs/results/123887619986596550-technical-program-manager-carrier-field-certification/?hl=en&jlo=en-US&location=San%20Diego,%20CA,%20USA&q=Rf; https://careers.google.com/jobs/results/142786664284988102-chip-package-signalpower-integrity-engineer/?hl=en&jlo=en-US&location=San%20Diego,%20CA,%20USA&q=Rf.

of the Asserted Patents is literally present in the accused products. To the extent that any element is not literally present, each such element is present under the doctrine of equivalents. Plaintiff's analysis below should not be taken as an admission that the preamble is limiting. While publicly available information is cited below, Plaintiff may rely on other forms of evidence to prove infringement, including evidence that is solely in the possession of Google and/or third parties.

9. The accused products include at least the following products, as well as products with reasonably similar functionality. Identification of the accused products will be provided in plaintiff's infringement contentions pursuant to the Court's scheduling order and local rules. Google imports into the United States, uses, makes, offers for sale, and sells in the United States the following products and infringes the asserted claims of the patents-in-suit (the "Accused Products"): Pixel 4a (5G), Pixel 5, Pixel 5a, Pixel 6, and Pixel 6 Pro.

COUNT I

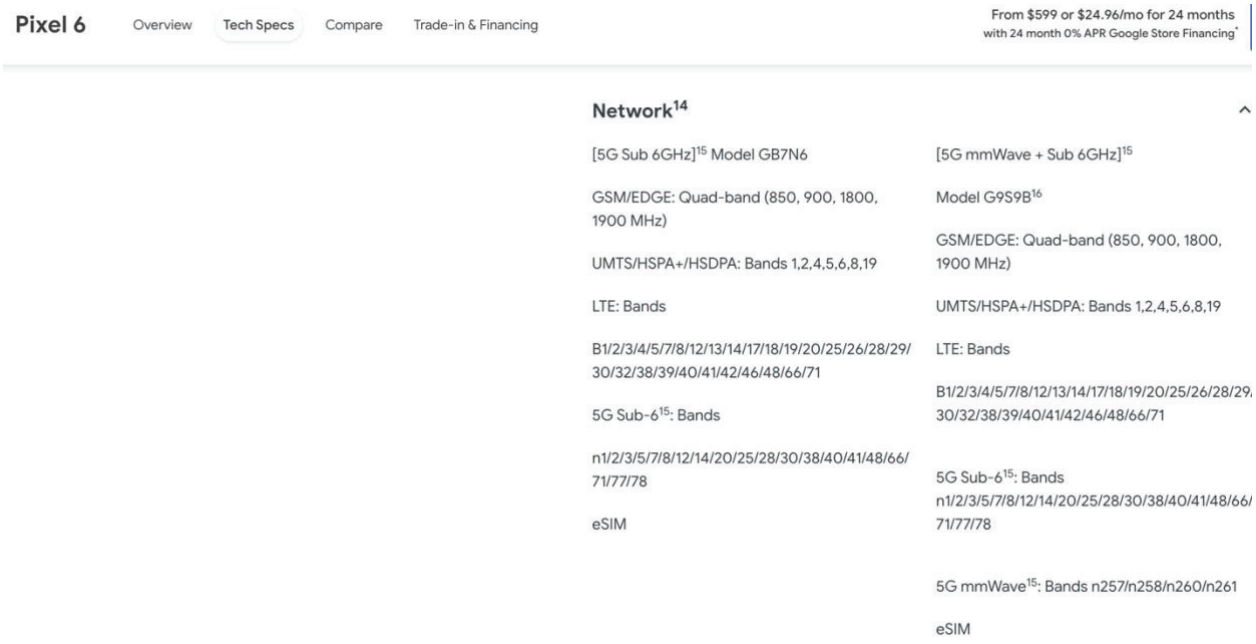
INFRINGEMENT OF U.S. PATENT NO. 8,345,780

10. Plaintiff realleges and incorporates by reference the foregoing paragraphs as if fully set forth herein.

11. Google has been and is now directly infringing the '780 Patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(a), including by making, using, selling, and/or offering for sale in the United States or importing into the United States infringing products, including at least the Accused Products identified above. The Accused Products satisfy all of the claim limitations of one or more claims of the '780 Patent, including but not limited to claim 9.

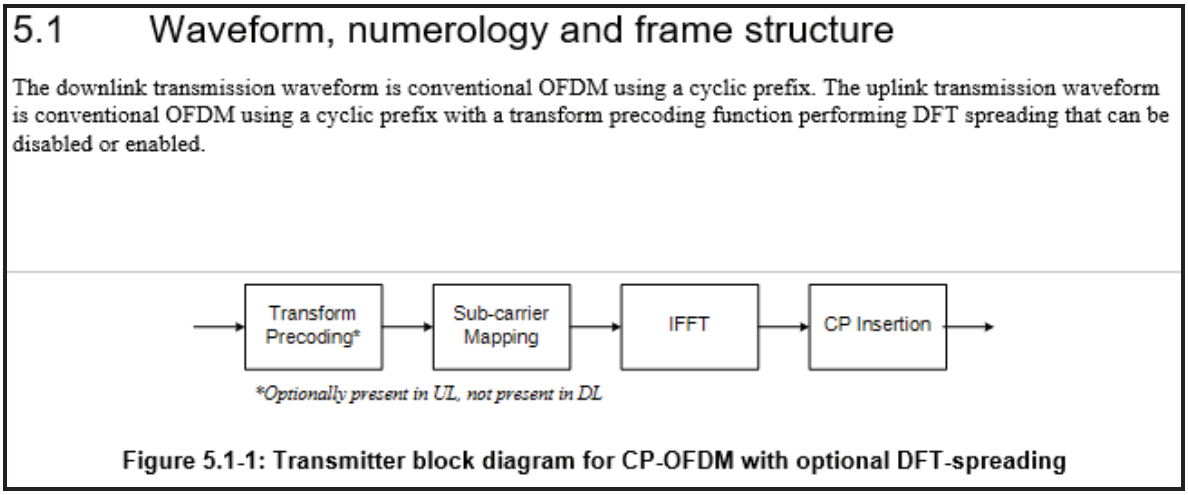
12. Claim 9 of the '780 Patent recites "[a] wireless communications device operable to communicate with an other wireless communications device via a wireless communications link having at least one settable link characteristic." To the extent the preamble is limiting, the Accused Products each comprise a wireless communications device operable to communicate with an other wireless

communications device via a wireless communications link having at least one settable link characteristic. For example, the Accused Products are configured to communicate with base stations using 5G cellular technology:



See https://store.google.com/product/pixel_6_specs?hl=en-US.

13. Claim 9 of the '780 Patent recites that the "wireless communications device" comprises "an orthogonal frequency-division multiplexing (OFDM) wireless transceiver." The Accused Products each comprise an orthogonal frequency-division multiplexing (OFDM) wireless transceiver. For example, 5G uses OFDM in both the uplink and the downlink:



See 3GPP TS 38.300 V15.13.0.

> **5.3.1 OFDM baseband signal generation for all channels except PRACH**
>
> The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port p and subcarrier spacing configuration μ for OFDM symbol $l \in \{0, 1, \ldots, N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by
>
> $$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi \left(k + k_0^{\mu} - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right) \Delta f \left(t - N_{\text{CP},l}^{\mu} T_c - t_{\text{start},l}^{\mu}\right)}$$
>
> $$k_0^{\mu} = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$
>
> where $t_{\text{start},l}^{\mu} \le t < t_{\text{start},l}^{\mu} + \left(N_{\text{u}}^{\mu} + N_{\text{CP},l}^{\mu}\right) T_c$ is the time within the subframe,
>
> $$N_{\text{u}}^{\mu} = 2048\, \kappa \cdot 2^{-\mu}$$
>
> $$N_{\text{CP},l}^{\mu} = \begin{cases} 512\, \kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\, \kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^{\mu} \\ 144\, \kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \neq 0 \text{ and } l \neq 7 \cdot 2^{\mu} \end{cases}$$

See 3GPP TS 38.211 V15.9.0.

14. Claim 9 of the '780 Patent recites "a controller coupled to said wireless transceiver and configured to store short term and long term historical characteristics of interference." The Accused Products each comprise a controller coupled to said wireless transceiver and configured to store short term and long term historical characteristics of interference. For example, the controllers in the Accused Products are configured to store short term and long term historical characteristics of interference:

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the *CSI-ReportConfig* is included (in this case, the cell on which the report is sent is determined by the received DCI). See TS 38.214 [19], clause 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
    reportConfigId                          CSI-ReportConfigId,
    carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
    resourcesForChannelMeasurement          CSI-ResourceConfigId,
    csi-IM-ResourcesForInterference         CSI-ResourceConfigId            OPTIONAL,   -- Need R
    nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId            OPTIONAL,   -- Need R
    reportConfigType                        CHOICE {
        periodic                                SEQUENCE {
            reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
            pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
        },
        semiPersistentOnPUCCH                   SEQUENCE {
            reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
            pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
        },
        semiPersistentOnPUSCH                   SEQUENCE {
            reportSlotConfig                        ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
            reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
            p0alpha                                 P0-PUSCH-AlphaSetId
        },
        aperiodic                               SEQUENCE {
            reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
        }
    },
    reportQuantity                          CHOICE {
        none                                    NULL,
        cri-RI-PMI-CQI                          NULL,
        cri-RI-i1                               NULL,
        cri-RI-i1-CQI                           SEQUENCE {
            pdsch-BundleSizeForCSI                  ENUMERATED {n2, n4}                                 OPTIONAL    -- Need S
        },
        cri-RI-CQI                              NULL,
        cri-RSRP                                NULL,
        ssb-Index-RSRP                          NULL,
        cri-RI-LI-PMI-CQI                       NULL
    },
```

See 3GPP TS 38.331 V15.15.0.

CSI-ReportConfig field descriptions
carrier Indicates in which serving cell the *CSI-ResourceConfig* indicated below are to be found. If the field is absent, the resources are on the same serving cell as this report configuration.
codebookConfig Codebook configuration for Type-1 or Type-2 including codebook subset restriction.
cqi-FormatIndicator Indicates whether the UE shall report a single (wideband) or multiple (subband) CQI (see TS 38.214 [19], clause 5.2.1.4).
cqi-Table Which CQI table to use for CQI calculation (see TS 38.214 [19], clause 5.2.2.1).
csi-IM-ResourcesForInterference CSI IM resources for interference measurement. *csi-ResourceConfigId* of a *CSI-ResourceConfig* included in the configuration of the serving cell indicated with the field "carrier" above. The *CSI-ResourceConfig* indicated here contains only CSI-IM resources. The *bwp-Id* in that *CSI-ResourceConfig* is the same value as the *bwp-Id* in the *CSI-ResourceConfig* indicated by *resourcesForChannelMeasurement*.
csi-ReportingBand Indicates a contiguous or non-contiguous subset of subbands in the bandwidth part which CSI shall be reported for. Each bit in the bit-string represents one subband. The right-most bit in the bit string represents the lowest subband in the BWP. The choice determines the number of subbands (subbands3 for 3 subbands, subbands4 for 4 subbands, and so on) (see TS 38.214 [19], clause 5.2.1.4). This field is absent if there are less than 24 PRBs (no sub band) and present otherwise (see TS 38.214 [19], clause 5.2.1.4).
dummy This field is not used in the specification. If received it shall be ignored by the UE.
groupBasedBeamReporting Turning on/off group beam based reporting (see TS 38.214 [19], clause 5.2.1.4).
non-PMI-PortIndication Port indication for RI/CQI calculation. For each CSI-RS resource in the linked ResourceConfig for channel measurement, a port indication for each rank R, indicating which R ports to use. Applicable only for non-PMI feedback (see TS 38.214 [19], clause 5.2.1.4.2). The first entry in *non-PMI-PortIndication* corresponds to the NZP-CSI-RS-Resource indicated by the first entry in *nzp-CSI-RS-Resources* in the *NZP-CSI-RS-ResourceSet* indicated in the first entry of *nzp-CSI-RS-ResourceSetList* of the *CSI-ResourceConfig* whose *CSI-ResourceConfigId* is indicated in a CSI-MeasId together with the above *CSI-ReportConfigId*; the second entry in *non-PMI-PortIndication* corresponds to the NZP-CSI-RS-Resource indicated by the second entry in *nzp-CSI-RS-Resources* in the *NZP-CSI-RS-ResourceSet* indicated in the first entry of *nzp-CSI-RS-ResourceSetList* of the same *CSI-ResourceConfig*, and so on until the NZP-CSI-RS-Resource indicated by the last entry in *nzp-CSI-RS-Resources* in the in the *NZP-CSI-RS-ResourceSet* indicated in the first entry of *nzp-CSI-RS-ResourceSetList* of the same *CSI-ResourceConfig*. Then the next entry corresponds to the NZP-CSI-RS-Resource indicated by the first entry in *nzp-CSI-RS-Resources* in the *NZP-CSI-RS-ResourceSet* indicated in the second entry of *nzp-CSI-RS-ResourceSetList* of the same *CSI-ResourceConfig* and so on.
nrofReportedRS The number (N) of measured RS resources to be reported per report setting in a non-group-based report. N <= N_max, where N_max is either 2 or 4 depending on UE capability. (see TS 38.214 [19], clause 5.2.1.4) When the field is absent the UE applies the value 1.
nzp-CSI-RS-ResourcesForInterference NZP CSI RS resources for interference measurement. *csi-ResourceConfigId* of a *CSI-ResourceConfig* included in the configuration of the serving cell indicated with the field "carrier" above. The *CSI-ResourceConfig* indicated here contains only NZP-CSI-RS resources. The *bwp-Id* in that *CSI-ResourceConfig* is the same value as the *bwp-Id* in the *CSI-ResourceConfig* indicated by *resourcesForChannelMeasurement*.

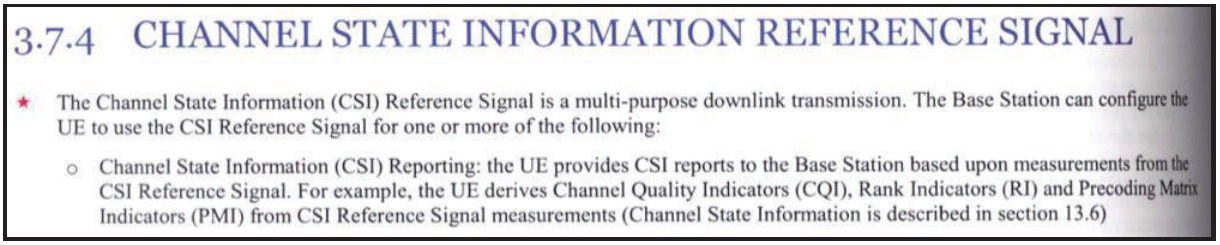
See 3GPP TS 38.331 V15.15.0.

resourcesForChannelMeasurement Resources for channel measurement. *csi-ResourceConfigId* of a *CSI-ResourceConfig* included in the configuration of the serving cell indicated with the field "carrier" above. The *CSI-ResourceConfig* indicated here contains only NZP-CSI-RS resources and/or SSB resources. This *CSI-ReportConfig* is associated with the DL BWP indicated by *bwp-Id* in that *CSI-ResourceConfig*.
subbandSize Indicates one out of two possible BWP-dependent values for the subband size as indicated in TS 38.214 [19], table 5.2.1.4-2 . If *csi-ReportingBand* is absent, the UE shall ignore this field.
timeRestrictionForChannelMeasurements Time domain measurement restriction for the channel (signal) measurements (see TS 38.214 [19], clause 5.2.1.1).
timeRestrictionForInterferenceMeasurements Time domain measurement restriction for interference measurements (see TS 38.214 [19], clause 5.2.1.1).

See 3GPP TS 38.331 V15.15.0.

> Many transmission features in modern radio-access technologies are based on the availability of more or less detailed knowledge about different characteristics of the radio channel over which a signal is to be transmitted. This may range from rough knowledge of the radio-channel path loss for transmit-power adjustment to detailed knowledge about the channel amplitude and phase in the time, frequency, and/or spatial domain. Many transmission features will also benefit from knowledge about the interference level experienced at the receiver side.
>
> Such knowledge about different channel characteristics can be acquired in different ways and by measurements on either the transmitter side or receiver side of a radio link. As an example, knowledge about downlink channel characteristics can be acquired by means of device measurements. The acquired information could then be reported to the network for the setting of different transmission parameters for subsequent downlink transmissions. Alternatively, if it can be assumed that the channel is reciprocal, that is, the channel characteristics of inter-

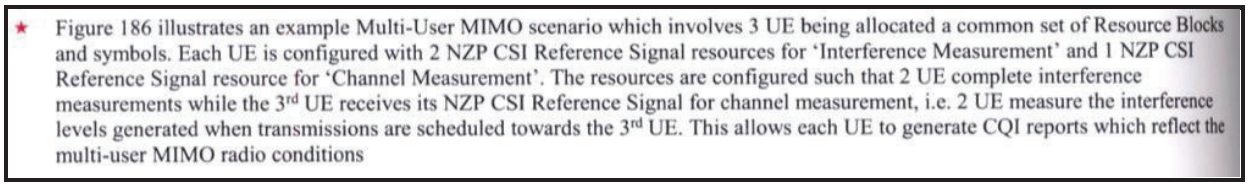
See Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Ch. 8 Abstract (2d Ed. 2018).



3.7.4 CHANNEL STATE INFORMATION REFERENCE SIGNAL

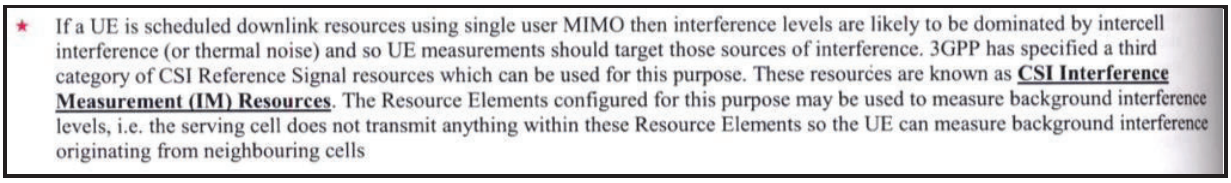
- The Channel State Information (CSI) Reference Signal is a multi-purpose downlink transmission. The Base Station can configure the UE to use the CSI Reference Signal for one or more of the following:
  - Channel State Information (CSI) Reporting: the UE provides CSI reports to the Base Station based upon measurements from the CSI Reference Signal. For example, the UE derives Channel Quality Indicators (CQI), Rank Indicators (RI) and Precoding Matrix Indicators (PMI) from CSI Reference Signal measurements (Channel State Information is described in section 13.6)

See Chris Johnson, 5G New Radio in Bullets, Section 3.7.4. (2019).



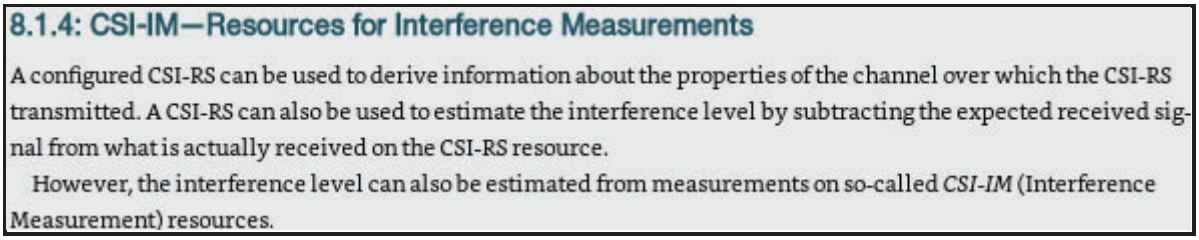
- Figure 186 illustrates an example Multi-User MIMO scenario which involves 3 UE being allocated a common set of Resource Blocks and symbols. Each UE is configured with 2 NZP CSI Reference Signal resources for 'Interference Measurement' and 1 NZP CSI Reference Signal resource for 'Channel Measurement'. The resources are configured such that 2 UE complete interference measurements while the 3rd UE receives its NZP CSI Reference Signal for channel measurement, i.e. 2 UE measure the interference levels generated when transmissions are scheduled towards the 3rd UE. This allows each UE to generate CQI reports which reflect the multi-user MIMO radio conditions

See Chris Johnson, 5G New Radio in Bullets, Section 3.7.4. (2019).



- If a UE is scheduled downlink resources using single user MIMO then interference levels are likely to be dominated by intercell interference (or thermal noise) and so UE measurements should target those sources of interference. 3GPP has specified a third category of CSI Reference Signal resources which can be used for this purpose. These resources are known as **CSI Interference Measurement (IM) Resources**. The Resource Elements configured for this purpose may be used to measure background interference levels, i.e. the serving cell does not transmit anything within these Resource Elements so the UE can measure background interference originating from neighbouring cells

See Chris Johnson, 5G New Radio in Bullets, Section 3.7.4. (2019).



8.1.4: CSI-IM—Resources for Interference Measurements

A configured CSI-RS can be used to derive information about the properties of the channel over which the CSI-RS transmitted. A CSI-RS can also be used to estimate the interference level by subtracting the expected received signal from what is actually received on the CSI-RS resource.

However, the interference level can also be estimated from measurements on so-called *CSI-IM* (Interference Measurement) resources.

See Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, § 8.1.4 (2d Ed. 2018).

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the *CSI-ReportConfig* is included (in this case, the cell on which the report is sent is determined by the received DCI). See TS 38.214 [19], clause 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
    reportConfigId                          CSI-ReportConfigId,
    carrier                                 ServCellIndex                   OPTIONAL,   -- Need S
    resourcesForChannelMeasurement          CSI-ResourceConfigId,
    csi-IM-ResourcesForInterference         CSI-ResourceConfigId            OPTIONAL,   -- Need R
    nzp-CSI-RS-ResourcesForInterference     CSI-ResourceConfigId            OPTIONAL,   -- Need R
    reportConfigType                        CHOICE {
        periodic                                SEQUENCE {
            reportSlotConfig                        CSI-ReportPeriodicityAndOffset,
            pucch-CSI-ResourceList                  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
        },
```

See 3GPP TS 38.331 V15.15.0.

15. Claim 9 of the '780 Patent recites that the "controller" is configured to "detect received interference." The Accused Products each comprise a controller configured to detect received interference. For example, the Accused Products are configured to receive the channel state information ("CSI") CSI-ReportConfig parameter structure that informs the user equipment ("UE") of the channel and interference measurements it should make:

★ Figure 187 summarises the four categories of CSI Reference Signal resource. These categories are described in greater detail within the following sections. Note that three of the categories are configured within the *CSI-ReportConfig* parameter structure because these categories are associated with UE measurements and reporting. The fourth category is configured within *PDSCH-Config* because this category is used to define Reserved Resources which are not available to the PDSCH

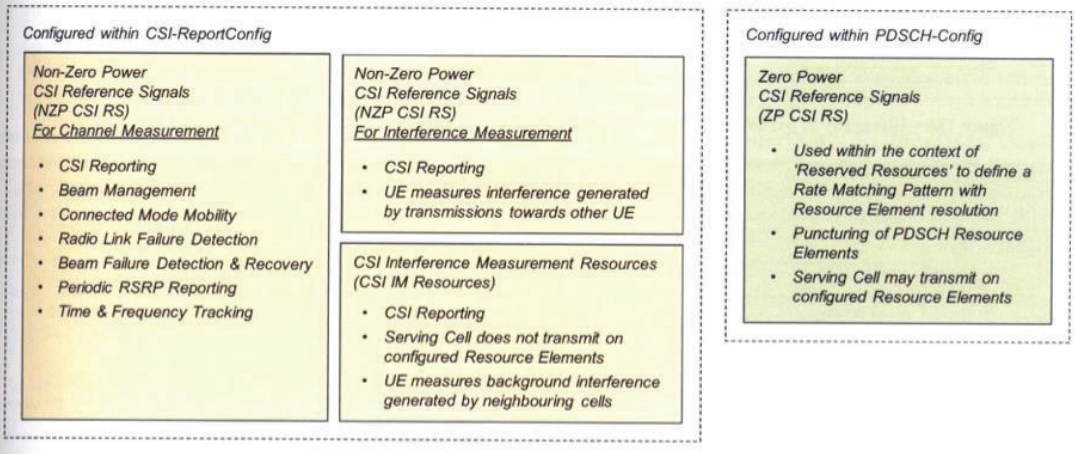


Figure 187 – Categories of CSI Reference Signal

★ The *CSI-ReportConfig* parameter structure is used to configure NZP CSI Reference Signal Resources for both Channel Measurement and Interference Measurement. It is also used to configure CSI Interference Measurement (IM) Resources. The hierarchy of parameters associated with the configuration of these resources is illustrated in Figure 188. A set of three information elements corresponding to the three types of resource point towards appropriate instances of *CSI-ResourceConfig*. Instances of *CSI-ResourceConfig* are configured within the *CSI-MeasConfig* parameter structure

See Chris Johnson, 5G New Radio in Bullets, Section 3.7.4. (2019).

8.2: Downlink Measurements and Reporting

An NR device can be configured to carry out different measurements, in most cases with corresponding reporting to the network. In general, such a configuration of a measurement and corresponding reporting are done by means of a *report configuration*, in the 3GPP specifications [15] referred to as a *CSI-ReportConfig*.[4]

Each resource configuration describes/indicates:

- The specific quantity or set of quantities to be reported;
- The downlink resource(s) on which measurements should be carried out in order to derive the quantity or quantities to be reported;
- How the actual reporting is to be carried out, for example, when the reporting is to be done and what uplink physical channel to use for the reporting.

See Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, § 8.2 (2d Ed. 2018).

– *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the *CSI-ReportConfig* is included (in this case, the cell on which the report is sent is determined by the received DCI). See TS 38.214 [19], clause 5.2.1.

***CSI-ReportConfig* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=                SEQUENCE {
    reportConfigId                      CSI-ReportConfigId,
    carrier                             ServCellIndex                   OPTIONAL,   -- Need S
    resourcesForChannelMeasurement      CSI-ResourceConfigId,
    csi-IM-ResourcesForInterference     CSI-ResourceConfigId            OPTIONAL,   -- Need R
    nzp-CSI-RS-ResourcesForInterference CSI-ResourceConfigId            OPTIONAL,   -- Need R
    reportConfigType                    CHOICE {
        periodic                            SEQUENCE {
            reportSlotConfig                    CSI-ReportPeriodicityAndOffset,
            pucch-CSI-ResourceList              SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
        },
        semiPersistentOnPUCCH               SEQUENCE {
            reportSlotConfig                    CSI-ReportPeriodicityAndOffset,
            pucch-CSI-ResourceList              SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource

        },
        semiPersistentOnPUSCH               SEQUENCE {
            reportSlotConfig                    ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},
            reportSlotOffsetList                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
            p0alpha                             P0-PUSCH-AlphaSetId
        },
        aperiodic                           SEQUENCE {
            reportSlotOffsetList                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
        }
    },
```

See 3GPP TS 38.331 V15.15.0.

– *CSI-MeasConfig*

The IE *CSI-MeasConfig* is used to configure CSI-RS (reference signals) belonging to the serving cell in which *CSI-MeasConfig* is included, channel state information reports to be transmitted on PUCCH on the serving cell in which *CSI-MeasConfig* is included and channel state information reports on PUSCH triggered by DCI received on the serving cell in which *CSI-MeasConfig* is included. See also TS 38.214 [19], clause 5.2.

***CSI-MeasConfig* information element**

```
-- ASN1START
-- TAG-CSI-MEASCONFIG-START

CSI-MeasConfig ::=                  SEQUENCE {
    nzp-CSI-RS-ResourceToAddModList     SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-Resources)) OF NZP-CSI-RS-Resource   OPTIONAL, -- Need N
    nzp-CSI-RS-ResourceToReleaseList    SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-Resources)) OF NZP-CSI-RS-ResourceId OPTIONAL, -- Need N
    nzp-CSI-RS-ResourceSetToAddModList  SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSet
                                                                                                                  OPTIONAL, -- Need N
    nzp-CSI-RS-ResourceSetToReleaseList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSetId
                                                                                                                  OPTIONAL, -- Need N
    csi-IM-ResourceToAddModList         SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-Resource           OPTIONAL, -- Need N
    csi-IM-ResourceToReleaseList        SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-ResourceId         OPTIONAL, -- Need N
    csi-IM-ResourceSetToAddModList      SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSet     OPTIONAL, -- Need N
    csi-IM-ResourceSetToReleaseList     SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSetId   OPTIONAL, -- Need N
    csi-SSB-ResourceSetToAddModList     SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSet   OPTIONAL, -- Need N
    csi-SSB-ResourceSetToReleaseList    SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSetId OPTIONAL, -- Need N
    csi-ResourceConfigToAddModList      SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfig
                                                                                                                  OPTIONAL, -- Need N
    csi-ResourceConfigToReleaseList     SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfigId
                                                                                                                  OPTIONAL, -- Need N
    csi-ReportConfigToAddModList        SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfig  OPTIONAL, -- Need N
    csi-ReportConfigToReleaseList       SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfigId
                                                                                                                  OPTIONAL, -- Need N
    reportTriggerSize                   INTEGER (0..6)                                                            OPTIONAL, -- Need M
    aperiodicTriggerStateList           SetupRelease { CSI-AperiodicTriggerStateList }                            OPTIONAL, -- Need M
    semiPersistentOnPUSCH-TriggerStateList    SetupRelease { CSI-SemiPersistentOnPUSCH-TriggerStateList }         OPTIONAL, -- Need M
    ...
}
```

See 3GPP TS 38.331 V15.15.0.

5.2 UE procedure for reporting channel state information (CSI)

5.2.1 Channel state information framework

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.

See 3GPP TS 38.214 V15.14.0.

5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *BWP-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band:codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, CRI, and SSBRI (SSB Resource Indicator).

The time domain behavior of the *CSI-ReportConfig* is indicated by the higher layer parameter *reportConfigType* and can be set to 'aperiodic', 'semiPersistentOnPUCCH', 'semiPersistentOnPUSCH', or 'periodic'. For periodic and semiPersistentOnPUCCH/semiPersistentOnPUSCH CSI reporting, the configured periodicity and slot offset applies in the numerology of the UL BWP in which the CSI report is configured to be transmitted on. The higher layer parameter *reportQuantity* indicates the CSI-related or L1-RSRP-related quantities to report. The *reportFreqConfiguration* indicates the reporting granularity in the frequency domain, including the CSI reporting band and if PMI/CQI reporting is wideband or sub-band. The *timeRestrictionForChannelMeasurements* parameter in *CSI-ReportConfig* can be configured to enable time domain restriction for channel measurements and *timeRestrictionForInterferenceMeasurements* can be configured to enable time domain restriction for interference measurements. The *CSI-ReportConfig* can also contain *CodebookConfig*, which contains configuration parameters for Type-I or Type II CSI including codebook subset restriction, and configurations of group based reporting.

See 3GPP TS 38.214 V15.14.0.

> 5.2.1.2 Resource settings
>
> Each CSI Resource Setting *CSI-ResourceConfig* contains a configuration of a list of S≥1 CSI Resource Sets (given by higher layer parameter *csi-RS-ResourceSetList*), where the list is comprised of references to either or both of NZP CSI-RS resource set(s) and SS/PBCH block set(s) or the list is comprised of references to CSI-IM resource set(s). Each CSI Resource Setting is located in the DL BWP identified by the higher layer parameter *BWP-id*, and all CSI Resource Settings linked to a CSI Report Setting have the same DL BWP.
>
> The time domain behavior of the CSI-RS resources within a CSI Resource Setting are indicated by the higher layer parameter *resourceType* and can be set to aperiodic, periodic, or semi-persistent. For periodic and semi-persistent CSI Resource Settings, the number of CSI-RS Resource Sets configured is limited to S=1. For periodic and semi-persistent CSI Resource Settings, the configured periodicity and slot offset is given in the numerology of its associated DL BWP, as given by *BWP-id*. When a UE is configured with multiple *CSI-ResourceConfigs* consisting the same NZP CSI-RS resource ID, the same time domain behavior shall be configured for the *CSI-ResourceConfigs*. When a UE is configured with multiple *CSI-ResourceConfigs* consisting the same CSI-IM resource ID, the same time-domain behavior shall be configured for the *CSI-ResourceConfigs*. All CSI Resource Settings linked to a CSI Report Setting shall have the same time domain behavior.
>
> The following are configured via higher layer signaling for one or more CSI Resource Settings for channel and interference measurement:
>
> - CSI-IM resource for interference measurement as described in clause 5.2.2.4.
> - NZP CSI-RS resource for interference measurement as described in clause 5.2.2.3.1.
> - NZP CSI-RS resource for channel measurement as described in clause 5.2.2.3.1.

See 3GPP TS 38.214 V15.14.0.

> 7.4.1.5 CSI reference signals
>
> 7.4.1.5.1 General
>
> Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined
>
> - for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE or by the *CSI-RS-Resource-Mobility* field in the *CSI-RS-ResourceConfigMobility* IE, the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3
> - for a zero-power CSI-RS configured by the *ZP-CSI-RS-Resource* IE, the UE shall assume that the resource elements defined in clause 7.4.1.5.3 are not used for PDSCH transmission subject to clause 5.1.4.2 of [6, TS 38.214]. The UE performs the same measurement/reception on channels/signals except PDSCH regardless of whether they collide with ZP CSI-RS or not.

See 3GPP TS 38.211 V15.9.0.

16. Claim 9 of the '780 Patent recites that the "controller" is configured to "determine a type of the received interference from among a plurality of interference types comprising wideband interference, self interference, and narrowband interference based upon comparing at least one characteristic of a current received signal with the short term and long term historical characteristics of interference." The Accused Products each comprise a controller configured to determine a type of the received interference from among a plurality of interference types comprising wideband interference, self interference, and narrowband interference based upon comparing at least one characteristic of a current received signal with the short term and long term historical characteristics of interference. For example, the channel

state information – reference signal ("CSI-RS") and channel state information – interference measurement ("CSI-IM") resource sets may be specified across the entire bandwidth-part or just a part of the bandwidth that the UE is configured to receive:

> **8.1.2: Frequency-Domain Structure of CSI-RS Configurations**
>
> A CSI-RS is configured for a given downlink bandwidth part and is then assumed to be confined within that bandwidth part and use the numerology of the bandwidth part.
>
> The CSI-RS can be configured to cover the full bandwidth of the bandwidth part or just a fraction of the bandwidth. In the latter case, the CSI-RS bandwidth and frequency-domain starting position are provided as part of the CSI-RS configuration.
>
> Within the configured CSI-RS bandwidth, a CSI-RS may be configured for transmission in every resource block, referred to as *CSI-RS density equal to one*. However, a CSI-RS may also be configured for transmission only in every second resource block, referred to as CSI-RS density equal to 1/2. In the latter case, the CSI-RS configuration includes information about the set of resource blocks (odd resource blocks or even resource blocks) within which the CSI-RS will be transmitted. CSI-RS density equal to 1/2 is not supported for CSI-RS with 4, 8, and 12 antenna ports.

See Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, § 8.1.2 (2d Ed. 2018).

★ The parameter structure used to configure a CSI IM Resource is presented in Table 125. This parameter structure includes a CSI IM Resource identity and a specification of the resources which are allocated to the CSI IM Resource. There is a choice of configuring either pattern 0 or pattern 1:

- Pattern 0 corresponds to a 2×2 grid of Resource Elements. *subcarrierLocation-p0* and *symbolLocation-p0* specify the first subcarrier and first symbol belonging to the 2×2 grid
- Pattern 1 corresponds to a 4×1 grid of Resource Elements (4 subcarriers × 1 symbol). *subcarrierLocation-p1* and *symbolLocation-p1* specify the first subcarrier and the only symbol belonging to the 4×1 grid

Examples of patterns 0 and 1 are illustrated in Figure 199

CSI-IM-Resource						
csi-IM-ResourceId	0 to 31					
csi-IM-ResourceElementPattern	CHOICE					
	pattern0				pattern1	
	subcarrierLocation-p0	0, 2, 4, 6, 8 10			subcarrierLocation-p1	0, 4, 8
	symbolLocation-p0	0 to 12			symbolLocation-p1	0 to 13
freqBand	startingRB	0 to 274, step 4				
	nrofRBs	24 to 276, step 4				
periodicityAndOffset	CHOICE					
	4 slots	0 to 3	20 slots	0 to 19	160 slots	0 to 159
	5 slots	0 to 4	32 slots	0 to 31	320 slots	0 to 319
	8 slots	0 to 7	40 slots	0 to 39	640 slots	0 to 639
	10 slots	0 to 9	64 slots	0 to 63		
	16 slots	0 to 15	80 slots	0 to 79		

Table 125 – Parameter structure used to configure a CSI IM Resource

★ The *freqBand* section of the parameter structure specifies the set of contiguous Resource Blocks across which the CSI IM Resource is configured. The *startingRB* is relative to Common Resource Block 0, i.e. the lower edge of the channel bandwidth, rather than the lower edge of the Bandwidth Part. The *nrofRBs* information element has a minimum value of 24 but if the Bandwidth Part occupies less than 24 Resource Blocks then the CSI IM Resource occupies only the Resource Blocks within the Bandwidth Part

See Chris Johnson, 5G New Radio in Bullets, Section 3.7.4. (2019).

– *NZP-CSI-RS-Resource*

The IE *NZP-CSI-RS-Resource* is used to configure Non-Zero-Power (NZP) CSI-RS transmitted in the cell where the IE is included, which the UE may be configured to measure on (see TS 38.214 [19], clause 5.2.2.3.1). A change of configuration between periodic, semi-persistent or aperiodic for an *NZP-CSI-RS-Resource* is not supported without a release and add.

***NZP-CSI-RS-Resource* information element**

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCE-START

NZP-CSI-RS-Resource ::=             SEQUENCE {
    nzp-CSI-RS-ResourceId               NZP-CSI-RS-ResourceId,
    resourceMapping                     CSI-RS-ResourceMapping,
    powerControlOffset                  INTEGER (-8..15),
    powerControlOffsetSS                ENUMERATED{db-3, db0, db3, db6}                 OPTIONAL,   -- Need R
    scramblingID                        ScramblingId,
    periodicityAndOffset                CSI-ResourcePeriodicityAndOffset                OPTIONAL,   -- Cond PeriodicOrSemiPersistent
    qcl-InfoPeriodicCSI-RS              TCI-StateId                                     OPTIONAL,   -- Cond Periodic
    ...
}
```

See 3GPP TS 38.331 V 15.15.0.

– *CSI-IM-Resource*

The IE *CSI-IM-Resource* is used to configure one CSI Interference Management (IM) resource.

***CSI-IM-Resource* information element**

```
-- ASN1START
-- TAG-CSI-IM-RESOURCE-START

CSI-IM-Resource ::=                 SEQUENCE {
    csi-IM-ResourceId                   CSI-IM-ResourceId,
    csi-IM-ResourceElementPattern           CHOICE {
        pattern0                                SEQUENCE {
            subcarrierLocation-p0                   ENUMERATED { s0, s2, s4, s6, s8, s10 },
            symbolLocation-p0                       INTEGER (0..12)
        },
        pattern1                                SEQUENCE {
            subcarrierLocation-p1                   ENUMERATED { s0, s4, s8 },
            symbolLocation-p1                       INTEGER (0..13)
        }
    }                                                                           OPTIONAL,   -- Need M
    freqBand                            CSI-FrequencyOccupation                 OPTIONAL,   -- Need M
    periodicityAndOffset                CSI-ResourcePeriodicityAndOffset        OPTIONAL,   -- Cond PeriodicOrSemiPersistent
    ...
}
```

See 3GPP TS 38.331 V 15.15.0.

5.2.2.3.1 NZP CSI-RS

The UE can be configured with one or more NZP CSI-RS resource set configuration(s) as indicated by the higher layer parameters *CSI-ResourceConfig*, and *NZP-CSI-RS-ResourceSet*. Each NZP CSI-RS resource set consists of $K \geq 1$ NZP CSI-RS resource(s).

The following parameters for which the UE shall assume non-zero transmission power for CSI-RS resource are configured via the higher layer parameter *NZP-CSI-RS-Resource, CSI-ResourceConfig* and *NZP-CSI-RS-ResourceSet* for each CSI-RS resource configuration:

- *nzp-CSI-RS-ResourceId* determines CSI-RS resource configuration identity.
- *periodicityAndOffset* defines the CSI-RS periodicity and slot offset for periodic/semi-persistent CSI-RS. All the CSI-RS resources within one set are configured with the same periodicity, while the slot offset can be same or different for different CSI-RS resources.
- *resourceMapping* defines the number of ports, CDM-type, and OFDM symbol and subcarrier occupancy of the CSI-RS resource within a slot that are given in clause 7.4.1.5 of [4, TS 38.211].
- *nrofPorts* in *resourceMapping* defines the number of CSI-RS ports, where the allowable values are given in clause 7.4.1.5 of [4, TS 38.211].
- *density* in *resourceMapping* defines CSI-RS frequency density of each CSI-RS port per PRB, and CSI-RS PRB offset in case of the density value of 1/2, where the allowable values are given in clause 7.4.1.5 of [4, TS 38.211]. For density 1/2, the odd/even PRB allocation indicated in *density* is with respect to the common resource block grid.
- *cdm-Type* in *resourceMapping* defines CDM values and pattern, where the allowable values are given in clause 7.4.1.5 of [4, TS 38.211].
- *powerControlOffset*: which is the assumed ratio of PDSCH EPRE to NZP CSI-RS EPRE when UE derives CSI feedback and takes values in the range of [-8, 15] dB with 1 dB step size.
- *powerControlOffsetSS*: which is the assumed ratio of NZP CSI-RS EPRE to SS/PBCH block EPRE.
- *scramblingID* defines scrambling ID of CSI-RS with length of 10 bits.
- *BWP-Id* in *CSI-ResourceConfig* defines which bandwidth part the configured CSI-RS is located in.
- *repetition* in *NZP-CSI-RS-ResourceSet* is associated with a CSI-RS resource set and defines whether UE can assume the CSI-RS resources within the NZP CSI-RS Resource Set are transmitted with the same downlink spatial domain transmission filter or not as described in clause 5.1.6.1.2. and can be configured only when the higher layer parameter *reportQuantity* associated with all the reporting settings linked with the CSI-RS resource set is set to 'cri-RSRP' or 'none'.
- *qcl-InfoPeriodicCSI-RS* contains a reference to a *TCI-State* indicating QCL source RS(s) and QCL type(s). If the *TCI-State* is configured with a reference to an RS with 'QCL-TypeD' association, that RS may be an SS/PBCH block located in the same or different CC/DL BWP or a CSI-RS resource configured as periodic located in the same or different CC/DL BWP.
- *trs-Info* in *NZP-CSI-RS-ResourceSet* is associated with a CSI-RS resource set and for which the UE can assume that the antenna port with the same port index of the configured NZP CSI-RS resources in the *NZP-CSI-RS-ResourceSet* is the same as described in clause 5.1.6.1.1 and can be configured when reporting setting is not configured or when the higher layer parameter *reportQuantity* associated with all the reporting settings linked with the CSI-RS resource set is set to 'none'.

See 3GPP TS 38.214 V15.14.0.

All CSI-RS resources within one set are configured with same *density* and same *nrofPorts*, except for the NZP CSI-RS resources used for interference measurement.

The UE expects that all the CSI-RS resources of a resource set are configured with the same starting RB and number of RBs and the same *cdm-type*.

The bandwidth and initial common resource block (CRB) index of a CSI-RS resource within a BWP, as defined in clause 7.4.1.5 of [4, TS 38.211], are determined based on the higher layer parameters *nrofRBs* and *startingRB*, respectively, within the CSI-FrequencyOccupation IE configured by the higher layer parameter *freqBand* within the *CSI-RS-ResourceMapping* IE. Both *nrofRBs* and *startingRB* are configured as integer multiples of 4 RBs, and the reference point for *startingRB* is CRB 0 on the common resource block grid. If $startingRB < N_{BWP}^{start}$, the UE shall assume that the initial CRB index of the CSI-RS resource is $N_{initial\ RB} = N_{BWP}^{start}$, otherwise $N_{initial\ RB} = startingRB$. If $nrofRBs > N_{BWP}^{size} + N_{BWP}^{start} - N_{initial\ RB}$, the UE shall assume that the bandwidth of the CSI-RS resource is $N_{CSI-RS}^{BW} = N_{BWP}^{size} + N_{BWP}^{start} - N_{initial\ RB}$, otherwise $N_{CSI-RS}^{BW} = nrofRBs$. In all cases, the UE shall expect that $N_{CSI-RS}^{BW} \geq \min(24, N_{BWP}^{size})$.

See 3GPP TS 38.214 V15.14.0.

5.2.2.4 Channel State Information – Interference Measurement (CSI-IM)

The UE can be configured with one or more CSI-IM resource set configuration(s) as indicated by the higher layer parameter *CSI-IM-ResourceSet*. Each CSI-IM resource set consists of $K \geq 1$ CSI-IM resource(s).

The following parameters are configured via higher layer parameter *CSI-IM-Resource* for each CSI-IM resource configuration:

- *csi-IM-ResourceId* determines CSI-IM resource configuration identity
- *subcarrierLocation-p0* or *subcarrierLocation-p1* defines subcarrier occupancy of the CSI-IM resource within a slot for *csi-IM-ResourceElementPattern* set to 'pattern0' or 'pattern1', respectively.
- *symbolLocation-p0* or *symbolLocation-p1* defines OFDM symbol location of the CSI-IM resource within a slot for *csi-IM-ResourceElementPattern* set to 'pattern0' or 'pattern1', respectively.
- *periodicityAndOffset* defines the CSI-IM periodicity and slot offset for periodic/semi-persistent CSI-IM.
- *freqBand* includes parameters to enable configuration of frequency-occupancy of CSI-IM

In each of the PRBs configured by *freqBand*, the UE shall assume each CSI-IM resource is located in,

- resource elements (k_{CSI-IM}, l_{CSI-IM}), $(k_{CSI-IM}, l_{CSI-IM}+1)$, $(k_{CSI-IM}+1, l_{CSI-IM})$ and $(k_{CSI-IM}+1, l_{CSI-IM}+1)$, if *csi-IM-ResourceElementPattern* is set to 'pattern0',
- resource elements (k_{CSI-IM}, l_{CSI-IM}), $(k_{CSI-IM}+1, l_{CSI-IM})$, $(k_{CSI-IM}+2, l_{CSI-IM})$ and $(k_{CSI-IM}+3, l_{CSI-IM})$ if *csi-IM-ResourceElementPattern* is set to 'pattern1',

where k_{CSI-IM} and l_{CSI-IM} are the configured frequency-domain location and time-domain location, respectively, given by the higher layer parameters in the above list.

See 3GPP TS 38.214 V15.14.0.

For example, channel measurements such as CQI are based upon either multiple in time or single time readings.

> 5.2.2 Channel state information
>
> 5.2.2.1 Channel quality indicator (CQI)
>
> The CQI indices and their interpretations are given in Table 5.2.2.1-2 or Table 5.2.2.1-4 for reporting CQI based on QPSK, 16QAM and 64QAM. The CQI indices and their interpretations are given in Table 5.2.2.1-3 for reporting CQI based on QPSK, 16QAM, 64QAM and 256QAM.
>
> Based on an unrestricted observation interval in time unless specified otherwise in this clause, and an unrestricted observation interval in frequency, the UE shall derive for each CQI value reported in uplink slot *n* the highest CQI index which satisfies the following condition:
>
> - A single PDSCH transport block with a combination of modulation scheme, target code rate and transport block size corresponding to the CQI index, and occupying a group of downlink physical resource blocks termed the CSI reference resource, could be received with a transport block error probability not exceeding:
>
> - 0.1, if the higher layer parameter *cqi-Table* in *CSI-ReportConfig* configures 'table1' (corresponding to Table 5.2.2.1-2), or 'table2' (corresponding to Table 5.2.2.1-3), or
>
> - 0.00001, if the higher layer parameter *cqi-Table* in *CSI-ReportConfig* configures 'table3' (corresponding to Table 5.2.2.1-4).
>
> If higher layer parameter *timeRestrictionForChannelMeasurements* is set to "*notConfigured*", the UE shall derive the channel measurements for computing CSI value reported in uplink slot n based on only the NZP CSI-RS, no later than the CSI reference resource, (defined in TS 38.211[4]) associated with the CSI resource setting.
>
> If higher layer parameter *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to "*Configured*", the UE shall derive the channel measurements for computing CSI reported in uplink slot n based on only the most recent, no later than the CSI reference resource, occasion of NZP CSI-RS (defined in [4, TS 38.211]) associated with the CSI resource setting.
>
> If higher layer parameter *timeRestrictionForInterferenceMeasurements* is set to "*notConfigured*", the UE shall derive the interference measurements for computing CSI value reported in uplink slot n based on only the CSI-IM and/or NZP CSI-RS for interference measurement no later than the CSI reference resource associated with the CSI resource setting.
>
> If higher layer parameter *timeRestrictionForInterferenceMeasurements* in *CSI-ReportConfig* is set to "*Configured*", the UE shall derive the interference measurements for computing the CSI value reported in uplink slot n based on the most recent, no later than the CSI reference resource, occasion of CSI-IM and/or NZP CSI-RS for interference measurement (defined in [4, TS 38.211]) associated with the CSI resource setting.

See 3GPP TS 38.214 §5.2.2.1.

For example, rank indicator ("RI") and pre-coding matrix indicator ("PMI") are also computed based on SRS measurements.

> To select a suitable rank and a corresponding precoder matrix, the network needs estimates of the channels between the device antenna ports and the corresponding network receive antennas. To enable this, a device configured for codebook-based PUSCH would typically be configured for transmission of at least one multi-port SRS. Based on measurements on the configured SRS, the network can sound the channel and determine a suitable rank and precoder matrix.

See Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, § 11.3.1 (2d Ed. 2018).

17. Claim 9 of the '780 Patent recites that the "controller" is configured to "set the at least one settable link characteristic to compensate for the received interference based upon the interference type." The Accused Products each comprise a controller configured to set the at least one settable link characteristic to compensate for the received interference based upon the interference type. For example, the Accused Products report at least wideband and subband CQI, wideband and subband PMI, and also RI:

> - wideband CQI or subband CQI reporting, as configured by the higher layer parameter *cqi-FormatIndicator*. When wideband CQI reporting is configured, a wideband CQI is reported for each codeword for the entire CSI reporting band. When subband CQI reporting is configured, one CQI for each codeword is reported for each subband in the CSI reporting band.

See 3GPP TS 38.214 V.15.14.0 §5.2.1.4.

> wideband PMI or subband PMI reporting as configured by the higher layer parameter *pmi-FormatIndicator*. When wideband PMI reporting is configured, a wideband PMI is reported for the entire CSI reporting band. When subband PMI reporting is configured, except with 2 antenna ports, a single wideband indication (i_1 in clause 5.2.2.2) is reported for the entire CSI reporting band and one subband indication (i_2 in clause 5.2.2.2) is reported for each subband in the CSI reporting band. When subband PMIs are configured with 2 antenna ports, a PMI is reported for each subband in the CSI reporting band.

See 3GPP TS 38.214 V.15.14.0 §5.2.1.4.

5.2.2.1 Channel quality indicator (CQI)

The CQI indices and their interpretations are given in Table 5.2.2.1-2 or Table 5.2.2.1-4 for reporting CQI based on QPSK, 16QAM and 64QAM. The CQI indices and their interpretations are given in Table 5.2.2.1-3 for reporting CQI based on QPSK, 16QAM, 64QAM and 256QAM.

Based on an unrestricted observation interval in time unless specified otherwise in this clause, and an unrestricted observation interval in frequency, the UE shall derive for each CQI value reported in uplink slot *n* the highest CQI index which satisfies the following condition:

- A single PDSCH transport block with a combination of modulation scheme, target code rate and transport block size corresponding to the CQI index, and occupying a group of downlink physical resource blocks termed the CSI reference resource, could be received with a transport block error probability not exceeding:
  - 0.1, if the higher layer parameter *cqi-Table* in *CSI-ReportConfig* configures 'table1' (corresponding to Table 5.2.2.1-2), or 'table2' (corresponding to Table 5.2.2.1-3), or
  - 0.00001, if the higher layer parameter *cqi-Table* in *CSI-ReportConfig* configures 'table3' (corresponding to Table 5.2.2.1-4).

If higher layer parameter *timeRestrictionForChannelMeasurements* is set to "*notConfigured*", the UE shall derive the channel measurements for computing CSI value reported in uplink slot n based on only the NZP CSI-RS, no later than the CSI reference resource, (defined in TS 38.211[4]) associated with the CSI resource setting.

If higher layer parameter *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to "*Configured*", the UE shall derive the channel measurements for computing CSI reported in uplink slot n based on only the most recent, no later than the CSI reference resource, occasion of NZP CSI-RS (defined in [4, TS 38.211]) associated with the CSI resource setting.

If higher layer parameter *timeRestrictionForInterferenceMeasurements* is set to "*notConfigured*", the UE shall derive the interference measurements for computing CSI value reported in uplink slot n based on only the CSI-IM and/or NZP CSI-RS for interference measurement no later than the CSI reference resource associated with the CSI resource setting.

See 3GPP TS 38.214 V.15.14.0.

The bitwidth for RI/LI/CQI/CRI of *codebookType=typeI-SinglePanel* is provided in Tables 6.3.1.1.2-3.

Table 6.3.1.1.2-3: RI, LI, CQI, and CRI of *codebookType=typeI-SinglePanel*

Field	Bitwidth				
	1 antenna port	2 antenna ports	4 antenna ports	>4 antenna ports	
				Rank1~4	Rank5~8
Rank Indicator	0	$\min(1,\lceil \log_2 n_{RI} \rceil)$	$\min(2,\lceil \log_2 n_{RI} \rceil)$	$\lceil \log_2 n_{RI} \rceil$	$\lceil \log_2 n_{RI} \rceil$
Layer Indicator	0	$\lceil \log_2 \upsilon \rceil$	$\min(2,\lceil \log_2 \upsilon \rceil)$	$\min(2,\lceil \log_2 \upsilon \rceil)$	$\min(2,\lceil \log_2 \upsilon \rceil)$
Wide-band CQI for the first TB	4	4	4	4	4
Wideband CQI for the second TB	0	0	0	0	4
Subband differential CQI for the first TB	2	2	2	2	2
Subband differential CQI for the second TB	0	0	0	0	2
CRI	$\lceil \log_2 (K_s^{CSI-RS}) \rceil$	$\lceil \log_2 (K_s^{CSI-RS}) \rceil$	$\lceil \log_2 (K_s^{CSI-RS}) \rceil$	$\lceil \log_2 (K_s^{CSI-RS}) \rceil$	$\lceil \log_2 (K_s^{CSI-RS}) \rceil$

n_{RI} in Table 6.3.1.1.2-3 is the number of allowed rank indicator values according to Clause 5.2.2.2.1 [6, TS 38.214].

υ is the value of the rank. The value of K_s^{CSI-RS} is the number of CSI-RS resources in the corresponding resource set. The values of the rank indicator field are mapped to allowed rank indicator values with increasing order, where '0' is mapped to the smallest allowed rank indicator value.

See 3GPP TS 38.212 V15.12.0 §6.3.1.1.2.

18. Google also knowingly and intentionally induces infringement of one or more claims of the '780 Patent in violation of 35 U.S.C. § 271(b). As of at least the filing and service of this complaint, Google has knowledge of the '780 Patent and the infringing nature of the Accused Products. Despite this knowledge of the '780 Patent, Google continues to actively encourage and instruct its customers and end users (for example, through user manuals and online instruction materials on its website) to use the Accused Products in ways that directly infringe the '780 Patent, for example by utilizing the accused 5G functionality on the Accused Products in an infringing manner. *See, e.g.*, https://support.google.com/pixelphone/answer/2926415?hl=en&ref_topic=7084391 (Google Pixel – "Connect to mobile networks on a Pixel phone"). Further, Google advertises the 5G functionality of the Accused Products to customers and end users. *See* https://store.google.com/product/pixel_6?hl=en-US ("Plus you get powerful 5G…"). Google provides these instructions and online materials to customers and end users knowing and intending (or with willful blindness to the fact) that its customers and end users will commit these infringing acts. Google also continues to make, use, offer for sale, sell, and/or import the Accused Products, despite its knowledge of the '780 Patent, thereby specifically intending for and inducing its customers to infringe the '780 Patent through the customers' normal and customary use of the Accused Products.

19. Google has also infringed, and continues to infringe, one or more claims of the '780 Patent by selling, offering for sale, or importing into the United States, the Accused Products, knowing that the Accused Products constitute a material part of the inventions claimed in the '780 Patent, are especially made or adapted to infringe the '780 Patent, and are not staple articles or commodities of commerce suitable for non-infringing use (as exemplified by the materials cited above). As of at least the filing and service of this complaint, Google has knowledge of the '780 Patent and the infringing nature of the Accused Products. Google has been, and

currently is, contributorily infringing the '780 Patent in violation of 35 U.S.C. §§ 271(c) and (f).

20. By making, using, offering for sale, selling and/or importing into the United States the Accused Products, Google has injured Plaintiff and is liable for infringement of the '780 Patent pursuant to 35 U.S.C. § 271.

21. As a result of Google's direct infringement of the '780 Patent, Plaintiff is entitled to monetary damages (past, present, and future) in an amount adequate to compensate for Google's infringement, but in no event less than a reasonable royalty for the use made of the invention by Google, together with interest and costs as fixed by the Court.

22. As a result of Google's indirect infringement of the '780 Patent (induced and contributory infringement), Plaintiff is entitled to monetary damages (present and future) in an amount adequate to compensate for Google's infringement, but in no event less than a reasonable royalty for the use made of the invention by Google, together with interest and costs as fixed by the Court.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests that this Court enter:

a. A judgment in favor of Plaintiff that Google has infringed, either literally and/or under the doctrine of equivalents, the '780 Patent;

b. A judgment and order requiring Google to pay Plaintiff its damages (past, present, and future), costs, expenses, and pre-judgment and post-judgment interest for Google's infringement of the '780 Patent;

c. A judgment and order requiring Google to pay Plaintiff compulsory ongoing licensing fees, as determined by the Court in equity.

d. A judgment and order requiring Google to provide an accounting and to pay supplemental damages to Plaintiff, including without limitation, pre-judgment and post-judgment interest and compensation for infringing products released after the filing of this case that are not colorably different from the accused products;

e. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Plaintiff its reasonable attorneys' fees against Google; and

f. Any and all other relief as the Court may deem appropriate and just under the circumstances.

DEMAND FOR JURY TRIAL

Plaintiff, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

Dated: March 21, 2022

Respectfully submitted,

/s/ Reza Mirzaie

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