**UNITED STATES DISTRICT COURT**
**FOR THE WESTERN DISTRICT OF TEXAS**
**WACO DIVISION**

| | |
|---|---|
| SPEIR TECHNOLOGIES LTD.,<br><br>Plaintiff,<br><br>v.<br><br>APPLE INC.,<br><br>Defendant. | Case No. 6:22-cv-00077-ADA<br><br>**JURY TRIAL DEMANDED** |

**PLAINTIFF'S PRELIMINARY DISCLOSURE OF ASSERTED CLAIMS AND INFRINGEMENT CONTENTIONS TO DEFENDANT APPLE INC.**

Speir Technologies Ltd. ("Plaintiff" or "Speir") submits the following Preliminary Disclosure of Asserted Claims and Infringement Contentions to Defendant Apple Inc. ("Defendant" or "Apple"). This disclosure is based on the information available to Speir as of the date of this disclosure, and Speir reserves the right to amend this disclosure to the full extent consistent with the Court's Rules and Orders.

## I. Asserted Claims

Speir asserts that Apple has infringed and continue to infringe at least the following claims of Speir's patents (collectively, the "Asserted Claims"):

A. **U.S. Patent No. 8,345,780 ("the '780 Patent"):** Claims 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, and 14.

B. **U.S. Patent No. 7,110,779 ("the '779 Patent"):** Claims 18, 19, 20, 21, and 23.

C. **U.S. Patent No. 7,321,777 ("the '777 Patent"):** Claims 1, 2, 3, 6, 12, 13, 14, 16, 20, and 21.

D. **U.S. Patent No. 7,765,399 ("the '399 Patent"):** Claims 1, 2, 3, 4, 5, 6, 7, and 9.



APPLE 1016

Speir reserves the right to seek leave of court to add, delete, substitute, or otherwise amend this list of asserted claims should further discovery, the Court's claim construction, or other circumstances so merit.

## II. Accused Products

Speir contends that the Asserted Claims are infringed by the various apparatuses used, made, sold, offered for sale, or imported into the United States by Apple (the "Accused Products"). The Accused Products include at least the following, as well as products with reasonably similar functionality:

- **'780 Patent:** iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPhone SE (3rd Generation), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPad Pro (5th Generation), iPad Air (5th Generation), iPad Mini (6th Generation), and any other products with 5G functionality.
- **'777 and '779 Patents:** iPhone 11, iPhone 11 Pro, iPhone 11 Pro Max, iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, AirTags, and any other products with ultra-wideband ("UWB") functionality.
- **'399 Patent:** iPhone 5s, iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPhone SE, iPhone 7, iPhone 7 Plus, iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS, iPhone XS Max, iPhone 11, iPhone 11 Pro, iPhone 11 Pro Max, iPhone SE (2nd Generation), iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone SE (3rd Generation), iPad (5th – 9th Generation with TouchID and/or FaceID), iPad Air (2nd – 5th Generation with TouchID and/or FaceID), iPad Pro (1st – 5th Generation with TouchID

and/or FaceID), iPad Mini (3rd – 6th Generation with TouchID and/or FaceID), MacBook Air (all models from 2018 – 2020 with TouchID), and MacBook Pro (all models from 2016 – present with TouchID).

Speir reserves the right to amend this list of Accused Products, as well as other information contained in this document and the exhibits hereto, to incorporate new information learned during the course of discovery, including, but not limited to, the inclusion of newly released products, versions, or any other equivalent devices ascertained through discovery. Further, to the extent any accused infringing products have gone through or will go through name changes, but were or will be used or sold with the same accused features, earlier corresponding products under different names also are accused.

## III. Claim Charts

Claim charts identifying a location of every element of every asserted claim of the asserted Speir Patents within accused products are attached hereto as Exhibits A-D. Speir's analysis of the Accused Products is based on limited publicly available information and based on Speir's own investigation prior to any discovery in this action. In an effort to focus the issues, Speir identifies exemplary evidence for each claim limitation. The evidence cited for a particular limitation should be considered in light of the additional evidence cited for the other claim limitations. Speir reserves the right to rely on evidence cited for any particular limitation of an asserted claim for any other limitation asserted for that claim. Unless otherwise indicated, the information provided that corresponds to each claim element is considered to indicate that each claim element is found within each of the different variations of each respective Accused Products described above.

These infringement contentions are prepared with public information and have not been prepared with the benefit of discovery. The references provided in the attached charts may cite

particular versions of a given IEEE or 3GPP or other technical specification. It should be understood that references and citations are exemplary in nature and do not limit infringement assertions to only those releases or versions. Speir's citation of portions of the IEEE and 3GPP standards herein should not be interpreted to limit Speir's infringement proof in expert reports or at trial in any way. Speir's citation of portions of the IEEE and 3GPP standards herein provides detailed notice of Speir's theory of infringement, but Speir intends to rely on additional evidence including, but not limited to, data sheets, design specifications, source code, testing information, reference designs, implementation and utilization information, and/or schematics as proof of infringement in expert reports and at trial.

Speir reserves the right to amend these claim charts, as well as other information contained in this document and the exhibits hereto. Speir further reserves the right to amend these claim charts to incorporate new information learned during the course of discovery, including, but not limited to, information that is not publicly available or readily discernible without discovery or undue burden.

## IV. Literal Infringement / Doctrine of Equivalents

Speir asserts that Apple infringes the Asserted Claims listed above under at least 35 U.S.C. § 271(a), (b), (c), and/or (f). Speir contends that Apple has directly infringed and continues to directly infringe the asserted claims by making, using, offering for sale, selling, and importing into the United States the Accused Products. Speir also contends that Apple (i) induces end users of the Accused Products to directly infringe the Asserted Claims and (ii) contributes to end users' direct infringement of the Asserted Claims. Speir asserts that, under the proper construction of the Asserted Claims and their claim terms, the limitations of the asserted claims of the asserted Speir patents are literally present in the Accused Products, as set forth in the claim charts attached hereto

as Exhibits A-D. Speir contends that any and all elements found not to be literally infringed are infringed under the doctrine of equivalents because the differences between the claimed inventions and the Accused Products, if any, are insubstantial.

Speir's contention is that each limitation is literally met, and necessarily also would be met under the doctrine of equivalents because there are no substantial differences between the Accused Products and the claims, in function, way, or result. If Apple attempts to argue that there is no infringement literally and also no infringement under doctrine of equivalents and attempts to draw any distinction between the claimed functionality and the functionality in the Accused Products, then Speir reserves its right to rebut the alleged distinction as a matter of literal infringement and/or as to whether any such distinction is substantial under the doctrine of equivalents.

Speir reserves the right to amend its Infringement Contentions as to literal infringement or infringement under the doctrine of equivalents in light of new information learned during the course of discovery and the Court's claim construction.

## V. Priority Dates

The Asserted Claims are entitled to a priority date of at least the following:

**A. U.S. Patent No. 8,345,780:** Each asserted claim of the '780 Patent is entitled to at least a priority date of June 4, 2008.

**B. U.S. Patent No. 7,110,779:** Each asserted claim of the '779 Patent is entitled to at least a priority date of January 29, 2004.

**C. U.S. Patent No. 7,321,777:** Each asserted claim of the '777 Patent is entitled to at least a priority date of January 29, 2004.

**D. U.S. Patent No. 7,765,399:** Each asserted claim of the '399 Patent is entitled to at least a priority date of February 22, 2006.

## VI. Identification of Instrumentalities Practicing the Claimed Inventions

At this time, Speir is not relying on any assertion that any of its own instrumentalities practice the claims of the Asserted Patents.

## VII. Document Production Accompanying Disclosure

Speir submits the following Document Production Accompanying Disclosure, along with an identification of the categories to which each of the documents corresponds.

Speir is presently unaware of any documents sufficient to evidence any discussion with, disclosure to, or other manner of providing to a third party, or sale of or offer to sell, the inventions recited in the Asserted Claims of the asserted patents prior to the application date or priority date for the asserted patents. A diligent search continues for documents and Speir reserves the right to supplement this response.

Speir is presently unaware of documents regarding the conception, reduction to practice, design, and development of each claimed invention of the asserted patents, which were created before the date of application for the asserted patent or the priority date identified above. A diligent search continues for documents and Speir reserves the right to supplement this response.

Speir identifies the following documents as being the file histories for the Asserted Patents: SPEIR-APPLE-00000077 - SPEIR-APPLE-00000866.

Dated: April 19, 2022

Respectfully submitted,

By: */s/ Brett E. Cooper*

Brett E. Cooper (NY SBN 4011011)
bcooper@raklaw.com
Reza Mirzaie (CA SBN 246953)
rmirzaie@raklaw.com
Marc A. Fenster (CA SBN 181067)
mfenster@raklaw.com

Seth Hasenour (TX SBN 24059910)
shasenour@raklaw.com
Drew B. Hollander (NY SBN 5378096)
dhollander@raklaw.com

**RUSS AUGUST & KABAT**
12424 Wilshire Blvd. 12th Floor
Los Angeles, CA 90025
Phone: (310) 826-7474
Facsimile: (310) 826-6991

***Attorneys for Plaintiff Speir Technology Limited***

## CERTIFICATE OF SERVICE

I certify that this document is being served upon counsel of record for Defendant via electronic service.

/s/*Drew B. Hollander*
Drew B. Hollander

# EXHIBIT A

## U.S. Patent No. 8,345,780 ("the '780 Patent")

Apple products with 5G functionality, including without limitation the Apple iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPhone SE (3rd Generation), iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPad Pro (5th Generation), iPad Air (5th Generation), iPad Mini (6th Generation), and any other products with 5G functionality ("Accused Products"), infringe at least Claims 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, and 14 of the '780 Patent.

**Claim 1**

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| [1pre] A wireless communication system comprising: | To the extent the preamble is limiting, each Accused Product is designed to be used as part of a wireless communication system.<br><br>In particular, the Accused Products are configured to communicate with base stations using 5G cellular technology. |

9

| Claim 1 | Exemplary Evidence of Infringement |
| --- | --- |
| | **iPhone 12** Learn more about Apple Card › Overview Switching to iPhone Tech Specs Buy<br><br>**Carriers** AT&T Sprint Now part of T-Mobile T-Mobile verizon<br><br>**Cellular and Wireless**<br>**Model A2172***<br>5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz)<br><br>**Model A2176***<br>5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz)<br><br>**All models**<br>5G (sub-6 GHz and mmWave)[7] |

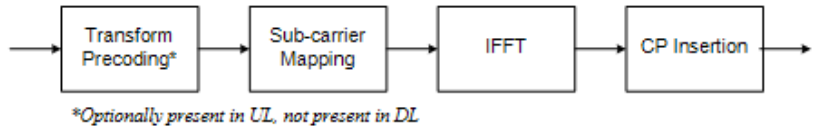
| Claim 1 | Exemplary Evidence of Infringement |
| --- | --- |
| | *See* https://www.apple.com/iphone-12/specs/ |

iPhone 13

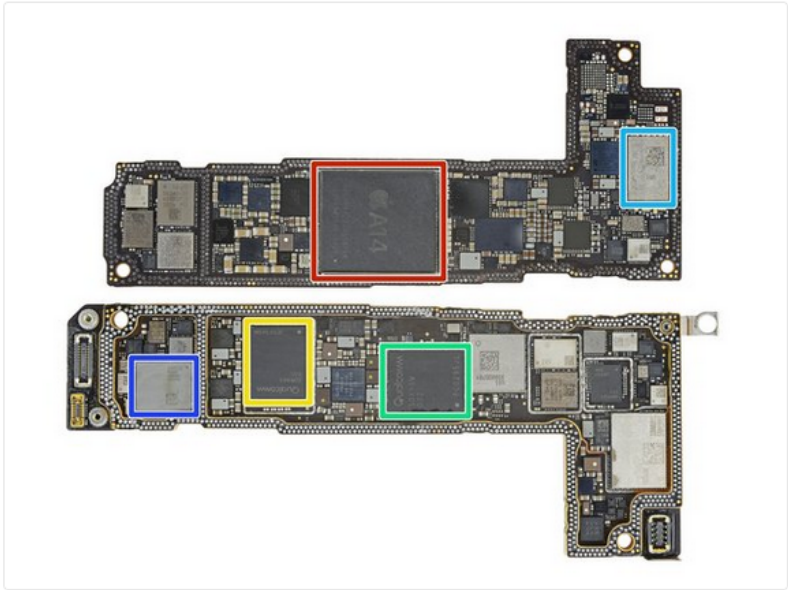
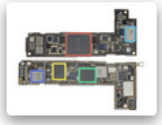
Overview | Switching to iPhone | Tech Specs | Buy

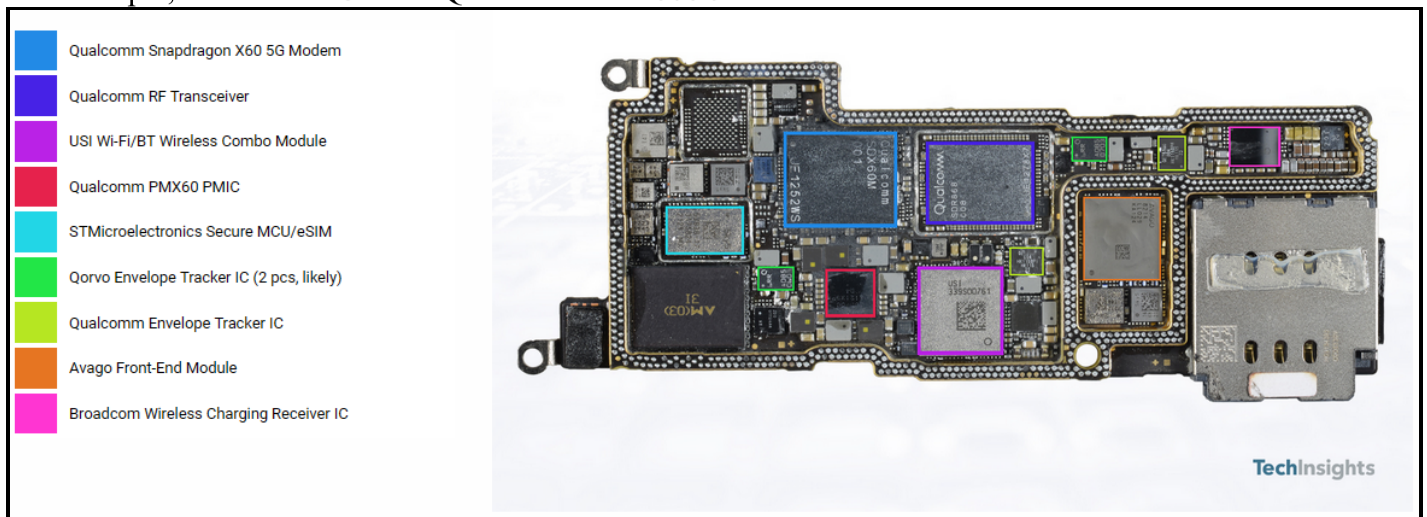
| | | |
|---|---|---|
| **Carriers** | AT&T, Sprint (Now part of T-Mobile), T-Mobile, verizon | |
| **Cellular and Wireless** | **Model A2481*** | 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n258, n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | **Model A2482*** | 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n258, n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | **All models** | 5G (sub-6 GHz and mmWave)[7] |

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| | *See* https://www.apple.com/iphone-13/specs/ |
| [1a] first and second wireless communications devices configured to communicate with one another via a wireless communications link having at least one settable link characteristic; | The Accused Products are configured to communicate with the base station via a wireless communications link having at least one settable link characteristic.<br><br>5G NR compatible devices are able to set at least the following link characteristics: CQI, PMI, and RI based upon channel measurements and interference types and levels. *See* Claim [9c.4].<br><br>5G NR compatible devices are also able to set the best beam on which to receive. *See* Claim 10. |
| [1b.1] **said first and second wireless communications devices comprising respective first and second orthogonal frequency-division multiplexing (OFDM) wireless transceivers** and respective first and second controllers | The Accused Products and 5G base stations comprise OFDM transceivers.<br><br>5G uses OFDM in both the uplink and the downlink. Thus, the Accused Products and the base station must have a transceiver designed for receiving and transmitting OFDM. |

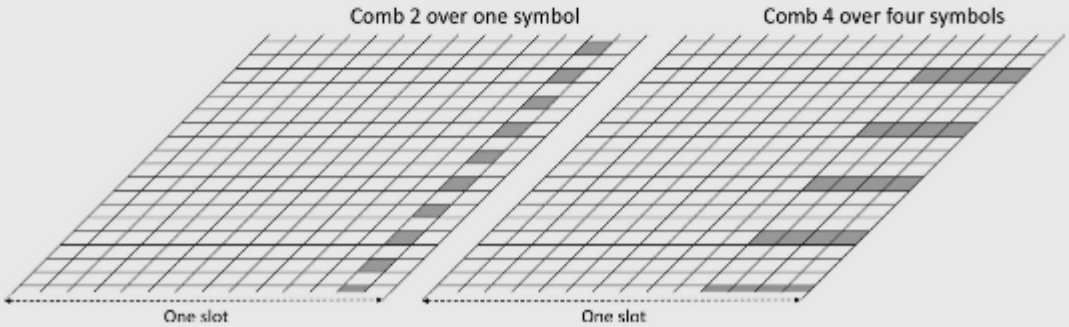
| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| coupled thereto and configured to store short term and long term historical characteristics of interference; | **5.1 Waveform, numerology and frame structure**<br>The downlink transmission waveform is conventional OFDM using a cyclic prefix. The uplink transmission waveform is conventional OFDM using a cyclic prefix with a transform precoding function performing DFT spreading that can be disabled or enabled.<br>  <br><br>**Figure 5.1-1: Transmitter block diagram for CP-OFDM with optional DFT-spreading**<br><br>*See* 3GPP TS 38.300 V15.13.0 (and all versions of Release 15 and Release 16)<br>**5.3.1 OFDM baseband signal generation for all channels except PRACH**<br>The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ 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<br>$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^{\mu} - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^{\mu} T_c - t_{\text{start},l}^{\mu}\right)}$$<br>$$k_0^{\mu} = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$<br>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,<br>$$N_{\text{u}}^{\mu} = 2048\,\kappa \cdot 2^{-\mu}$$<br>$$N_{\text{CP},l}^{\mu} = \begin{cases} 512\,\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\,\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix,} \quad l = 0 \text{ or } l = 7 \cdot 2^{\mu} \\ 144\,\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix,} \quad l \ne 0 \text{ and } l \ne 7 \cdot 2^{\mu} \end{cases}$$ |

| Claim 1 | Exemplary Evidence of Infringement |
| --- | --- |
| | *See* 3GPP TS 38.211 V15.9.0 (and all versions of Release 15 and Release 16).<br><br>For example, the iPhone 12 has a Qualcomm SDR865 5G / LTE transceiver. |

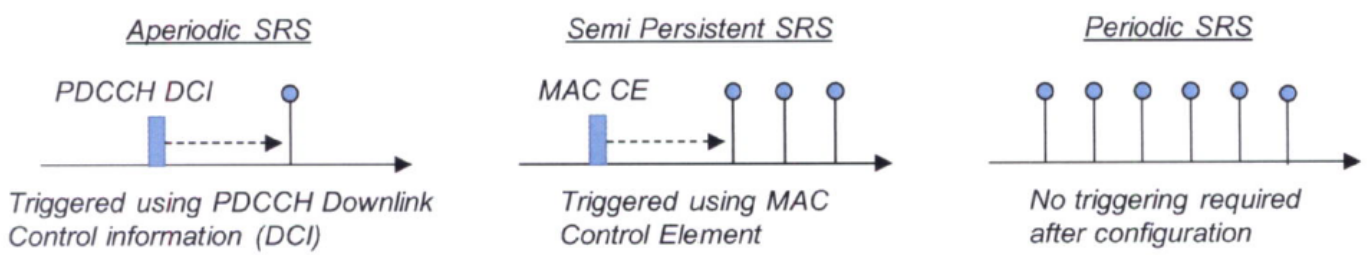
| Claim 1 | Exemplary Evidence of Infringement |
| --- | --- |
| |   • A little heat (a lot of heat) and a little prying yields two boards for the price of one! We split one of the iPhone 12 boards open to get a look at all that sweet silicon, and if it seems hard to guess which one, you're not alone—the logic boards of the 12 and 12 Pro are nearly identical, apart from a few serial numbers.<br>• Apple APL1W01 A14 Bionic SoC, layered under Micron D9XMR MT53D512M64D4UA-046 XT:F 4 GB LPDDR4 SDRAM (6 GB RAM on the 12 Pro)<br>• KICM224AY4402TWNA12029, 64 GB of Kioxia NAND flash memory.<br>• Qualcomm SDR865 5G and LTE transceiver<br>• Qualcomm SDX55M 5G modem-RF system and SMR526 intermediate frequency IC<br>• USI/Apple U1 ultra-wideband chip<br>• Avago AFEM-8200 high/mid power amplifier with integrated duplexer<br>• Apple APL1094 343S00437 power management IC<br><br>*See* https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669 |

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| | For example, the iPhone 13 has a Qualcomm SDR868 5G transceiver.<br>  <br><br>Figure 3. Apple iPhone Pro Board Shot<br><br>*See* https://www.techinsights.com/blog/teardown/apple-iphone-13-pro-teardown |
| [1b.2] said first and second wireless communications devices comprising respective first and second orthogonal frequency-division multiplexing (OFDM) wireless transceivers **and respective first and second** | The Accused Products are configured to store short term and long term historical characteristics of interference. *See* Claim [9b].<br><br>The base stations are configured to store short term and long term historical characteristics of interference. The base stations can configure the Accused Products to transmit Sounding Reference Signals (SRS) in the UL. These SRS may be used by the base stations to perform Signal to Interference and Noise (SINR) measurements over varying lengths of time. |

| Claim 1 | Exemplary Evidence of Infringement |
| --- | --- |
| **controllers coupled thereto and configured to store short term and long term historical characteristics of interference;** | 7.5.3 SOUNDING REFERENCE SIGNAL<br><br>★ The Sounding Reference Signal (SRS) is transmitted by the UE according to instructions provided by the Base Station. The Base Station measures the uplink propagation channel from the SRS. This UE specific measurement can then be used for:<br><br>○ uplink channel aware scheduling and link adaptation. The Base Station can use the SRS to measure the uplink propagation channel for each Resource Block within the active Bandwidth Part. The packet scheduler can then identify the best set of Resources Blocks to allocate. In addition, the uplink SINR can be measured from the SRS and this can be used as an input for link adaptation when identifying the appropriate Modulation and Coding Scheme (MCS)<br><br>*See* Chris Johnson, 5G New Radio in Bullets, Section 7.5.3 (2019). |

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| | **8.3: Uplink Channel Sounding—SRS**<br><br>To enable uplink channel sounding a device can be configured for transmission of *sounding reference signals* (SRS). In many respects SRS can be seen as the uplink equivalence to the downlink CSI-RS in the sense that both CSI-RS and SRS are intended for channel sounding albeit in different transmission directions. Both CSI-RS and SRS can also serve as QCL references in the sense that other physical channels can be configured to be transmitted quasi-co-located with CSI-RS and SRS, respectively. Thus, given knowledge of a suitable receiver beam for the CSI-RS/SRS, the receiver knows that the same receiver beam should be suitable also for the physical channel in question.<br>However, on a more detailed level, the structure of SRS is quite different from CSI-RS.<br><br>• SRS is limited to a maximum of four antenna ports while CSI-RS supports up to 32 antenna ports<br>• Being an uplink signal, SRS is designed to have low cubic-metric [57] enabling high device power-amplifier efficiency<br><br>The basic time/frequency structure of an SRS is exemplified in Fig. 8.11. In the general case, an SRS spans one, two, or four consecutive OFDM symbols and is located somewhere within the last six symbols of a slot.[6] In the frequency domain, an SRS has a so-called comb structure, implying that an SRS is transmitted on every $N^{th}$ subcarrier where $N$ can take the values two or four ("comb-2" and "comb-4," respectively).<br><br>  <br><br>FIG. 8.11 Examples of SRS time/frequency structures. |

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| | *See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 8.3 (2d Ed. 2018).<br><br>6.4.1.4 Sounding reference signal<br><br>6.4.1.4.1 SRS resource<br><br>An SRS resource is configured by the *SRS-Resource* IE and consists of<br><br>- $N_{\text{ap}}^{\text{SRS}} \in \{1,2,4\}$ antenna ports $\{p_i\}_{i=0}^{N_{\text{ap}}^{\text{SRS}}-1}$, where the number of antenna ports is given by the higher layer parameter *nrofSRS-Ports*, $p_i = 1000 + i$ when the SRS resource is in a SRS resource set with higher-layer parameter *usage* in *SRS-ResourceSet* not set to 'nonCodebook', or determined according to [6, TS 38.214] when the SRS resource is in a SRS resource set with higher-layer parameter *usage* in *SRS-ResourceSet* set to 'nonCodebook'<br><br>- $N_{\text{symb}}^{\text{SRS}} \in \{1,2,4\}$ consecutive OFDM symbols given by the field *nrofSymbols* contained in the higher layer parameter *resourceMapping*<br><br>- $l_0$, the starting position in the time domain given by $l_0 = N_{\text{symb}}^{\text{slot}} - 1 - l_{\text{offset}}$ where the offset $l_{\text{offset}} \in \{0,1,\ldots,5\}$ counts symbols backwards from the end of the slot and is given by the field *startPosition* contained in the higher layer parameter *resourceMapping* and $l_{\text{offset}} \geq N_{\text{symb}}^{\text{SRS}} - 1$<br><br>- $k_0$, the frequency-domain starting position of the sounding reference signal<br><br>*See* 3GPP TS 38.211 V15.9.0 (and all versions of Release 15 and Release 16).<br><br>The base station can configure the SRS to be periodic, semi-persistent or aperiodic. |

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| | **8.3.3: Time-Domain Structure of SRS**<br>Similar to CSI-RS, an SRS can be configured for *periodic*, *semi-persistent*, or *aperiodic* transmission:<br>• A periodic SRS is transmitted with a certain configured periodicity and a certain configured slot offset within that periodicity;<br>• A semi-persistent SRS has a configured periodicity and slot offset in the same way as a periodic SRS. However, actual SRS transmission according to the configured periodicity and slot offset is activated and deactivated by means of MAC-CE signaling;<br>• An aperiodic SRS is only transmitted when explicitly triggered by means of DCI.<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 8.3.3 (2d Ed. 2018).<br><br>  <br><br>**Figure 294 – Triggering mechanisms for the SRS**<br><br>*See* Chris Johnson, 5G New Radio in Bullets, Section 7.5.3 (2019). |

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| | ```
SRS-Resource ::=  SEQUENCE {
    srs-ResourceId  SRS-ResourceId,
    nrofSRS-Ports  ENUMERATED {port1, ports2, ports4},
    ptrs-PortIndex  ENUMERATED {n0, n1 }  OPTIONAL,  -- Need R
    transmissionComb  CHOICE {
        n2  SEQUENCE {
            combOffset-n2  INTEGER (0..1),
            cyclicShift-n2  INTEGER (0..7)
        },
        n4  SEQUENCE {
            combOffset-n4  INTEGER (0..3),
            cyclicShift-n4  INTEGER (0..11)
        }
    },
    resourceMapping  SEQUENCE {
        startPosition  INTEGER (0..5),
        nrofSymbols  ENUMERATED {n1, n2, n4},
        repetitionFactor  ENUMERATED {n1, n2, n4}
    },
    freqDomainPosition  INTEGER (0..67),
    freqDomainShift  INTEGER (0..268),
    freqHopping  SEQUENCE {
        c-SRS  INTEGER (0..63),
        b-SRS  INTEGER (0..3),
        b-hop  INTEGER (0..3)
    },
    groupOrSequenceHopping  ENUMERATED { neither, groupHopping, sequenceHopping },
    resourceType  CHOICE {
        aperiodic  SEQUENCE {
            ...
        },
        semi-persistent  SEQUENCE {
            periodicityAndOffset-sp  SRS-PeriodicityAndOffset,
            ...
        },
        periodic  SEQUENCE {
            periodicityAndOffset-p  SRS-PeriodicityAndOffset,
            ...
        }
    },
    sequenceId  INTEGER (0..1023),
    spatialRelationInfo  SRS-SpatialRelationInfo  OPTIONAL,  -- Need R
    ...
}
```<br><br>*See* 3GPP TS 38.331 V15.15.0 (and all versions of Release 15 and Release 16). |
| [1c] said first controller configured to detect received | *See* Claim [9c.1]. |
```

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| interference, | |
| [1d.1] **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, and | *See* Claim [9c.2] |
| [1d.2] determine a type of the received interference from among a plurality of interference types comprising wideband | *See* Claim [9c.3] |

| Claim 1 | Exemplary Evidence of Infringement |
|---|---|
| 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, and** | |
| [1e] set the at least one settable link characteristic to compensate for the received interference based upon the interference type. | *See* Claim [9c.4] |

**Claim 2**

| Claim 2 | Exemplary Evidence of Infringement |
|---|---|
| [2] The wireless communication system according to claim 1 wherein said first controller is configured | The first controller of the wireless communication system according to claim 1 is configured to repeat the detecting, determining, and setting.<br><br>The Accused Products may be configured to repeatedly perform CSI-IM measurements and to repeatedly transmit CSI reports to the base station containing CQI, PMI, and RI information. *See* Claim [9b]. |

| Claim 2 | Exemplary Evidence of Infringement |
|---|---|
| to repeat the detecting, determining, and setting. | |

**Claim 3**

| Claim 3 | Exemplary Evidence of Infringement |
|---|---|
| [3] The wireless communication system according to claim 1 wherein the at least one settable link characteristic comprises at least one receive processing characteristic. | *See* Claim 10. |

**Claim 4**

| Claim 4 | Exemplary Evidence of Infringement |
|---|---|
| [4] The wireless communication system according to claim 1 wherein the at least one settable link characteristic comprises at least one transmit processing characteristic; and wherein said first | *See* Claim 11. |

| Claim 4 | Exemplary Evidence of Infringement |
|---|---|
| controller is configured to cooperate with said second controller to set the at least one transmit processing characteristic. | |

**Claim 7**

| Claim 7 | Exemplary Evidence of Infringement |
|---|---|
| [7] The wireless communication system according to claim 1 wherein said first controller is configured to determine the interference type based upon at least one of fade characteristics, noise characteristics, and path characteristics. | The first controller of the wireless communication system according to claim 1 is configured to determine the interference type based upon at least one of fade characteristics, noise characteristics, and path characteristics. For example, it is configured to determine the interference type based upon noise characteristics measurements.<br><br>*See* Claim [9b] and Claim [9c.1]. |

**Claim 8**

| Claim 8 | Exemplary Evidence of Infringement |
|---|---|
| [8] The wireless communication system according to claim 1 wherein the at least one settable link | The settable link characteristic of the wireless communication system according to claim 1 comprises at least one of transmission power, frequency diversity, time diversity, modulation, forward error correction (FEC), channel bandwidth, and adaptive filtering.<br><br>For example, the settable link characteristic includes the CQI which indicates both the modulation and |

| Claim 8 | Exemplary Evidence of Infringement |
|---|---|
| characteristic comprises at least one of transmission power, frequency diversity, time diversity, modulation, forward error correction (FEC), channel bandwidth, and adaptive filtering. | forward error correction.<br><br>*See* Claim 11. |

**Claim 9**

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| [9pre] 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, the wireless communications device comprising: | To the extent the preamble is limiting, each Accused Product includes a wireless communications device operable to communicate with an an other wireless communications device via a wireless communications link having at least one settable link characteristic.<br><br>In particular, the Accused Products are configured to communicate with base stations using 5G cellular technology. |

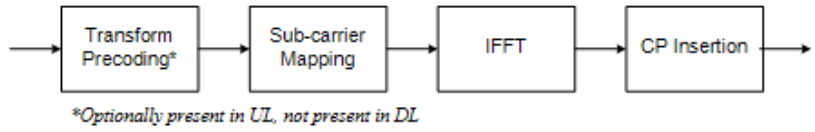
| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | iPhone 12 Learn more about Apple Card › Overview Switching to iPhone Tech Specs Buy<br><br>Carriers AT&T Sprint Now part of T Mobile T Mobile verizon<br><br>Cellular and Wireless<br>Model A2172*: 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz)<br><br>Model A2176*: 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz)<br><br>All models: 5G (sub-6 GHz and mmWave)[7] |

| Claim 9 | Exemplary Evidence of Infringement |
| --- | --- |
| | *See* https://www.apple.com/iphone-12/specs/ |

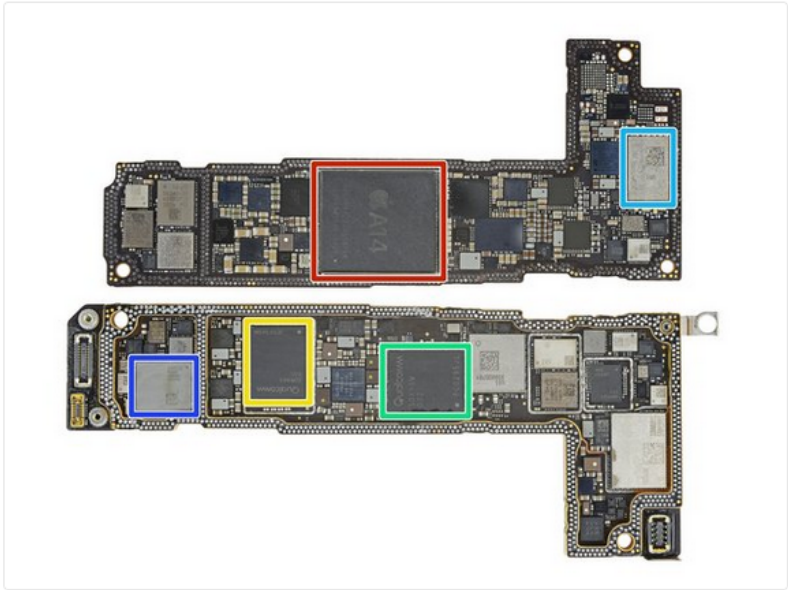
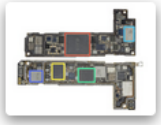
iPhone 13

Overview | Switching to iPhone | Tech Specs | Buy

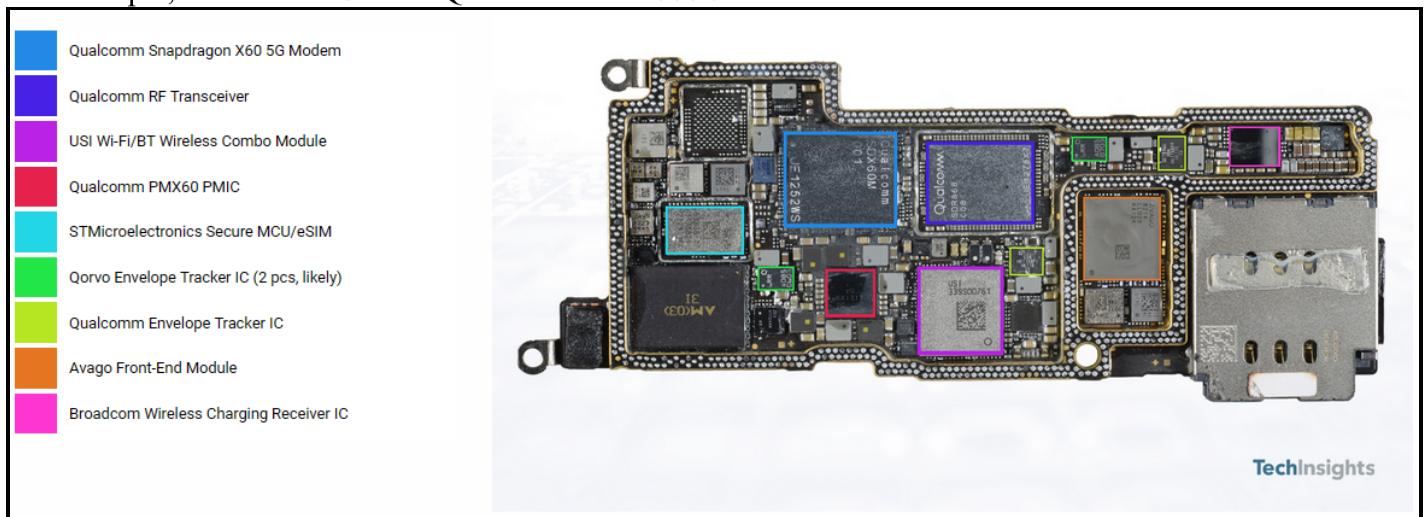
| | | |
|---|---|---|
| **Carriers** | AT&T, Sprint (Now part of T-Mobile), T-Mobile, verizon | |
| **Cellular and Wireless** | **Model A2481*** | 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n258, n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | **Model A2482*** | 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)<br>5G NR mmWave (Bands n258, n260, n261)<br>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | **All models** | 5G (sub-6 GHz and mmWave)[7] |

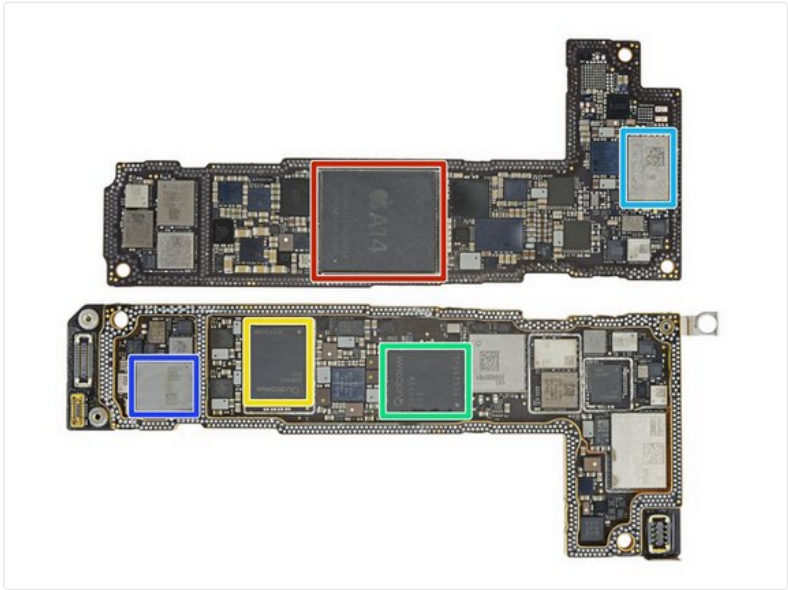
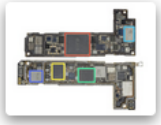
| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | *See* https://www.apple.com/iphone-13/specs/<br><br>5G NR compatible devices are able to set at least the following network characteristics: CQI, PMI, and RI based upon channel measurements and interference types and levels. *See* Claim [9c.4]. |
| [9a] an orthogonal frequency-division multiplexing (OFDM) wireless transceiver; and | In each Accused Product, the device includes an orthogonal frequency-division multiplexing (OFDM) wireless transceiver.<br><br>5G uses OFDM in both the uplink and the downlink. Thus, the Accused Products must have a transceiver designed for receiving and transmitting OFDM.<br><br>5.1 Waveform, numerology and frame structure<br><br>The downlink transmission waveform is conventional OFDM using a cyclic prefix. The uplink transmission waveform is conventional OFDM using a cyclic prefix with a transform precoding function performing DFT spreading that can be disabled or enabled.<br><br>  <br>**Figure 5.1-1: Transmitter block diagram for CP-OFDM with optional DFT-spreading**<br><br>*See* 3GPP TS 38.300 V15.13.0 (and all versions of Release 15 and Release 16). |

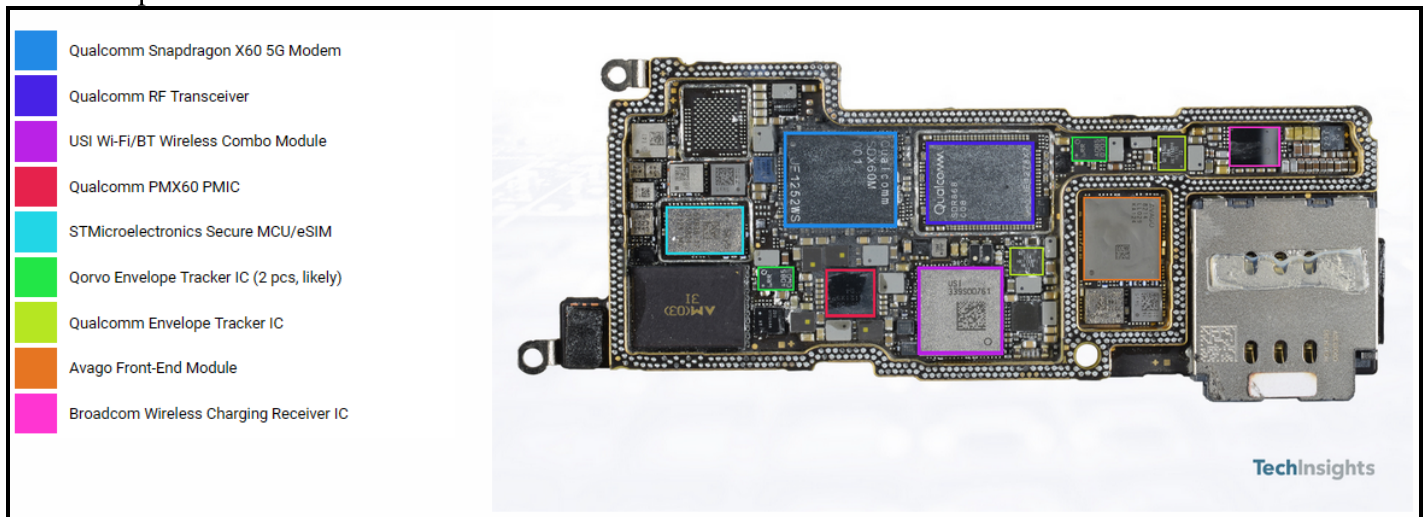
| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | **5.3.1 OFDM baseband signal generation for all channels except PRACH**<br><br>The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0, 1, \ldots, N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by<br><br>$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^{\mu} - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^{\mu} T_c - t_{\text{start},l}^{\mu}\right)}$$<br>$$k_0^{\mu} = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$<br><br>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,<br><br>$$N_{\text{u}}^{\mu} = 2048\,\kappa \cdot 2^{-\mu}$$<br>$$N_{\text{CP},l}^{\mu} = \begin{cases} 512\,\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\,\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix,} \quad l = 0 \text{ or } l = 7 \cdot 2^{\mu} \\ 144\,\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix,} \quad l \ne 0 \text{ and } l \ne 7 \cdot 2^{\mu} \end{cases}$$<br><br>*See* 3GPP TS 38.211 V15.9.0 (and all versions of Release 15 and Release 16).<br><br>For example, the iPhone 12 has a Qualcomm SDR865 5G / LTE transceiver. |

| Claim 9 | Exemplary Evidence of Infringement |
| --- | --- |
| |  <br>  <br>• A little heat (a lot of heat) and a little prying yields two boards for the price of one! We split one of the iPhone 12 boards open to get a look at all that sweet silicon, and if it seems hard to guess which one, you're not alone—the logic boards of the 12 and 12 Pro are nearly identical, apart from a few serial numbers.<br>• Apple APL1W01 A14 Bionic SoC, layered under Micron D9XMR MT53D512M64D4UA-046 XT:F 4 GB LPDDR4 SDRAM (6 GB RAM on the 12 Pro)<br>• KICM224AY4402TWNA12029, 64 GB of Kioxia NAND flash memory.<br>• Qualcomm SDR865 5G and LTE transceiver<br>• Qualcomm SDX55M 5G modem-RF system and SMR526 intermediate frequency IC<br>• USI/Apple U1 ultra-wideband chip<br>• Avago AFEM-8200 high/mid power amplifier with integrated duplexer<br>• Apple APL1094 343S00437 power management IC<br><br>*See* https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669 |

33

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | For example, the iPhone 13 has a Qualcomm SDR868 5G transceiver.<br>  <br><br>Figure 3. Apple iPhone Pro Board Shot<br><br>*See* https://www.techinsights.com/blog/teardown/apple-iphone-13-pro-teardown |
| [9b] a controller coupled to said wireless transceiver and configured to store short term and long term historical characteristics of interference; | Each Accused Product includes a controller coupled to said wireless transceiver and configured to store short term and long term historical characteristics of interference.<br><br>For example, the iPhone 12 contains a Qualcomm SDX55M 5G modem that contains one or more controllers that is coupled to the transceiver. |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| |  <br>  <br>• A little heat (a lot of heat) and a little prying yields two boards for the price of one! We split one of the iPhone 12 boards open to get a look at all that sweet silicon, and if it seems hard to guess which one, you're not alone—the logic boards of the 12 and 12 Pro are nearly identical, apart from a few serial numbers.<br>• Apple APL1W01 A14 Bionic SoC, layered under Micron D9XMR MT53D512M64D4UA-046 XT:F 4 GB LPDDR4 SDRAM (6 GB RAM on the 12 Pro)<br>• KICM224AY4402TWNA12029, 64 GB of Kioxia NAND flash memory.<br>• Qualcomm SDR865 5G and LTE transceiver<br>• Qualcomm SDX55M 5G modem-RF system and SMR526 intermediate frequency IC<br>• USI/Apple U1 ultra-wideband chip<br>• Avago AFEM-8200 high/mid power amplifier with integrated duplexer<br>• Apple APL1094 343S00437 power management IC<br><br>*See* https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669<br><br>For example, the iPhone 13 has a Qualcomm Snapdragon X60 5G modem that contains one or more controllers |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | that is coupled to the transceiver.<br>  <br><br>Figure 3. Apple iPhone Pro Board Shot<br><br>*See* https://www.techinsights.com/blog/teardown/apple-iphone-13-pro-teardown<br><br>The controllers in the Accused Products are configured to store short term and long term historical characteristics of interference. For example, 5G-NR compatible UE are configured in the downlink with channel-state-information reference signals (CSI-RS) and channel-state-information interference measurement (CSI-IM) resource sets. These are used to perform CSI measurements which result in the reporting of at least wideband / narrowband CQI, PMI, RI, and cri. |

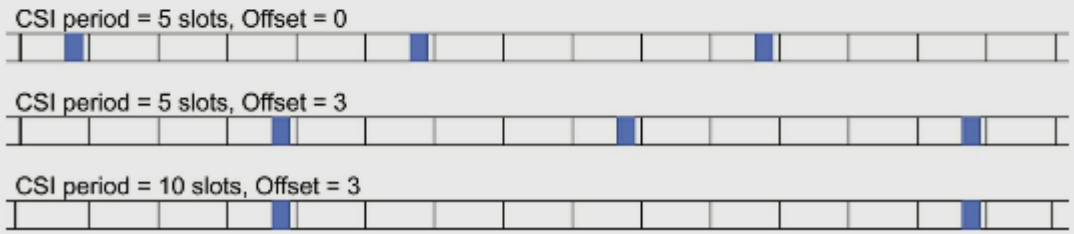
| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | – *CSI-ReportConfig*<br><br>The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent 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.<br><br>***CSI-ReportConfig* information element**<br><br>-- ASN1START<br>-- TAG-CSI-REPORTCONFIG-START<br><br>CSI-ReportConfig ::= SEQUENCE {<br>reportConfigId CSI-ReportConfigId,<br>carrier ServCellIndex OPTIONAL, -- Need S<br>resourcesForChannelMeasurement CSI-ResourceConfigId,<br>csi-IM-ResourcesForInterference CSI-ResourceConfigId OPTIONAL, -- Need R<br>nzp-CSI-RS-ResourcesForInterference CSI-ResourceConfigId OPTIONAL, -- Need R<br>reportConfigType CHOICE {<br>periodic SEQUENCE {<br>reportSlotConfig CSI-ReportPeriodicityAndOffset,<br>pucch-CSI-ResourceList SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource<br>},<br>semiPersistentOnPUCCH SEQUENCE {<br>reportSlotConfig CSI-ReportPeriodicityAndOffset,<br>pucch-CSI-ResourceList SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource<br>},<br>semiPersistentOnPUSCH SEQUENCE {<br>reportSlotConfig ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},<br>reportSlotOffsetList SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),<br>p0alpha P0-PUSCH-AlphaSetId<br>},<br>aperiodic SEQUENCE {<br>reportSlotOffsetList SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)<br>}<br>},<br>reportQuantity CHOICE {<br>none NULL,<br>cri-RI-PMI-CQI NULL,<br>cri-RI-i1 NULL,<br>cri-RI-i1-CQI SEQUENCE {<br>pdsch-BundleSizeForCSI ENUMERATED {n2, n4} OPTIONAL -- Need S<br>},<br>cri-RI-CQI NULL,<br>cri-RSRP NULL,<br>ssb-Index-RSRP NULL,<br>cri-RI-LI-PMI-CQI NULL<br>},<br><br>*See* 3GPP TS 38.331 V15.15.0 (and all versions of Release 15 and Release 16). |

37

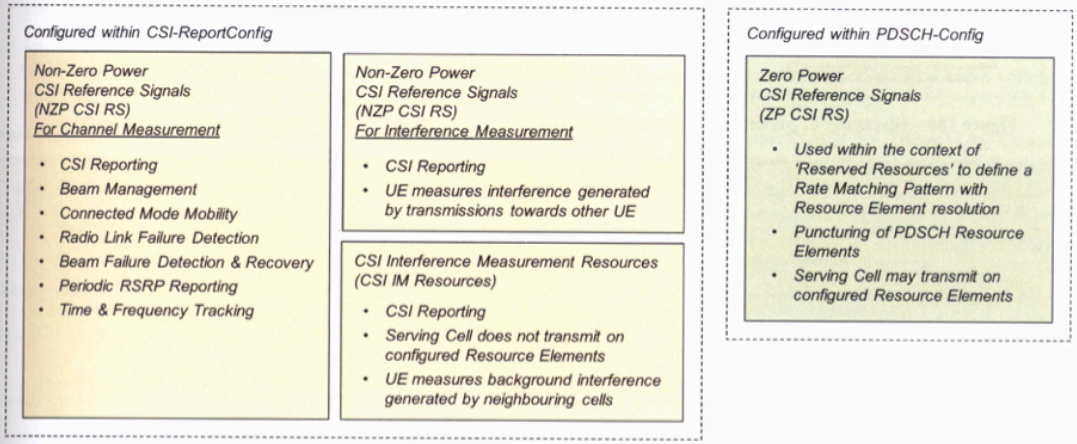
| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | **_CSI-ReportConfig_ field descriptions**<br>**_carrier_**<br>Indicates in which serving cell the *CSI-ResourceConfig* indicated below are to be found. If the field is absent, the resources are on the same serving cell as this report configuration.<br>**_codebookConfig_**<br>Codebook configuration for Type-1 or Type-2 including codebook subset restriction.<br>**_cqi-FormatIndicator_**<br>Indicates whether the UE shall report a single (wideband) or multiple (subband) CQI (see TS 38.214 [19], clause 5.2.1.4).<br>**_cqi-Table_**<br>Which CQI table to use for CQI calculation (see TS 38.214 [19], clause 5.2.2.1).<br>**_csi-IM-ResourcesForInterference_**<br>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*.<br>**_csi-ReportingBand_**<br>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).<br>**_dummy_**<br>This field is not used in the specification. If received it shall be ignored by the UE.<br>**_groupBasedBeamReporting_**<br>Turning on/off group beam based reporting (see TS 38.214 [19], clause 5.2.1.4).<br>**_non-PMI-PortIndication_**<br>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).<br>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.<br>**_nrofReportedRS_**<br>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.<br>(see TS 38.214 [19], clause 5.2.1.4) When the field is absent the UE applies the value 1.<br>**_nzp-CSI-RS-ResourcesForInterference_**<br>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*.<br>*Id.*<br><br>**_resourcesForChannelMeasurement_**<br>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*.<br>**_subbandSize_**<br>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.<br>**_timeRestrictionForChannelMeasurements_**<br>Time domain measurement restriction for the channel (signal) measurements (see TS 38.214 [19], clause 5.2.1.1).<br>**_timeRestrictionForInterferenceMeasurements_**<br>Time domain measurement restriction for interference measurements (see TS 38.214 [19], clause 5.2.1.1).<br>*Id.* |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | 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.<br>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-<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Ch. 8 Abstract (2d Ed. 2018).<br><br>The CSI-RS can be used for Channel State Information reporting.<br><br>3.7.4 CHANNEL STATE INFORMATION REFERENCE SIGNAL<br>★ 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:<br>○ 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)<br><br>*See* Chris Johnson, 5G New Radio in Bullets, Section 3.7.4. (2019).<br><br>The CSI-RS can also be used for interference measurement as well as for channel measurement. |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | ★ 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<br><br>*Id.*<br><br>The CSI-IM resources can be used for measuring self-interference.<br><br>★ 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<br><br>*Id.*<br><br>**8.1.4: CSI-IM—Resources for Interference Measurements**<br>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.<br>However, the interference level can also be estimated from measurements on so-called *CSI-IM* (Interference Measurement) resources.<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 8.1.4 (2d Ed. 2018).<br><br>CSI-RS and CSI-IM can be configured to have a periodicity (i.e. repetition rate). |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | **8.1.3: Time-Domain Property of CSI-RS Configurations**<br>The per-resource-block CSI-RS structure outlined here describes the structure of a CSI-RS transmission, assuming the CSI-RS is actually transmitted in a given slot. In general, a CSI-RS can be configured for *periodic*, *semi-persistent*, or *aperiodic* transmission.<br>In the case of periodic CSI-RS transmission, a device can assume that a configured CSI-RS transmission occurs every $N^{th}$ slot, where $N$ ranges from as low as four, that is, CSI-RS transmissions every fourth slot, to as high as 640, that is, CSI-RS transmission only every $640^{th}$ slot. In addition to the periodicity, the device is also configured with a specific slot offset for the CSI-RS transmission, see Fig. 8.6.<br>  <br><br>FIG. 8.6 Examples of CSI-RS periodicity and slot offset.<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 8.1.3 (2d Ed. 2018).<br><br>The time-domain property of a CSI-IM resource is the same as that of CSI-RS, that is, a CSI-IM resource could be periodic, semi-persistent (activation/deactivation by means of MAC-CE), or aperiodic (triggered by DCI). Furthermore, for periodic and semi-persistent CSI-IM, the set of supported periodicities is the same as for CSI-RS.<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 8.1.4 (2d Ed. 2018).<br><br>The reporting of the CSI information may also be configured to be periodic. |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | – *CSI-ReportConfig*<br><br>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.<br><br>***CSI-ReportConfig* information element**<br><br>-- ASN1START<br>-- TAG-CSI-REPORTCONFIG-START<br><br>CSI-ReportConfig ::= SEQUENCE {<br>reportConfigId CSI-ReportConfigId,<br>carrier ServCellIndex OPTIONAL, -- Need S<br>resourcesForChannelMeasurement CSI-ResourceConfigId,<br>csi-IM-ResourcesForInterference CSI-ResourceConfigId OPTIONAL, -- Need R<br>nzp-CSI-RS-ResourcesForInterference CSI-ResourceConfigId OPTIONAL, -- Need R<br>reportConfigType CHOICE {<br>periodic SEQUENCE {<br>reportSlotConfig CSI-ReportPeriodicityAndOffset,<br>pucch-CSI-ResourceList SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource<br>},<br><br>*See* 3GPP TS 38.331 V15.15.0 (and all versions of Release 15 and Release 16). |
| [9c.1] said controller configured to detect received interference, | Each Accused Product includes a controller configured to detect received interference.<br><br>The Accused Products are configured to receive the CSI-ReportConfig parameter structure that informs the UE of the channel and interference measurements it should make. |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | ★ 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<br>  <br><br>**Figure 187 – Categories of CSI Reference Signal**<br>★ 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<br><br>*See* Chris Johnson, 5G New Radio in Bullets, Section 3.7.4. (2019). |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|

## 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, Section 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)
        }
    },
```

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | *See* 3GPP TS 38.331 V15.15.0 (and all versions of Release 15 and Release 16). |

– *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 (and all versions of Release 15 and Release 16).

## 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.

| Claim 9 | Exemplary Evidence of Infringement |
| --- | --- |
| | *See* 3GPP TS 38.214 V15.14.0 (and all versions of Release 15 and Release 16).<br><br>5.2.1.1 Reporting settings<br><br>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).<br><br>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.<br><br>*Id.* |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | 5.2.1.2 Resource settings<br><br>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.<br><br>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.<br><br>The following are configured via higher layer signaling for one or more CSI Resource Settings for channel and interference measurement:<br><br>- CSI-IM resource for interference measurement as described in clause 5.2.2.4.<br>- NZP CSI-RS resource for interference measurement as described in clause 5.2.2.3.1.<br>- NZP CSI-RS resource for channel measurement as described in clause 5.2.2.3.1.<br><br>*Id.*<br><br>7.4.1.5 CSI reference signals<br><br>7.4.1.5.1 General<br><br>Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined<br><br>- 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<br>- 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. |

47

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | *See* 3GPP TS 38.211 V15.9.0 (and all versions of Release 15 and Release 16). |
| [9c.2] **determine a type of the received interference from among a plurality of interference types according to 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, and | Each of the Accused Products determines a type of the received interference from among a plurality of interference types according to 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.<br><br>For example, the CSI-RS and 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.<br><br>**8.1.2: Frequency-Domain Structure of CSI-RS Configurations**<br>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.<br>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.<br>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.<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 8.1.2 (2d Ed. 2018). |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|

★ 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).

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|

– *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 (and all versions of Release 15 and Release 16).

– *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
    ...
}
```

*Id*.

51

#### 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'.

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | *See* 3GPP 38.214 V15.14.0 (and all versions of Release 15 and Release 16).<br><br>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.<br><br>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*.<br><br>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 $N_{CSI-RS}^{BW} \geq \min(24, N_{BWP}^{size})$.<br><br>*Id*. |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | 5.2.2.4 Channel State Information – Interference Measurement (CSI-IM)<br><br>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).<br><br>The following parameters are configured via higher layer parameter *CSI-IM-Resource* for each CSI-IM resource configuration:<br><br>- *csi-IM-ResourceId* determines CSI-IM resource configuration identity<br>- *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.<br>- *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.<br>- *periodicityAndOffset* defines the CSI-IM periodicity and slot offset for periodic/semi-persistent CSI-IM.<br>- *freqBand* includes parameters to enable configuration of frequency-occupancy of CSI-IM<br><br>In each of the PRBs configured by *freqBand*, the UE shall assume each CSI-IM resource is located in,<br><br>- 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',<br>- 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',<br><br>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.<br><br>*Id.* |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| [9c.3] determine a type of the received interference from among a plurality of interference types according to 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, and** | Each of the Accused Products determines a type of the received interference from among a plurality of interference types according to 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.<br><br>For example, 3GPP TS 38.214 specifies that channel measurements are based upon either multiple in time or single time readings: |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | 5.2.2 Channel state information<br><br>5.2.2.1 Channel quality indicator (CQI)<br><br>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.<br><br>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:<br><br>- 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:<br><br>  - 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<br><br>  - 0.00001, if the higher layer parameter *cqi-Table* in *CSI-ReportConfig* configures 'table3' (corresponding to Table 5.2.2.1-4).<br><br>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.<br><br>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.<br><br>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.<br><br>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. |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | *See* 3GPP TS 38.214 §5.2.2.1 (and all versions of Release 15 and Release 16).<br><br>RI and PMI are also computed based on SRS measurements.<br><br>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.<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 11.3.1 (2d Ed. 2018). |
| [9c.4] set the at least one settable link characteristic to compensate for the received interference based upon the interference type. | The Accused Products set the at least one settable link characteristic to compensate for the received interference based upon the interference type. For example, the Accused Products set a transmit characteristic by reporting at least wideband and subband CQI, wideband and subband PMI, and also RI based upon the type of interference and its magnitude.<br><br>The CQI is computed on both a wideband and narrowband basis.<br><br>- 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.<br><br>*See* 3GPP TS 38.214 V.15.14.0 §5.2.1.4 (and all versions of Release 15 and Release 16).<br><br>The PMI is computed on both a wideband and narrowband basis. |

| Claim 9 | Exemplary Evidence of Infringement |
| --- | --- |
| | 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.<br><br>*Id*. |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|
| | 5.2.2 Channel state information<br>5.2.2.1 Channel quality indicator (CQI)<br>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.<br>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:<br>- 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:<br>  - 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<br>  - 0.00001, if the higher layer parameter *cqi-Table* in *CSI-ReportConfig* configures 'table3' (corresponding to Table 5.2.2.1-4).<br>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.<br>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.<br>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.<br>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.<br>*See* 3GPP TS 38.214 V.15.14.0 (and all versions of Release 15 and Release 16). |

| Claim 9 | Exemplary Evidence of Infringement |
|---|---|

The RI is reported on a wideband basis.

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].

$\upsilon$ 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 (and all versions of Release 15 and Release 16).

The Accused Products further set the at least one settable link characteristic to compensate for the received interference based upon the interference type. For example, the Accused Products set a receive processing characteristic. *See* Claim 10.

**Claim 10**

| Claim 10 | Exemplary Evidence of Infringement |
|---|---|
| The wireless communications device according to claim 9 wherein the at least one settable link characteristic comprises at least one receive processing characteristic | The Accused Products according to Claim 9 are configured to set a settable link characteristic comprising at least one receive processing characteristic. For example, the Accused Products may be configured with a CSI report quantity, *reportQuantity*, set to *none*.<br><br>`CSI-ReportConfig ::= SEQUENCE {`<br>`  reportConfigId  CSI-ReportConfigId,`<br>`  carrier  ServCellIndex  OPTIONAL,  -- Need S`<br>`  resourcesForChannelMeasurement  CSI-ResourceConfigId,`<br>`  csi-IM-ResourcesForInterference  CSI-ResourceConfigId  OPTIONAL,  -- Need R`<br>`  nzp-CSI-RS-ResourcesForInterference  CSI-ResourceConfigId  OPTIONAL,  -- Need R`<br>`  reportConfigType  CHOICE {`<br>`  periodic  SEQUENCE {`<br>`  reportSlotConfig  CSI-ReportPeriodicityAndOffset,`<br>`  pucch-CSI-ResourceList  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource`<br>`  },`<br>`  semiPersistentOnPUCCH  SEQUENCE {`<br>`  reportSlotConfig  CSI-ReportPeriodicityAndOffset,`<br>`  pucch-CSI-ResourceList  SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource`<br>`  },`<br>`  semiPersistentOnPUSCH  SEQUENCE {`<br>`  reportSlotConfig  ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},`<br>`  reportSlotOffsetList  SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),`<br>`  p0alpha  P0-PUSCH-AlphaSetId`<br>`  },`<br>`  aperiodic  SEQUENCE {`<br>`  reportSlotOffsetList  SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)`<br>`  }`<br>`  },`<br>`  reportQuantity  CHOICE {`<br>`  none  NULL,`<br>`  cri-RI-PMI-CQI  NULL,`<br>`  cri-RI-i1  NULL,`<br>`  cri-RI-i1-CQI  SEQUENCE {`<br>`  pdsch-BundleSizeForCSI  ENUMERATED {n2, n4}`<br>`  },`<br>`  cri-RI-CQI  NULL,`<br>`  cri-RSRP  NULL,`<br>`  ssb-Index-RSRP  NULL,`<br>`  cri-RI-LI-PMI-CQI  NULL`<br>`  },`<br><br>*See* 3GPP TS 38.331 V15.15.0 (and all versions of Release 15 and Release 16).<br><br>This is done so as to facilitate the setting of UE receive side only parameters. |

60

| Claim 10 | Exemplary Evidence of Infringement |
|---|---|
| | There are also situations when a device needs to carry out measurements without any corresponding reporting to the network. One such case is when a device should carry out measurements for receiver-side downlink beam-forming. As will be described in Chapter 12, in such a case a device may measure on downlink reference signals using different receiver beams. However, the result of the measurement is not reported to the network but only used internally within the device to select a suitable receiver beam. At the same time the device needs to be configured with the reference signals to measure on. Such a configuration is also covered by report configurations for which, in this case, the quantity to be reported is defined as "None."<br><br>*See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 8.2.2 (2d Ed. 2018).<br><br>The second part of the *CSI-reportConfig* parameter structure is presented in Table 293. The *reportQuantity* specifies the content of the reports to be provided by the UE. The majority of reports include a CSI Reference Signal Resource Indicator (CRI) which is used for Beam Management purposes, i.e. the UE specifies the best CSI Reference Signal beam to be used for subsequent downlink data transfer. The *reportQuantity* can be configured with the following values:<br>○ '*none*': in this case the UE does not provide the Base Station with a CSI report. This is applicable to scenarios where the UE uses the CSI Reference Signal for its own internal procedures rather than for providing feedback to the Base Station. For example, the 'P3' phase of Beam Management illustrated in Figure 190 (Section 3.7.4.1) involves the Base Station repeating a CSI Reference Signal transmission to allow the UE to attempt reception with each UE beam. The UE is then able to identify the best UE beam and use that beam for subsequent data transfer. The Base Station does not require knowledge of the beam selected by the UE<br><br>*See* Chris Johnson, 5G New Radio in Bullets, Section 13.6 (2019).<br><br>In this case, the UE uses the configured CSI-RS resources to measure the characteristics of the various beams and to select the best beam. |

## 12.2.2: Downlink Receiver-Side Beam Adjustment

Receiver-side beam adjustment aims at finding the best receive beam, given the current transmit beam. To enable this, the device should once again be configured with a set of downlink reference signals that, in this case, are transmitted within *the same* network-side beam (the current serving beam). As outlined in Fig. 12.3, the device can then do a receiver-side beam sweep to measure on the configured reference signals in sequence over a set of receiver beams. Based on these measurements the device may adjust its current receiver beam.

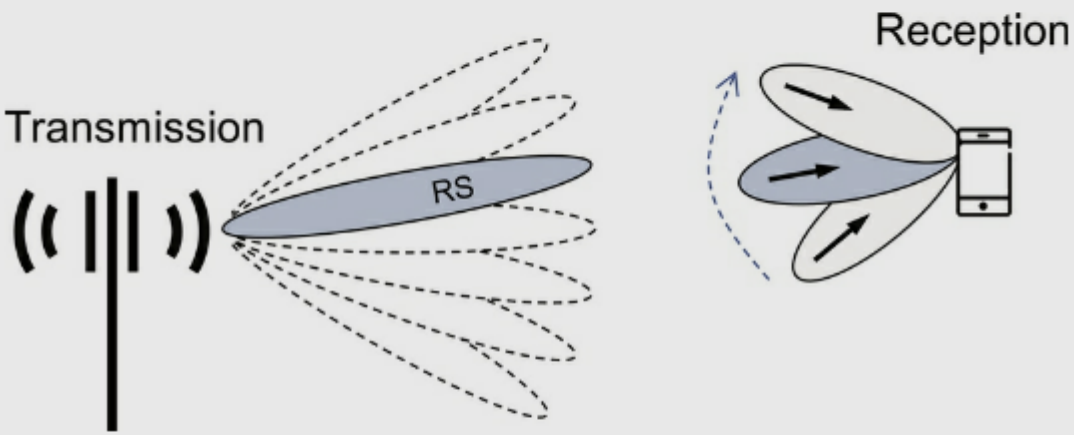
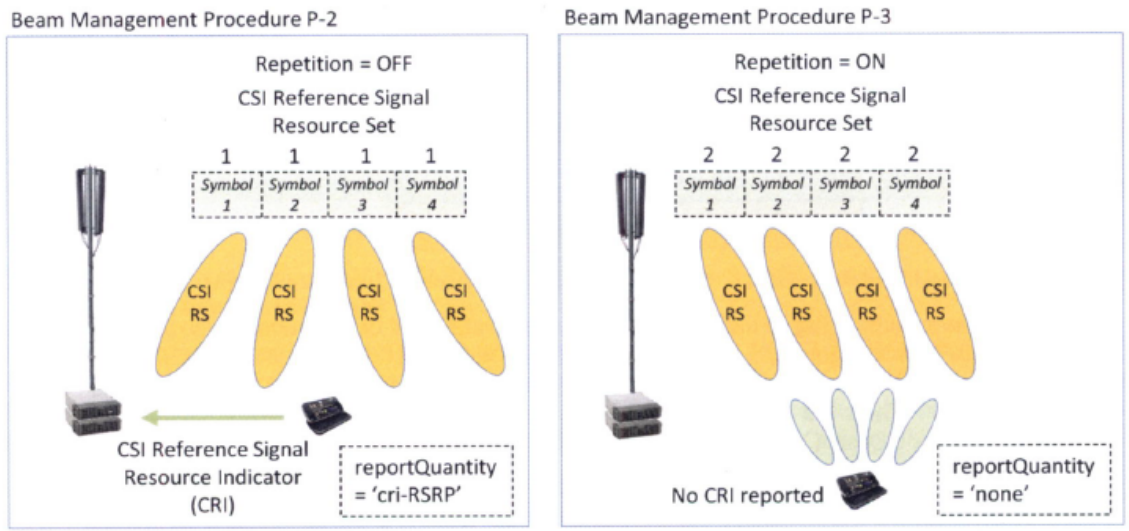



FIG. 12.3 Downlink receiver-side beam adjustment.

Downlink receiver-side beam adjustment can be based on similar report configurations as for transmitter-side beam adjustment. However, as the receiver-side beam adjustment is done internally within the device, there is no report quantity associated with receiver-side beam adjustment. According to Section 8.2, the report quantity should thus be set to "None."

To allow for analog beamforming at the receiver side, the different reference signals within the resource set should be transmitted in different symbols, allowing for the receiver-side beam to sweep over the set of reference signals. At the same time, the device should be allowed to assume that the different reference signals in the resource set are transmitted using the same spatial filter, in practice the same transmit beam. In general, a configured resource set includes a "*repetition*" flag that indicates whether or not a device can assume that all reference signals within the resource set are transmitted using the same spatial filter. For a resource set to be used for downlink receiver-side beam adjustment, the repetition flag should thus be set.

| Claim 10 | Exemplary Evidence of Infringement |
|---|---|
| | *See* Erik Dahlman et al., 5G NR: The Next Generation Wireless Access Technology, Section 12.2.2 (2d Ed. 2018).<br><br>Procedure P-3 is used to select the best beam at the UE. The Base Station transmits repetitions of the CSI Reference Signal using the beam selected during P-2. This provides the UE with sufficient time to switch between its own beam positions and identify the best beam for pairing with the already selected Base Station beam. Figure 190 indicates that the UE has been configured with 4 CSI Reference Signal Resources belonging to Resource Set 2. The repetition flag has been set to 'ON' so the Base Station applies the same beamforming to each CSI Reference Signal. In this case, the Resource Set is linked to a *reportQuantity* set to 'none' so the UE does not provide the Base Station with any information regarding the selected beam<br><br>  <br><br>**Figure 190 – Use of the 'Repetition' flag during Beam Management procedures**<br><br>*See* Chris Johnson, 5G New Radio in Bullets, Section 3.7.4.1 (2019).<br><br>For example, the selected beam is the settable link characteristic on the receive side. |

**Claim 11**

| Claim 11 | Exemplary Evidence of Infringement |
|---|---|
| The wireless communications device according to claim 9 wherein the at least one settable link characteristic comprises at least one transmit processing characteristic; and | The Accused Products according to Claim 9 are configured to set a settable link characteristic comprising at least one transmit processing characteristic.<br><br>For example, the transmit processing characteristic is one of wideband CQI, subband CQI, wideband PMI, subband PMI or RI. *See* Claim [9c.4.] |
| wherein said controller is configured to cooperate with the other wireless communications device to set the at least one transmit processing characteristic. | The controller on the Accused Products is configured to cooperate with the other wireless communications device to set the at least one transmit processing characteristic.<br><br>For example, the controller on the Accused Products is configured to transmit a CSI report to the serving base station, the CSI report containing at least one or more of wideband CQI, subband CQI, wideband PMI, subband PMI and RI. The serving base station uses this information to set the MCS and to configure the MIMO transmission scheme. |

| Claim 11 | Exemplary Evidence of Infringement |
|---|---|
| | 13.6 CHANNEL STATE REPORTING<br><br>★ The UE reports Channel State Information (CSI) to the Base Station using either the PUSCH or the PUCCH. The Base Station uses the CSI to support its downlink transmissions on the PDSCH and PDCCH<br><br>★ Channel State Information (CSI) includes:<br>○ Channel Quality Indicator (CQI)<br>○ Rank Indicator (RI)<br>○ Precoding Matrix Indicator (PMI)<br>○ SS/PBCH Block Resource Indicator (SSBRI)<br>○ CSI-RS Resource Indicator (CRI)<br>○ Layer Indicator (LI)<br>○ L1-RSRP<br><br>★ The Base Station can use this information within its Packet Scheduler and Link Adaptation algorithms, i.e. when the Base Station is selecting UE to receive resource allocations, and when the Base Station is identifying the Modulation and Coding Schemes (MCS) for each PDSCH transmission. In the case of the PDCCH, the Channel State Information can be used when selecting an appropriate Control Channel Element (CCE) aggregation level, i.e. UE in poor coverage are allocated higher aggregation levels<br><br>★ Channel State Information is used for open loop and closed loop MIMO transmission schemes. Open loop schemes rely upon the UE reporting CQI and RI, whereas closed loop schemes rely upon the UE reporting CQI, RI and PMI, i.e. closed loop schemes allow the UE to recommend a precoding matrix for downlink transmission. The value of this recommendation depends upon the rate at which the radio environment is changing. Open loop schemes can be more appropriate for rapidly changing radio environments because recommended precoding matrices become invalid before being used. It is also possible to use semi-open loop MIMO which is based upon having partial precoding matrix feedback from the UE, i.e. the UE provides coarse precoding information which is less likely to be changing rapidly over time<br><br>*See* Chris Johnson, 5G New Radio in Bullets, Section 13.6 (2019). |

65

**Claim 12**

| Claim 12 | Exemplary Evidence of Infringement |
|---|---|
| [12pre] A method for compensating interference in a wireless communication | To the extent the preamble is limiting, each Accused Product performs a method for compensating interference in a wireless communication system comprising first and second orthogonal frequency-division multiplexing (OFDM) wireless communications devices communicating with one another |

| Claim 12 | Exemplary Evidence of Infringement |
|---|---|
| system comprising first and second orthogonal frequency-division multiplexing (OFDM) wireless communications devices communicating with one another via a wireless communications link having at least one settable link characteristic, the method comprising: | via a wireless communications link having at least one settable link characteristic.<br><br>*See*, Claim [9pre] and Claim [9a]. |
| [12a] detecting received interference; | *See*, Claim [9c.1] |
| [12b] storing short term and long term historical characteristics of interference; | *See*, Claim [9b] |
| [12c.1] **determining 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 | *See*, Claim [9c.2] |

| Claim 12 | Exemplary Evidence of Infringement |
|---|---|
| the short term and long term historical characteristics of interference; and | |
| [12c.2] determining 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; and** | *See*, Claim [9c.3] |
| [12d] setting the at least one settable link characteristic to compensate for the received interference based upon the interference type. | *See*, Claim [9c.4] |

**Claim 13**

| Claim 13 | Exemplary Evidence of Infringement |
|---|---|
| [13] The method according to claim 12 further comprising repeating the detecting, determining, and | *See*, Claim 2. |

| Claim 13 | Exemplary Evidence of Infringement |
|---|---|
| setting. | |

**Claim 14**

| Claim 14 | Exemplary Evidence of Infringement |
|---|---|
| [14] The method according to claim 12 wherein the at least one settable link characteristic comprises at least one transmit processing characteristic; and further comprising cooperating between the first and second wireless communications devices to set the at least one transmit processing characteristic. | *See*, Claim 11. |