

**Exhibit B - U.S. Patent No. 8,554,196 (“196 Patent”)**

Accused Instrumentalities: cellular base stations that support providing network coverage using different types of beams and networks, *e.g.* 4G LTE and 5G NR wireless networks, and all versions and variations thereof since the issuance of the asserted patent.

Based upon publicly available information and without the benefit of discovery in this case, the accused products include, but are not limited to the following Samsung products: 4G base stations (including but not limited to Base Band Unit and Remote Radio Head components), 5G base stations (including but not limited to Base Band Unit and Remote Radio Head components), 4T4R CBRS Radio, 32T32R Radio, 64T64R Radio, C-Band Radio, CDU50, One Antenna Radio, Link Hub, and Link HubPro.

**Claim 1:**

| Claim 1                                                                                      | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| [1pre] A method for providing network coverage for a group of devices in an area comprising: | <p>To the extent the preamble is construed to be a limitation, each Accused Instrumentality practices the claimed method.</p> <p>For example, each Accused Instrumentality practices the claimed method by providing simultaneous 5G and LTE coverage for a group of devices (gNB/eNB).</p> <p><i>See, e.g.:</i></p> <p style="text-align: center;"><b>Universal Support for 5G Commercial Strategies</b></p> <p style="text-align: center;"><u>Expanding network coverage will be one of the key concerns for operators with the advent of 5G.</u></p> <p style="text-align: center;">Samsung’s complete radio portfolio can facilitate a fast and smooth 5G deployment.</p> <p style="text-align: center;">Samsung’s radio solutions provide a wide range of products that support various frequencies, output powers and antenna configurations.</p> <p style="text-align: center;"><b>Future-proof Solutions with Simultaneous LTE-5G Operations</b></p> <p style="text-align: center;"><u>Samsung’s solution enables a gradual and smooth migration to 5G through software feature upgrades in frequencies that are currently being used for LTE while keeping the existing hardware.</u> For example, the 8T8R radio can operate in a split mode, to be used to support a 4T4R LTE cell and a 4T4R 5G cell simultaneously. The dual band radio, which supports two carriers in one unit, can also support flexible LTE/5G simultaneous operation with one carrier supporting LTE and the other 5G. Dynamic Spectrum Sharing(DSS) will give more room for operators to adjust between LTE and 5G by operating the two technologies in the same frequency and dynamically switching between the two technologies depending on traffic.</p> <p style="text-align: center;"><a href="https://www.samsung.com/global/business/networks/products/radio-access/radio/">https://www.samsung.com/global/business/networks/products/radio-access/radio/</a></p> |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|         | <p>Mobile network operators (MNOs) continue to find ways to provide better services for their subscribers. Some of the techniques focus on increasing data capacity, while other solutions improve coverage. And with these enhanced services, subscribers' performance expectations continue to rise, too. One of the keys to this success is M-MIMO.</p> <p>M-MIMO is one of the techniques that achieve both increased data capacity and better coverage. By increasing the number of data paths to the end-user, the cell site sends more data to the user at the same time, resulting in faster connections. By adding more data paths, massive MIMO and beamforming, which is an intelligent antenna technology that focuses radio signal or transmission energy in the direction of the mobile user, taking these improvements up</p> <p>...</p> <p><b>Samsung Massive MIMO Unit (MMU):</b> The key product in the solution is the Samsung Massive MIMO Unit (MMU), which is operating in the 2.5 GHz and CBRS (3.5 GHz) spectrum bands. This product also supports the following RAN technologies:</p> <ul style="list-style-type: none"> <li>• 4G LTE</li> <li>• 5G NR</li> <li>• Co-deploy 4G LTE and 5G NR.</li> </ul> <p>A key differentiator of Samsung's MMU is its ability to support LTE and 5G NR simultaneously. The "split mode" configuration allocates 32 of the 64 transmit-receiver pairs to each of the RAN technologies. This unique capability reduces the CAPEX spend by MNOs for co-deployment of LTE and 5G in those sites, as the existing equipment supports both technologies in the existing footprint.</p> <p>...</p> |

| Claim 1                                                                                                                                                                  | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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|                                                                                                                                                                          | <p><b>MIMO and MU-MIMO:</b> In addition to supports 2x2 and 4x4 single-user MIMO, the MMU supports multi-user MIMO with by allowing up to 16 layers, or independent streams, of downlink transmission for up to 16 users. For 2.5 GHz deployments, the MMU supports up to 2 layers for uplink MU-MIMO transmissions for multi-user MIMO, while the CBRS solution in the 3.5 GHz spectrum allows up to 8 layers for uplink transmissions.</p> <p>Samsung Delivers the Promises of Massive MIMO, <i>available at</i> <a href="https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf">https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf</a></p> |
| <p>[1a] cycling over time through a coverage sequence that includes providing a first coverage configuration and providing a second coverage configuration, wherein:</p> | <p>Each Accused Instrumentality practices cycling over time through a coverage sequence that includes providing a first coverage configuration and providing a second coverage configuration.</p> <p>For example, each Accused Instrumentality has beamforming capabilities to provide different coverage configurations as described below. LTE and 5G provide at least a first and a second coverage areas for broadcast channel PBCH and control channel PDCCH, and for PDSCH channels. The SU-MIMO and MU-MIMO also comprise different coverage areas.</p> <p><i>See, e.g.:</i></p>                                                                                                                                                                                                                                                                                                                                            |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|         | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- <a href="#">Physical Downlink Shared Channel, PDSCH</a></li> <li>- <a href="#">Physical Broadcast Channel, PBCH</a></li> <li>- <a href="#">Physical Downlink Control Channel, PDCCH</a>.</li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- Antenna ports starting with 2000 for PDCCH</li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- Antenna ports starting with 4000 for SS/PBCH block transmission</li> </ul> <p>The UE shall not assume that two antenna ports are quasi co-located with respect to any QCL type unless specified otherwise.</p> <p>TS 38.211 V15.8.0</p> |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|         | <p><b><u>Multiuser MIMO</u></b></p> <p>Main difference in <u>MU-MIMO</u> and <u>SU-MIMO</u> is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p>MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</p> <p><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p><br><p><b>7.3.1.3 Layer mapping</b></p> <p>The UE shall assume that complex-valued modulation symbols for each of the codewords to be transmitted are mapped onto one or several layers according to Table 7.3.1.3-1. Complex-valued modulation symbols <math>d^{(q)}(0), \dots, d^{(q)}(M_{\text{symb}}^{(q)} - 1)</math> for codeword <math>q</math> shall be mapped onto the layers <math>x(i) = [x^{(0)}(i) \dots x^{(v-1)}(i)]^T, i = 0, 1, \dots, M_{\text{symb}}^{\text{layer}} - 1</math> where <math>v</math> is the number of layers and <math>M_{\text{symb}}^{\text{layer}}</math> is the number of modulation symbols per layer.</p> |

Table 7.3.1.3-1: Codeword-to-layer mapping for spatial multiplexing.

| Number of layers | Number of codewords | Codeword-to-layer mapping<br>$i = 0, 1, \dots, M_{\text{symlb}}^{\text{layer}} - 1$                                                                                                                                                                                                                                                                     |
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| 1                | 1                   | $x^{(0)}(i) = d^{(0)}(i)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)}$                                                                                                                                                                                                                                                                 |
| 2                | 1                   | $x^{(0)}(i) = d^{(0)}(2i)$<br>$x^{(1)}(i) = d^{(0)}(2i+1)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)} / 2$                                                                                                                                                                                                                            |
| 3                | 1                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)} / 3$                                                                                                                                                                                            |
| 4                | 1                   | $x^{(0)}(i) = d^{(0)}(4i)$<br>$x^{(1)}(i) = d^{(0)}(4i+1)$<br>$x^{(2)}(i) = d^{(0)}(4i+2)$<br>$x^{(3)}(i) = d^{(0)}(4i+3)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)} / 4$                                                                                                                                                            |
| 5                | 2                   | $x^{(0)}(i) = d^{(0)}(2i)$<br>$x^{(1)}(i) = d^{(0)}(2i+1)$<br>$x^{(2)}(i) = d^{(1)}(3i)$<br>$x^{(3)}(i) = d^{(1)}(3i+1)$<br>$x^{(4)}(i) = d^{(1)}(3i+2)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)} / 2 = M_{\text{symlb}}^{(1)} / 3$                                                                                                 |
| 6                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$<br>$x^{(3)}(i) = d^{(1)}(3i)$<br>$x^{(4)}(i) = d^{(1)}(3i+1)$<br>$x^{(5)}(i) = d^{(1)}(3i+2)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)} / 3 = M_{\text{symlb}}^{(1)} / 3$                                                                 |
| 7                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$<br>$x^{(3)}(i) = d^{(1)}(4i)$<br>$x^{(4)}(i) = d^{(1)}(4i+1)$<br>$x^{(5)}(i) = d^{(1)}(4i+2)$<br>$x^{(6)}(i) = d^{(1)}(4i+3)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)} / 3 = M_{\text{symlb}}^{(1)} / 4$                                 |
| 8                | 2                   | $x^{(0)}(i) = d^{(0)}(4i)$<br>$x^{(1)}(i) = d^{(0)}(4i+1)$<br>$x^{(2)}(i) = d^{(0)}(4i+2)$<br>$x^{(3)}(i) = d^{(0)}(4i+3)$<br>$x^{(4)}(i) = d^{(1)}(4i)$<br>$x^{(5)}(i) = d^{(1)}(4i+1)$<br>$x^{(6)}(i) = d^{(1)}(4i+2)$<br>$x^{(7)}(i) = d^{(1)}(4i+3)$<br>$M_{\text{symlb}}^{\text{layer}} = M_{\text{symlb}}^{(0)} / 4 = M_{\text{symlb}}^{(1)} / 4$ |

TS 38.211 V15.8.0

See also elements [1b]-[1c] below

| Claim 1                                                                                                                                                                           | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <p>[1b] providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for the group of devices; and</p> | <p>Each Accused Instrumentality practices providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for the group of devices.</p> <p>For example, each Accused Instrumentality provides wide-beam channels configured to provide coverage for the group of devices, as shown below. On beam type if used to provide coverage to broadcast channels and another beam type is used to provide coverage to traffic channels, SU-MIMO and MU-MIMO transmission modes.</p> <p><i>See, e.g.:</i></p> |

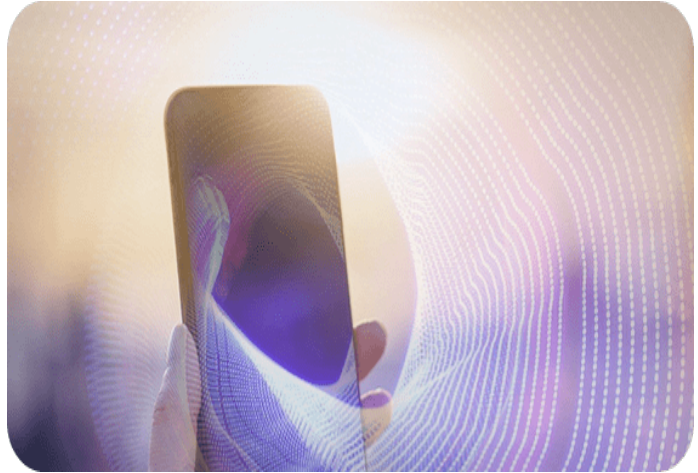
| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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|         | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- Physical Downlink Shared Channel, PDSCH</li> <li>- <u>Physical Broadcast Channel, PBCH</u></li> <li>- <u>Physical Downlink Control Channel, PDCCH.</u></li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- <u>Antenna ports starting with 2000 for PDCCH</u></li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- <u>Antenna ports starting with 4000 for SS/PBCH block transmission</u></li> </ul> <p><u>The UE shall not assume that two antenna ports are quasi co-located with respect to any QCL type unless specified otherwise.</u></p> <p>TS 38.211 V15.8.0</p> |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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|         | <p><i><b>Introduction</b></i></p> <p>NR connected to 5GC provides support for <i>Public Warning Systems</i> (PWS) by means of system information broadcasting.</p> <p>NR is responsible for scheduling and broadcasting of the warning messages.</p> <p>NR is also responsible for paging the UE to provide indication that the warning message is being broadcasted.</p> <p>...</p> <p><i><b>Commercial Mobile Alert System</b></i> (CMAS) is a public warning system developed for the delivery of multiple, concurrent warning notifications. These messages include CMAS Presidential Level Alerts, CMAS Child Abduction Emergency (e.g. AMBER), Imminent Threat, Public Safety etc...</p> <p>Paging is used to inform UEs about ETWS and CMAS indications. UE monitors ETWS/CMAS indications in its own paging occasion for RRC_IDLE and RRC_INACTIVE and in any paging occasion for RRC_CONNECTED.</p> <p>Paging indicating ETWS/CMAS notification triggers acquisition of system information (without delaying until the next modification period).</p> <p><a href="http://howltestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html">http://howltestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html</a></p> |

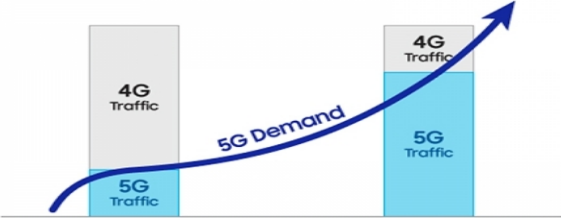
| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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|         | <p>For paging CORESET configuration, we reuse the same configuration as for SIB1 CORESET indicated in PBCH.</p> <p><b>6.4.1 Paging Mechanism</b></p> <p>Paging scheduling DCI and paging Message may be sent in the same slot. NR supports <u>paging mechanism sending short messages, e.g., systemInfoModification, etwsAndCmas-Indication.</u> Short messages can be transmitted on PDCCH using P-RNTI with or without associated paging message using short message field (8-bits) in DCI format 1_0.</p> <p>In Release 15, 2-bits are designated for indicating</p> <ul style="list-style-type: none"> <li>• <a href="#">Fundamentals of 5G Communications: Connectivity for Enhanced Mobile and Beyond (5G Book)</a> (Page 143)</li> </ul> <p>systemInfoModification, i.e., indication of a BCCH modification other than SIB6, SIB7, and SIB8, and etwsAndCmasIndication, i.e., indication of an earthquake and tsunami warning system (ETWS) primary notification and/or an ETWS secondary notification and/or a commercial mobile alert system (CMAS) notification.</p> <p><b>6.4.2 Other Paging Characteristics</b></p> <p><u><b>QCL Assumptions</b> The UE may assume QCL between SSBs, Paging DCIs and Paging Messages. UEs are not</u></p> |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|         | <p><b>5G Beams Types: <u>Broadcast</u> &amp; Traffic Beams – <u>SSB</u>, CSI-RS, PMI &amp; SRS</b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p><u>The Broadcast beams are mainly the common channel beams that are used to transmit SSB.</u> The same beams are also used for other broadcast channels like CSI resources. Then we have traffic beams which are mostly based on PMI or SRS. If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– <u>SSB Beams are Broadcast Type beams and cover larger areas</u></li> <li>– PMI based Beams are more focused and narrower. They are Traffic Type Beams.</li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

| Claim 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| <p>[1c] providing the second coverage configuration includes transmitting a second beam of the first network that is narrower than the first beam and configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network and providing coverage by a second network to a plurality of interval use devices of the group of devices.</p> | <p>Each Accused Instrumentality practices providing the second coverage configuration includes transmitting a second beam of the first network that is narrower than the first beam and configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network, and providing coverage by a second network to a plurality of interval use devices of the group of devices.</p> <p>For example, each Accused Instrumentality provides narrow beams focusing energy on each client device to provide high data rates and provides coverage to lower data rate requirement devices using a second network, <i>e.g.</i> a 5G network.</p> <p><i>See, e.g.:</i></p> <p><b>5G Beams Types: Broadcast &amp; <u>Traffic Beams</u> – SSB, CSI-RS, <u>PMI &amp; SRS</u></b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p>The Broadcast beams are mainly the common channel beams that are used to transmit SSB. The same beams are also used for other broadcast channels like CSI resources. <u>Then we have traffic beams which are mostly based on PMI or SRS.</u> If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– SSB Beams are Broadcast Type beams and cover larger areas</li> <li>– <u>PMI based Beams are more focused and narrower.</u> <u>They are Traffic Type Beams.</u></li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|         | <p>For consumers, some of the most exciting prospects of 5G's widespread adoption are the Enhanced Mobile Broadband (eMBB) services that are coming with it. 5G's high bandwidth and <u>exceptional speeds are supercharging services like high-definition (HD) video streaming, virtual reality (VR) and augmented reality (AR) and enabling mobile device users to stay connected like never before.</u> Whereas with 4G, at a speed of 500Mbps (Megabits per second), a 15GB HD movie file would take roughly four minutes to download, with 20Gbps 5G, it would take just six seconds. eMBB will also enable high-traffic venues like airports and stadiums to support seamless HD streaming services and allow users to enjoy data speeds of at least 100Mbps in areas where cellular signals are weak.</p> <p>5G: New era of connectivity, <a href="https://semiconductor.samsung.com/insights/topic/5g/">https://semiconductor.samsung.com/insights/topic/5g/</a></p> <p style="text-align: center;"><b>Different Modems for Different Needs</b></p> <p><i>Samsung has developed two types of modems for 5G base stations.</i> The first modem helps a smooth LTE migration and introduction of 5G NR. It supports both <u>4G</u> and <u>5G</u> to enable backward compatibility with previous LTE products while supporting the latest Massive MIMO and 5G standards. The new modem is placed in expandable channel cards and has been developed to be deployed in environments with high-capacity requirements. The second modem has been developed based on years of research experience in the mmWave spectrum. The modem supports high performance but runs on low power and is optimal for compact mmWave base stations.</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/technology/">https://www.samsung.com/global/business/networks/solutions/technology/</a></p>  |

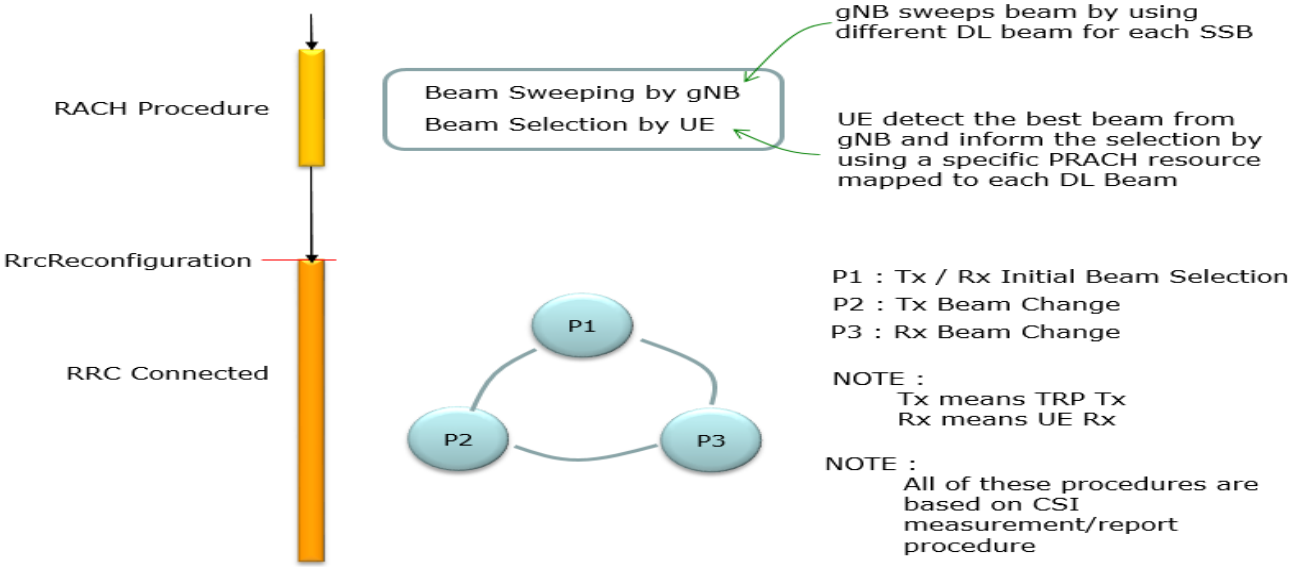
| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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|         | <p><b>Montreal, Canada - December 13, 2019</b> - Samsung Electronics today announced that it will provide 4G LTE-Advanced (LTE-A) and 5G radio access networks solutions to Videotron, a Canadian telecommunications operator. This is the first time Samsung is delivering network solutions in Canada.</p> <p>After many successful decades in the cable television and internet access business, Videotron deployed its wireless operation in 2010 and has been the fastest growing new operator since then. Currently providing 4G LTE service, Videotron plans to launch commercial LTE-A and 5G services in late 2020.</p> <p><u>Starting in early 2020, Samsung will deliver 4G LTE-A solutions across Quebec and Ottawa in which the solutions from Samsung include Massive MIMO and Dual-band base stations, supporting the operator's 4G LTE frequencies, and 5G solutions for both 3.5GHz and 28GHz spectrum.</u></p> <p>Providing commercially proven <u>4G LTE-A solutions</u> and combined with <u>5G commercial solutions</u> from global markets, Samsung will increase efficiency in accelerating expansion of 5G service coverage to match pace with Canada's 5G commercial launch, which is expected to take place in late 2020.</p> <p>"We have been all over the world to find the best supplier suited to meet the evolving needs of our customers. This partnership will allow us to deliver the most advanced telecommunications solutions to Quebecers. While 4G technology has profoundly transformed telecommunications in the world, LTE Advanced and 5G will undoubtedly revolutionize the way we interact with our loved ones and the environment around us," said Jean François Pruneau, President and Chief Executive Officer of Videotron. "We want to be with our customers through these major changes and the choice of Samsung as a supplier is not a coincidence, we are convinced that they represent the best option to achieve this objective.</p> <p><a href="https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/">https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/</a></p> |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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|         | <p data-bbox="680 313 1606 354">Samsung supplies DDS tech for Verizon's 5G network</p>  <p data-bbox="651 641 1829 1078"> Samsung Electronics on Tuesday said it has supplied its dynamic spectrum sharing (DSS) technology to Verizon's network. DSS allows for <u>4G base stations</u> to process <u>5G signals</u>. It allows carriers to use spectrum they used in 4G for 5G. Verizon launched its 5G nationwide service that uses DSS technology in October last year. The carrier timed it with Apple's launch of iPhone 12, which supports 5G. Ericsson and Nokia had supplied their DSS technology then. Verizon's 5G network at the time covered 200 million people, according to the company. Last month, Verizon said it has expanded its coverage by 24 million people. Samsung's DSS supply comes two months later than its European rivals. The South Korean tech company's equipment covers around 10% of Verizon's 5G coverage to 230 million people. Samsung's kits are being used in central Texas, Tulsa, Oklahoma, upstate New York and New England. Samsung Network used vRAN 2.0 to supply the DSS technology. vRAN 2.0 uses both virtualized distributed unit and core unit. Samsung has supplied virtualized core unit to Japan's KDDI before (called vRAN 1.0) but its supply to Verizon is the first time it is offering virtualized distributed unit as well. Samsung is expected to take away shares from Nokia within Verizon's supply chain this year. Last year, it signed a US\$6.64 billion deal with the carrier to supply 4G and 5G equipment. </p> <p data-bbox="651 1118 1409 1149">출처 : THE ELEC, Korea Electronics Industry Media(<a href="http://thelec.net">http://thelec.net</a>)</p> <p data-bbox="634 1187 1390 1218"><a href="https://www.thelec.net/news/articleView.html?idxno=2254">https://www.thelec.net/news/articleView.html?idxno=2254</a></p> |

| Claim 1 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|         | <p style="text-align: center;"><b>One Spectrum, Two Technologies</b></p> <p>Samsung's Dynamic Spectrum Sharing (DSS) offers a unique solution for an easy, uninterrupted transition to 5G. This advanced technology can be leveraged to deploy 5G networks in LTE spectrum bands, minimizing the impact on existing services. With DSS, mobile network operators can reuse their existing LTE hardware and infrastructure and enable 5G with software upgrade. However, spectrum resource limitation may be caused as two different systems need to share finite resources and overhead from LTE and NR signal transmission impacts overall capacity of the network. Samsung's DSS solution dynamically assigns resources to LTE and 5G based on the traffic demands for each technology, allowing optimal resource utilization.</p> <p><b>Facilitating a Smooth Shift to 5G</b></p> <p>Today, low spectrum bands are largely dominated by LTE. Therefore, operators who deploy 5G in low spectrum bands want a way for smooth migration minimizing the impact on LTE networks. One way to solve this is with LTE-NR dynamic spectrum sharing. By utilizing this feature, service providers can deploy LTE and NR in the same bands. Within one carrier network, LTE users access the network using LTE cells while 5G users are connected using 5G cells. Samsung's DSS supports a variety of deployment options, increasing flexibility for operators. Our solution can run on both virtualized and physical RAN platforms. Customers can choose to rollout new hardware, but they can also reuse legacy. Samsung's DSS solution can also co-exist with 2G, 3G and LTE vertical services such as eMTC and NB-IoT, enabling a 5G launch without negatively impacting legacy systems</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/">https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/</a></p> |

**Claim 2:**

| Claim 2                                                                                                                                                                                                                                         | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <p>[2] The method of claim 1, wherein the providing the second coverage configuration comprises determining a direction of transmission for the second beam based at least in part on a location of the at least one continuous use device.</p> | <p>The Accused Instrumentalities practice a method wherein the providing the second coverage configuration comprises determining a direction of transmission for the second beam based at least in part on a location of the at least one continuous use device.</p> <p>For example, 5G does beam sweeping, using narrow beams, to direct beams in different directions toward different locations in the coverage area. A UE will choose a beam with high signal strength which is in part related to the location of the UE relative to the gNB.</p> <p><b>NR Beam Management in a Nutshell</b></p> <p>If you ask me to explain about NR Beam Management in a few seconds, I would summarize the whole process in an illustration as shown below. As you see here, Beam Management plays important role in two periods - During RACH procedure and After the call connection.</p> |

| Claim 2 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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|         |  <p><b>RACH Procedure</b></p> <p><b>RrcReconfiguration</b></p> <p><b>RRC Connected</b></p> <p>Beam Sweeping by gNB<br/>Beam Selection by UE</p> <p>gNB sweeps beam by using different DL beam for each SSB</p> <p>UE detect the best beam from gNB and inform the selection by using a specific PRACH resource mapped to each DL Beam</p> <p>P1 : Tx / Rx Initial Beam Selection<br/>P2 : Tx Beam Change<br/>P3 : Rx Beam Change</p> <p>NOTE :<br/>Tx means TRP Tx<br/>Rx means UE Rx</p> <p>NOTE :<br/>All of these procedures are based on CSI measurement/report procedure</p> <p><b>Where to point my beam ?</b></p> <p>We can think of this question in terms of two different cases : transmitting case and receiving case.</p> <p><b>When transmitting,</b></p> <p>Now let's think of which direction a gNB or UE has to point its beam when they try to transmit the signal ?</p> <p>The answer is simple. They (gNB or UE) has to transmit the signal in the direction that can reach the receiver with the best signal quality'.</p> <p>Then you would have another question. How can they(gNB or UE) figure out which direction is the one that can reach the receiver with the best signal quality ?</p> |

| Claim 2 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|         | <p>Now the answer would be a little bit trickier, but the big picture is as follows.</p> <ul style="list-style-type: none"> <li>• When gNB is transmitting, gNB figure out this direction by evaluating the quality of a specific reference signal of multiple beam from UE. gNB evaluate the quality of the reference signal from each of the multiple beam and chose the best one. The reference signal from UE is called SRS.</li> <li>• When UE is transmitting, UE figure out this direction by evaluating the quality of a specific reference signal of multiple beam from gNB. UE evaluate the quality of the reference signal from each of the multiple beam and chose the best one. The reference signal from gNB in this case can vary depending on situation. Sometimes it can be SSB and sometimes it can be CSI-RS. (NOTE : CSI-RS play many different roles in addition to beam management and very complex topic. Refer to <a href="#">CSI-RS signal generation</a> and <a href="#">CSI report page</a> for further details).</li> </ul> <p>NOTE : This kind of estimation of reference signal quality should be done sometime before they transmit signal.</p> <p>3GPP TR 38.802 (V14.2.0)-6.1.6.1 describes on this situation as follows :</p> <ul style="list-style-type: none"> <li>• TRP is able to determine a TRP Tx beam for the downlink transmission based on TRP's uplink measurement on TRP's one or more Rx beams</li> <li>• UE is able to determine a UE Tx beam for the uplink transmission based on UE's downlink measurement on UE's one or more Rx beams</li> </ul> <p>NOTE : TRP is a transmission point of a gNB.</p> <p><b>When receiving,</b></p> <p>Now let's think of which direction a gNB or UE has to point its beam when they try to receive signal ? (In this case, the word 'beam' may be a little misleading because the receiver does not form any real beam. So it would be better to change the phrase 'to point its beam' to 'to tune its receiver to a certain direction').</p> <p>The answer is simple. They (gNB or UE) has to tune their receiver in the direction in which they can receive the signal from the transmitter with best quality.</p> <p>Then you would have another question. How can they(gNB or UE) figure out which direction is the one in which they can receive the signal from the transmitter with best quality ?</p> <p>Overall logic is as follows :</p> |

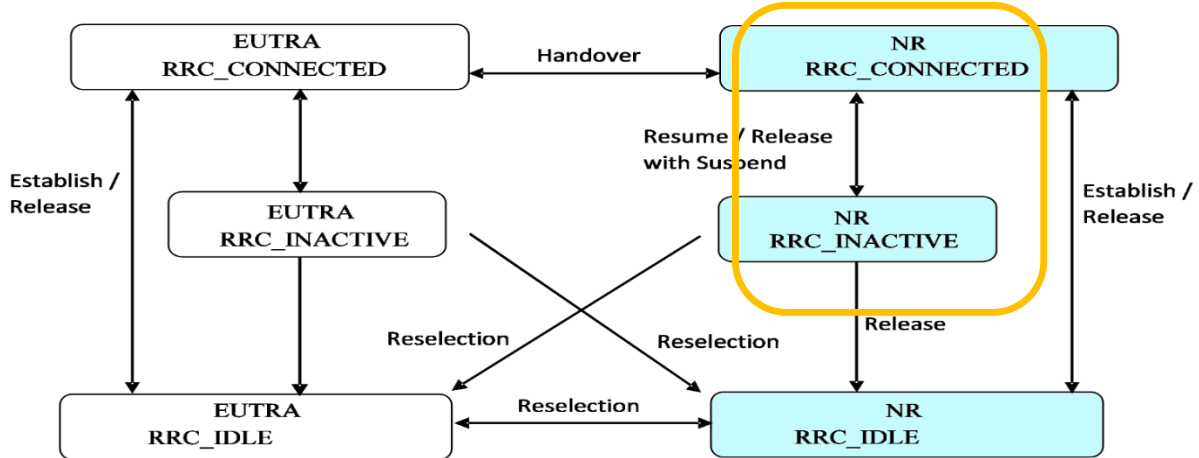
| Claim 2 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | <ul style="list-style-type: none"> <li>• When gNB receiving signal from UE, (before doing this) gNB is supposed to get the information of the <u>best direction from UE</u> in the form of CSI report.</li> <li>• When UE receiving signal from gNB, (before doing this) UE is supposed to get the information of <u>the best direction</u> from gNB (gNB has detected the best direction based on the measurement of SRS signal quality of multiple beams from UE and indicates the UE of the best direction).</li> </ul> <p><a href="https://www.sharetechnote.com/html/5G/5G_Phy_BeamManagement.html">https://www.sharetechnote.com/html/5G/5G_Phy_BeamManagement.html</a></p> |

**Claim 3:**

| Claim 3                                                                                                                                                                             | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| <p>[3] The method of claim 1, wherein the second beam of the first network is further configured to provide coverage to a second continuous use device of the group of devices.</p> | <p>The Accused Instrumentalities practice a method wherein the second beam of the first network is further configured to provide coverage to a second continuous use device of the group of devices.</p> <p>For example, in MU-MIMO the gNB can support as many as 16 devices in the second coverage area, by configuring the second beam to provide coverage to a second device.</p> <p><b><u>Multiuser MIMO</u></b></p> <p>Main difference in <u>MU-MIMO</u> and <u>SU-MIMO</u> is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p>MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</p> <p><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p> |

**Claim 4:**

| Claim 4                                                                                                                                                                                                                                                                                                                                           | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| <p>[4] The method of claim 1, wherein a subsequent iteration of providing the second coverage configuration includes transmitting the second beam of the first network configured to provide coverage to a second continuous use device, and wherein the at least one continuous use device has transitioned to being an interval use device.</p> | <p>The Accused Instrumentalities practice a method wherein a subsequent iteration of providing the second coverage configuration includes transmitting the second beam of the first network configured to provide coverage to a second continuous use device, and wherein the at least one continuous use device has transitioned to being an interval use device.</p> <p>For example, in MU-MIMO the gNB can support as many as 16 devices in the second coverage area, by configuring the second beam to provide coverage to a second device. In 5G devices transition from transmitting data active mode to inactive or idle modes.</p> <p><b><u>Multiuser MIMO</u></b></p> <p>Main difference in <u>MU-MIMO</u> and <u>SU-MIMO</u> is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p>MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</p> <p><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p> |

| Claim 4 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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|         |  <p>Radio Resource Control (RRC) is a layer within the 5G NR protocol stack. It exists only in the control plane, in the UE and in the gNB. The behaviour and functions of RRC are governed by the current state of RRC. In 5G NR, RRC has three distinct states: RRC_IDLE, RRC_CONNECTED and RRC_INACTIVE.</p> <p>In both RRC_IDLE and RRC_INACTIVE, UE does measurements of neighboring cells and can do <b>reselection</b>. In RRC_CONNECTED, UE mobility is controlled by the CN and <b>handovers</b> can be initiated. Data transfer, CA, DC and measurement reporting are supported.</p> <p>In RRC_IDLE, <b>UE paging</b> is initiated by the CN. In RRC_INACTIVE, UE paging is initiated by NG-RAN. To page a UE, it's location must be known. In RRC_IDLE, this is the Tracking Area (RA). In RRC_INACTIVE, this is the RAN-based Notification Area (RNA) and UE may initiate RNA updates.</p> <p><a href="https://devopedia.org/5g-ue-rrc-states">https://devopedia.org/5g-ue-rrc-states</a></p> |

**Claim 5:**

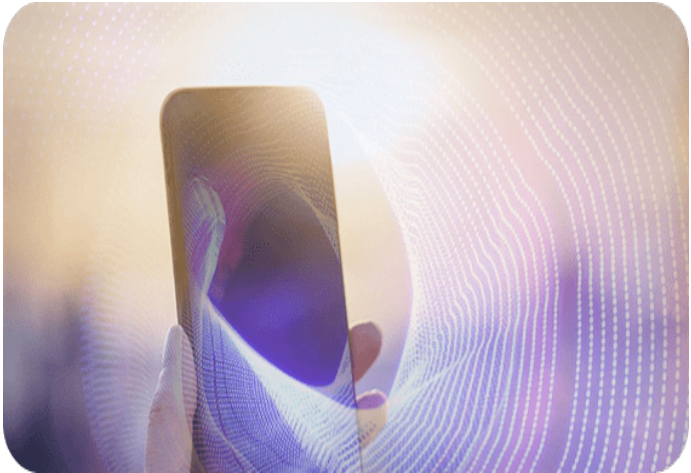
| Claim 5                                                                                                         | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <p>[5] The method of claim 1, wherein the first network and the second network are different network types.</p> | <p>The Accused Instrumentalities practice a method wherein the first network and the second network are different network types.</p> <p>For example, Dynamic Spectrum Sharing (DSS) is used to share the spectrum between LTE and 5G as the technology is transitioned from 4G to 5G.</p> <p style="text-align: center;"><b>One Spectrum, Two Technologies</b></p> <p>Samsung's Dynamic Spectrum Sharing (DSS) offers a unique solution for an easy, uninterrupted transition to 5G. This advanced technology can be leveraged to deploy 5G networks in LTE spectrum bands, minimizing the impact on existing services. With DSS, mobile network operators can reuse their existing LTE hardware and infrastructure and enable 5G with software upgrade. However, spectrum resource limitation may be caused as two different systems need to share finite resources and overhead from LTE and NR signal transmission impacts overall capacity of the network. Samsung's DSS solution dynamically assigns resources to LTE and 5G based on the traffic demands for each technology, allowing optimal resource utilization.</p> <p><b>Facilitating a Smooth Shift to 5G</b></p> <p>Today, low spectrum bands are largely dominated by LTE. Therefore, operators who deploy <u>5G</u> in low spectrum bands want a way for smooth migration minimizing the impact on LTE networks. One way to solve this is with <u>LTE-NR</u> dynamic spectrum sharing. By utilizing this feature, service providers can deploy LTE and NR in the same bands. Within one carrier network, LTE users access the network using LTE cells while 5G users are connected using 5G cells. Samsung's DSS supports a variety of deployment options, increasing flexibility for operators. Our solution can run on both virtualized and physical RAN platforms. Customers can choose to rollout new hardware, but they can also reuse legacy. Samsung's DSS solution can also co-exist with 2G, 3G and LTE vertical services such as eMTC and NB-IoT, enabling a 5G launch without negatively impacting legacy systems</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/">https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/</a></p> |

**Claim 7:**

| Claim 7                                                                                                                                                                                                                                         | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <p>[7] The method of claim 1, wherein the first network and the second network are the same network types, and wherein the at least one continuous use device is allowed access to the second beam based on an admission control parameter.</p> | <p>The Accused Instrumentalities practice a method wherein the first network and the second network are the same network types, and wherein the at least one continuous use device is allowed access to the second beam based on an admission control parameter.</p> <p>For example, Samsung has 5G solutions for both 3.5 and 28 GHz mmWave bands. The 28 GHz band provides high data rates but has short coverage. The 3.5 GHz band has larger coverage area than the 28 GHz band, and the device would operate on 3.5 GHz band when there is poor coverage on the 28 GHz band. Continuous use devices are assigned resources for data transmission using the PDCCH control channel and the Downlink Control Information (DCI) to schedule resources to the device.</p> <p><b>Montreal, Canada - December 13, 2019</b> - Samsung Electronics today announced that it will provide 4G LTE-Advanced (LTE-A) and 5G radio access networks solutions to Videotron, a Canadian telecommunications operator. This is the first time Samsung is delivering network solutions in Canada.</p> <p>After many successful decades in the cable television and internet access business, Videotron deployed its wireless operation in 2010 and has been the fastest growing new operator since then. Currently providing 4G LTE service, Videotron plans to launch commercial LTE-A and 5G services in late 2020.</p> <p>Starting in early 2020, Samsung will deliver 4G LTE-A solutions across Quebec and Ottawa in which the solutions from Samsung include Massive MIMO and <u>Dual-band base stations</u>, supporting the operator's 4G LTE frequencies, and <u>5G solutions for both 3.5GHz and 28GHz spectrum</u>.</p> <p>Providing commercially proven 4G LTE-A solutions and combined with 5G commercial solutions from global markets, Samsung will increase efficiency in accelerating expansion of 5G service coverage to match pace with Canada's 5G commercial launch, which is expected to take place in late 2020.</p> <p>"We have been all over the world to find the best supplier suited to meet the evolving needs of our customers. This partnership will allow us to deliver the most advanced telecommunications solutions to Quebecers. While 4G technology has profoundly transformed telecommunications in the world, LTE Advanced and 5G will undoubtedly revolutionize the way we interact with our loved ones and the environment around us," said Jean François Pruneau, President and Chief Executive Officer of Videotron. "We want to be with our customers through these major changes and the choice of Samsung as a supplier is not a coincidence, we are convinced that they represent the best option to achieve this objective.</p> <p><a href="https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/">https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/</a></p> |

| Claim 7 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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|         | <p>10.2 Downlink Scheduling</p> <p>In the downlink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible assignments when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.</p> <p>The gNB may pre-empt an ongoing PDSCH transmission to one UE with a latency-critical transmission to another UE. The gNB can configure UEs to monitor interrupted transmission indications using INT-RNTI on a PDCCH. If a UE receives the interrupted transmission indication, the UE may assume that no useful information to that UE was carried by the resource elements included in the indication, even if some of those resource elements were already scheduled to this UE.</p> <p>In addition, with Semi-Persistent Scheduling (SPS), the gNB can allocate downlink resources for the initial HARQ transmissions to UEs: RRC defines the periodicity of the configured downlink assignments while PDCCH addressed to CS-RNTI can either signal and activate the configured downlink assignment, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the downlink assignment can be implicitly reused according to the periodicity defined by RRC, until deactivated.</p> <p>NOTE: When required, retransmissions are explicitly scheduled on PDCCH(s).</p> <p>The dynamically allocated downlink reception overrides the configured downlink assignment in the same serving cell, if they overlap in time. Otherwise a downlink reception according to the configured downlink assignment is assumed, if activated.</p> <p>The UE may be configured with up to 8 active configured downlink assignments for a given BWP of a serving cell. When more than one is configured:</p> <ul style="list-style-type: none"> <li>- The network decides which of these configured downlink assignments are active at a time (including all of them); and</li> <li>- <u>Each configured downlink assignment is activated separately using a DCI command and deactivation of configured downlink assignments is done using a DCI command, which can either deactivate a single configured downlink assignment or multiple configured downlink assignments jointly.</u></li> </ul> <p>TS 38.300 version 16.2.0</p> |

**Claim 10:**

| Claim 10                                                                                                                                                          | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| <p>[10] The method of claim 1, wherein the at least one continuous use device is engaged in at least one of a voice call, a download, or a content streaming.</p> | <p>The Accused Instrumentalities practice a method wherein the at least one continuous use device is engaged in at least one of a voice call, a download, or a content streaming.</p> <p>For example, a continuous use device may receive high speed video streaming in the first (5G) network.</p> <p>For consumers, some of the most exciting prospects of 5G's widespread adoption are the Enhanced Mobile Broadband (eMBB) services that are coming with it. 5G's high bandwidth and exceptional speeds are supercharging services like high-definition (HD) <u>video streaming</u>, virtual reality (VR) and augmented reality (AR) and enabling mobile device users to stay connected like never before. Whereas with 4G, at a speed of 500Mbps (Megabits per second), a 15GB HD movie file would take roughly four minutes to download, with 20Gbps 5G, it would take just six seconds. eMBB will also enable high-traffic venues like airports and stadiums to support seamless HD streaming services and allow users to enjoy data speeds of at least 100Mbps in areas where cellular signals are weak.</p> <p>5G: New era of connectivity, <a href="https://semiconductor.samsung.com/insights/topic/5g/">https://semiconductor.samsung.com/insights/topic/5g/</a></p>  |

**Claim 12:**

| Claim 12                                                                                                                                              | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <p>[12] The method of claim 1, wherein the second beam is narrower than the first beam in at least one of a horizontal plane or a vertical plane.</p> | <p>The Accused Instrumentalities practice a method wherein the second beam is narrower than the first beam in at least one of a horizontal plane or a vertical plane.</p> <p>For example, each Accused Instrumentality uses narrower beams for traffic channel than for broadcast channels. Narrower beams may be narrower in azimuth or elevation or both azimuth and elevation.</p> <p><b>5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS</b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p>The Broadcast beams are mainly the common channel beams that are used to transmit SSB. The same beams are also used for other broadcast channels like CSI resources. <u>Then we have traffic beams which are mostly based on PMI or SRS.</u> If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"><li>– SSB Beams are Broadcast Type beams and cover larger areas</li><li>– <u>PMI based Beams are more focused and narrower. They are Traffic Type Beams.</u></li><li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li></ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

**Claim 14:**

| Claim 14                                                                                      | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| [14pre] A method for providing network coverage for a group of devices in an area comprising: | <p>To the extent the preamble is construed to be a limitation, each Accused Instrumentality practices the claimed method for providing network coverage for a group of devices in an area.</p> <p>For example, each Accused Instrumentality practices the claimed method by providing simultaneous 5G and LTE coverage for a group of devices (gNB/eNB).</p> <p><i>See, e.g.:</i></p> <p><b>Universal Support for 5G Commercial Strategies</b></p> <p><u>Expanding network coverage will be one of the key concerns for operators with the advent of 5G.</u></p> <p>Samsung's complete radio portfolio can facilitate a fast and smooth 5G deployment.</p> <p>Samsung's radio solutions provide a wide range of products that support various frequencies, output powers and antenna configurations.</p> <p><b>Future-proof Solutions with Simultaneous LTE-5G Operations</b></p> <p><u>Samsung's solution enables a gradual and smooth migration to 5G through software feature upgrades in frequencies that are currently being used for LTE while keeping the existing hardware.</u> For example, the 8T8R radio can operate in a split mode, to be used to support a 4T4R LTE cell and a 4T4R 5G cell simultaneously. The dual band radio, which supports two carriers in one unit, can also support flexible LTE/5G simultaneous operation with one carrier supporting LTE and the other 5G. Dynamic Spectrum Sharing(DSS) will give more room for operators to adjust between LTE and 5G by operating the two technologies in the same frequency and dynamically switching between the two technologies depending on traffic.</p> <p><a href="https://www.samsung.com/global/business/networks/products/radio-access/radio/">https://www.samsung.com/global/business/networks/products/radio-access/radio/</a></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p>Mobile network operators (MNOs) continue to find ways to provide better services for their subscribers. Some of the techniques focus on increasing data capacity, while other solutions improve coverage. And with these enhanced services, subscribers' performance expectations continue to rise, too. One of the keys to this success is M-MIMO.</p> <p>M-MIMO is one of the techniques that achieve both increased data capacity and better coverage. By increasing the number of data paths to the end-user, the cell site sends more data to the user at the same time, resulting in faster connections. By adding more data paths, massive MIMO and beamforming, which is an intelligent antenna technology that focuses radio signal or transmission energy in the direction of the mobile user, taking these improvements up</p> <p>...</p> <p><b>Samsung Massive MIMO Unit (MMU):</b> The key product in the solution is the Samsung Massive MIMO Unit (MMU), which is operating in the 2.5 GHz and CBRS (3.5 GHz) spectrum bands. This product also supports the following RAN technologies:</p> <ul style="list-style-type: none"> <li>• 4G LTE</li> <li>• 5G NR</li> <li>• Co-deploy 4G LTE and 5G NR.</li> </ul> <p>A key differentiator of Samsung's MMU is its ability to support LTE and 5G NR simultaneously. The "split mode" configuration allocates 32 of the 64 transmit-receiver pairs to each of the RAN technologies. This unique capability reduces the CAPEX spend by MNOs for co-deployment of LTE and 5G in those sites, as the existing equipment supports both technologies in the existing footprint.</p> <p>...</p> |

| Claim 14                                                                                                                                                                                                             | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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|                                                                                                                                                                                                                      | <p><b>MIMO and MU-MIMO:</b> In addition to supports 2x2 and 4x4 single-user MIMO, the MMU supports multi-user MIMO with by allowing up to 16 layers, or independent streams, of downlink transmission for up to 16 users. For 2.5 GHz deployments, the MMU supports up to 2 layers for uplink MU-MIMO transmissions for multi-user MIMO, while the CBRS solution in the 3.5 GHz spectrum allows up to 8 layers for uplink transmissions.</p> <p>Samsung Delivers the Promises of Massive MIMO, <i>available at</i> <a href="https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf">https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf</a></p>                                                                                                                                                                                          |
| <p>[14a] cycling over time through a coverage sequence that includes providing a first coverage configuration, providing a second coverage configuration, and providing a third coverage configuration, wherein:</p> | <p>Each Accused Instrumentality practices a method that includes cycling over time through a coverage sequence that includes providing a first coverage configuration, providing a second coverage configuration, and providing a third coverage configuration.</p> <p>For example, each Accused Instrumentality has beamforming capabilities to provide different coverage configurations as described below. 5G gNB, a first network, provides a first, a second and a third coverage areas. The coverage areas are for broadcast channel PBCH and control channel PDCCH. Second and third coverage areas correspond to different transmission modes of PDSCH. Second coverage covers MU-MIMO devices, and the third coverage area covers SU-MIMO mode. LTE eNB provides a second network. The second network, LTE, may provide coverage to devices in LTE mode by sharing the spectrum between the LTE and 5G networks. Devices that are served by the 5G network may also be dynamically served by the LTE network during the spectrum sharing transition between the LTE and 5G networks.</p> <p><i>See, e.g.:</i></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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|          | <p>For paging CORESET configuration, we reuse the same configuration as for SIB1 CORESET indicated in PBCH.</p> <p><b>6.4.1 Paging Mechanism</b></p> <p>Paging scheduling DCI and paging Message may be sent in the same slot. <u>NR supports paging mechanism sending short messages, e.g., systemInfoModification, etwsAndCmas-Indication.</u></p> <p>Short messages can be transmitted on PDCCH using P-RNTI with or without associated paging message using short message field (8-bits) in DCI format 1_0.</p> <p>In Release 15, 2-bits are designated for indicating</p> <ul style="list-style-type: none"> <li>• <a href="#">Fundamentals of 5G Communications: Connectivity for Enhanced Mobile and Beyond (5G Book)</a> (Page 143)</li> </ul> <p>systemInfoModification, i.e., indication of a BCCH modification other than SIB6, SIB7, and SIB8, and etwsAndCmasIndication, i.e., indication of an earthquake and tsunami warning system (ETWS) primary notification and/or an ETWS secondary notification and/or a commercial mobile alert system (CMAS) notification.</p> <p><b>6.4.2 Other Paging Characteristics</b></p> <p><b>QCL Assumptions</b> The UE may assume QCL between SSBs, Paging DCIs and Paging Messages. UEs are not</p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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|          | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- <u>Physical Downlink Shared Channel, PDSCH</u></li> <li>- <u>Physical Broadcast Channel, PBCH</u></li> <li>- <u>Physical Downlink Control Channel, PDCCH.</u></li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- Antenna ports starting with 2000 for PDCCH</li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- Antenna ports starting with 4000 for SS/PBCH block transmission</li> </ul> <p>The UE shall not assume that two antenna ports are quasi co-located with respect to any QCL type unless specified otherwise.</p> <p>TS 38.211 V15.8.0</p> |



Table 7.3.1.3-1: Codeword-to-layer mapping for spatial multiplexing.

| Number of layers | Number of codewords | Codeword-to-layer mapping<br>$i = 0, 1, \dots, M_{\text{symb}}^{\text{layer}} - 1$                                                                                                                                                                                                                                                                |
|------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | 1                   | $x^{(0)}(i) = d^{(0)}(i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)}$                                                                                                                                                                                                                                                                |
| 2                | 1                   | $x^{(0)}(i) = d^{(0)}(2i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 2$<br>$x^{(1)}(i) = d^{(0)}(2i+1)$                                                                                                                                                                                                                           |
| 3                | 1                   | $x^{(0)}(i) = d^{(0)}(3i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$                                                                                                                                                                                           |
| 4                | 1                   | $x^{(0)}(i) = d^{(0)}(4i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 4$<br>$x^{(1)}(i) = d^{(0)}(4i+1)$<br>$x^{(2)}(i) = d^{(0)}(4i+2)$<br>$x^{(3)}(i) = d^{(0)}(4i+3)$                                                                                                                                                           |
| 5                | 2                   | $x^{(0)}(i) = d^{(0)}(2i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 2 = M_{\text{symb}}^{(1)} / 3$<br>$x^{(1)}(i) = d^{(0)}(2i+1)$<br>$x^{(2)}(i) = d^{(1)}(3i)$<br>$x^{(3)}(i) = d^{(1)}(3i+1)$<br>$x^{(4)}(i) = d^{(1)}(3i+2)$                                                                                                 |
| 6                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3 = M_{\text{symb}}^{(1)} / 3$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$<br>$x^{(3)}(i) = d^{(1)}(3i)$<br>$x^{(4)}(i) = d^{(1)}(3i+1)$<br>$x^{(5)}(i) = d^{(1)}(3i+2)$                                                                 |
| 7                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3 = M_{\text{symb}}^{(1)} / 4$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$<br>$x^{(3)}(i) = d^{(1)}(4i)$<br>$x^{(4)}(i) = d^{(1)}(4i+1)$<br>$x^{(5)}(i) = d^{(1)}(4i+2)$<br>$x^{(6)}(i) = d^{(1)}(4i+3)$                                 |
| 8                | 2                   | $x^{(0)}(i) = d^{(0)}(4i)$ $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 4 = M_{\text{symb}}^{(1)} / 4$<br>$x^{(1)}(i) = d^{(0)}(4i+1)$<br>$x^{(2)}(i) = d^{(0)}(4i+2)$<br>$x^{(3)}(i) = d^{(0)}(4i+3)$<br>$x^{(4)}(i) = d^{(1)}(4i)$<br>$x^{(5)}(i) = d^{(1)}(4i+1)$<br>$x^{(6)}(i) = d^{(1)}(4i+2)$<br>$x^{(7)}(i) = d^{(1)}(4i+3)$ |

TS 38.211 V15.8.0

See also elements [1b]-[1c] below

| Claim 14                                                                                                                                                                                                                                                                                   | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <p>[14b] providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for a first set of the group of devices, and providing coverage by a second network to at least a second set of the group of devices;</p> | <p>Each Accused Instrumentality practices a method that includes providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for a first set of the group of devices, and providing coverage by a second network to at least a second set of the group of devices.</p> <p>For example, each Accused Instrumentality provides wide-beam channels configured to provide coverage for the group of devices, as shown below. On beam type if used to provide coverage to broadcast channels and another beam type is used to provide coverage to traffic channels, SU-MIMO and MU-MIMO transmission modes. 5G gNB provides coverage as a first network, and an LTE network provides coverage as a second network.</p> <p><i>See, e.g.:</i></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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|          | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- Physical Downlink Shared Channel, PDSCH</li> <li>- <u>Physical Broadcast Channel, PBCH</u></li> <li>- <u>Physical Downlink Control Channel, PDCCH.</u></li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- <u>Antenna ports starting with 2000 for PDCCH</u></li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- <u>Antenna ports starting with 4000 for SS/PBCH block transmission</u></li> </ul> <p><u>The UE shall not assume that two antenna ports are quasi co-located with respect to any QCL type unless specified otherwise.</u></p> <p>TS 38.211 V15.8.0</p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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|          | <p><i><b>Introduction</b></i></p> <p>NR connected to 5GC provides support for <i>Public Warning Systems</i> (PWS) by means of system information broadcasting.</p> <p>NR is responsible for scheduling and broadcasting of the warning messages.</p> <p>NR is also responsible for paging the UE to provide indication that the warning message is being broadcasted.</p> <p>...</p> <p><i><b>Commercial Mobile Alert System</b></i> (CMAS) is a public warning system developed for the delivery of multiple, concurrent warning notifications. These messages include CMAS Presidential Level Alerts, CMAS Child Abduction Emergency (e.g. AMBER), Imminent Threat, Public Safety etc...</p> <p>Paging is used to inform UEs about ETWS and CMAS indications. UE monitors ETWS/CMAS indications in its own paging occasion for RRC_IDLE and RRC_INACTIVE and in any paging occasion for RRC_CONNECTED.</p> <p>Paging indicating ETWS/CMAS notification triggers acquisition of system information (without delaying until the next modification period).</p> <p><a href="http://howltestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html">http://howltestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html</a></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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|          | <p>For paging CORESET configuration, we reuse the same configuration as for SIB1 CORESET indicated in PBCH.</p> <p><b>6.4.1 Paging Mechanism</b></p> <p>Paging scheduling DCI and paging Message may be sent in the same slot. NR supports <u>paging mechanism sending short messages, e.g., systemInfoModification, etwsAndCmas-Indication.</u> Short messages can be transmitted on PDCCH using P-RNTI with or without associated paging message using short message field (8-bits) in DCI format 1_0.</p> <p>In Release 15, 2-bits are designated for indicating</p> <p>systemInfoModification, i.e., indication of a BCCH modification other than SIB6, SIB7, and SIB8, and etwsAndCmasIndication, i.e., indication of an earthquake and tsunami warning system (ETWS) primary notification and/or an ETWS secondary notification and/or a commercial mobile alert system (CMAS) notification.</p> <p><b>6.4.2 Other Paging Characteristics</b></p> <p><b>QCL Assumptions</b> <u>The UE may assume QCL between SSBs, Paging DCIs and Paging Messages. UEs are not</u></p> <ul style="list-style-type: none"> <li>• <a href="#">Fundamentals of 5G Communications: Connectivity for Enhanced Mobile and Beyond (5G Book)</a> (Page 143)</li> </ul> |

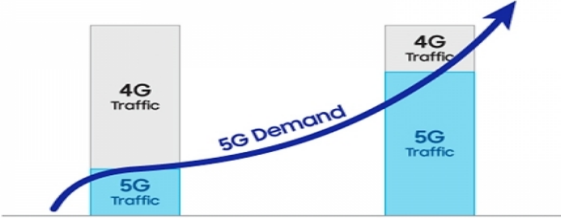
| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p><b>5G Beams Types: <u>Broadcast</u> &amp; Traffic Beams – <u>SSB</u>, CSI-RS, PMI &amp; SRS</b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p><u>The Broadcast beams are mainly the common channel beams that are used to transmit SSB.</u> The same beams are also used for other broadcast channels like CSI resources. Then we have traffic beams which are mostly based on PMI or SRS. If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– <u>SSB Beams are Broadcast Type beams and cover larger areas</u></li> <li>– PMI based Beams are more focused and narrower. They are Traffic Type Beams.</li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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|          | <p style="text-align: center;"><b>One Spectrum, Two Technologies</b></p> <p>Samsung's Dynamic Spectrum Sharing (DSS) offers a unique solution for an easy, uninterrupted transition to 5G. This advanced technology can be leveraged to deploy 5G networks in LTE spectrum bands, minimizing the impact on existing services. With DSS, mobile network operators can reuse their existing LTE hardware and infrastructure and enable 5G with software upgrade. However, spectrum resource limitation may be caused as two different systems need to share finite resources and overhead from LTE and NR signal transmission impacts overall capacity of the network. Samsung's DSS solution dynamically assigns resources to LTE and 5G based on the traffic demands for each technology, allowing optimal resource utilization.</p> <p><b>Facilitating a Smooth Shift to 5G</b></p> <p>Today, low spectrum bands are largely dominated by LTE. Therefore, operators who deploy 5G in low spectrum bands want a way for smooth migration minimizing the impact on LTE networks. One way to solve this is with LTE-NR dynamic spectrum sharing. By utilizing this feature, service providers can deploy LTE and NR in the same bands. <u>Within one carrier network, LTE users access the network using LTE cells</u> while 5G users are connected using 5G cells. Samsung's DSS supports a variety of deployment options, increasing flexibility for operators. Our solution can run on both virtualized and physical RAN platforms. Customers can choose to rollout new hardware, but they can also reuse legacy. Samsung's DSS solution can also co-exist with 2G, 3G and LTE vertical services such as eMTC and NB-IoT, enabling a 5G launch without negatively impacting legacy systems</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/">https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/</a></p> |

| Claim 14                                                                                                                                                                                                                                                                                                 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <p>[14c] providing the second coverage configuration includes transmitting a second beam of the first network that is configured to provide coverage for the second set of the group of devices, and providing coverage by the second network to at least the first set of the group of devices; and</p> | <p>Each Accused Instrumentality practices a method that includes providing the second coverage configuration includes transmitting a second beam of the first network that is configured to provide coverage for the second set of the group of devices, and providing coverage by the second network to at least the first set of the group of devices.</p> <p>For example, each Accused Instrumentality provides narrow beams focusing energy on each client device to provide high data rates and provides coverage to lower data rate requirement devices using a second network, <i>e.g.</i> a 5G network. The second network, LTE, may provide coverage to devices in LTE mode by sharing the spectrum between the LTE and 5G networks. Devices that are served by the 5G network may also be dynamically served by the LTE network during the spectrum sharing transition between the LTE and 5G networks.</p> <p><i>See, e.g.:</i></p> <p><b>5G Beams Types: Broadcast &amp; <u>Traffic Beams</u> – SSB, CSI-RS, <u>PMI</u> &amp; SRS</b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p>The Broadcast beams are mainly the common channel beams that are used to transmit SSB. The same beams are also used for other broadcast channels like CSI resources. <u>Then we have traffic beams which are mostly based on PMI or SRS.</u> If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– SSB Beams are Broadcast Type beams and cover larger areas</li> <li>– <u>PMI based Beams are more focused and narrower. They are Traffic Type Beams.</u></li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

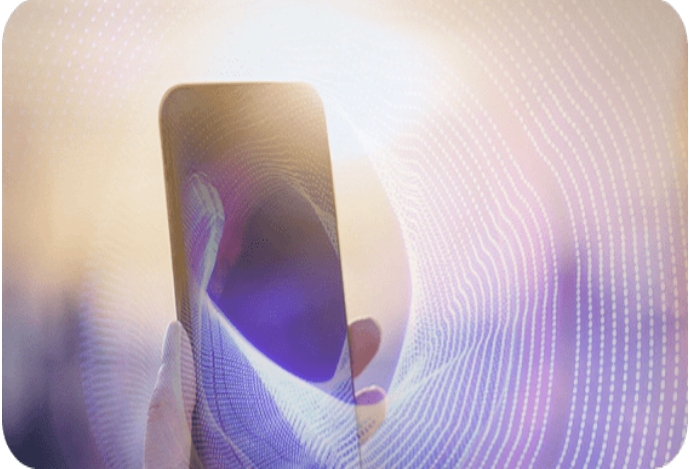
| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|          | <p><b><u>Multiuser MIMO</u></b></p> <p>Main difference in <u>MU-MIMO</u> and SU-MIMO is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p>MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</p> <p><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p> |

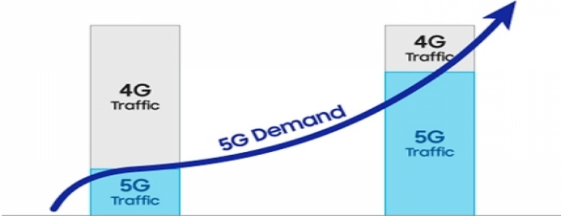
| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|          | <p data-bbox="793 272 1942 310"><a href="https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/">https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/</a></p> <p data-bbox="1016 342 1472 375"><b>One Spectrum, Two Technologies</b></p> <p data-bbox="638 378 1850 456">Samsung's Dynamic Spectrum Sharing (DSS) offers a unique solution for an easy, uninterrupted transition to 5G. This advanced technology can be leveraged to deploy 5G networks in LTE spectrum bands, minimizing the impact on existing services.</p> <p data-bbox="611 459 1879 483">With DSS, mobile network operators can reuse their existing LTE hardware and infrastructure and enable 5G with software upgrade.</p> <p data-bbox="638 487 1850 540">However, spectrum resource limitation may be caused as two different systems need to share finite resources and overhead from LTE and NR signal transmission impacts overall capacity of the network. Samsung's DSS solution dynamically</p> <p data-bbox="642 662 1094 695"><b>Facilitating a Smooth Shift to 5G</b></p> <p data-bbox="642 698 1843 938">Today, low spectrum bands are largely dominated by LTE. Therefore, operators who deploy 5G in low spectrum bands want a way for smooth migration minimizing the impact on LTE networks. One way to solve this is with LTE-NR dynamic spectrum sharing. By utilizing this feature, service providers can deploy LTE and NR in the same bands. Within one carrier network, LTE users access the network using LTE cells while 5G users are connected using 5G cells. Samsung's DSS supports a variety of deployment options, increasing flexibility for operators. Our solution can run on both virtualized and physical RAN platforms. Customers can choose to rollout new hardware, but they can also reuse legacy. Samsung's DSS solution can also co-exist with 2G, 3G and LTE vertical services such as eMTC and NB-IoT, enabling a 5G launch without negatively impacting legacy</p> <p data-bbox="684 1040 1808 1084"><a href="https://www.thelec.net/news/articleView.html?idxno=2254">https://www.thelec.net/news/articleView.html?idxno=2254</a></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <p data-bbox="680 272 1608 316">Samsung supplies DDS tech for Verizon's 5G network</p>  <p data-bbox="648 602 1829 1040"> Samsung Electronics on Tuesday said it has supplied its dynamic spectrum sharing (DSS) technology to Verizon's network. DSS allows for <u>4G base stations</u> to process 5G signals. It allows carriers to use spectrum they used in 4G for 5G. Verizon launched its 5G nationwide service that uses DSS technology in October last year. The carrier timed it with Apple's launch of iPhone 12, which supports 5G. Ericsson and Nokia had supplied their DSS technology then. Verizon's 5G network at the time covered 200 million people, according to the company. Last month, Verizon said it has expanded its coverage by 24 million people. Samsung's DSS supply comes two months later than its European rivals. The South Korean tech company's equipment covers around 10% of Verizon's 5G coverage to 230 million people. Samsung's kits are being used in central Texas, Tulsa, Oklahoma, upstate New York and New England. Samsung Network used vRAN 2.0 to supply the DSS technology. vRAN 2.0 uses both virtualized distributed unit and core unit. Samsung has supplied virtualized core unit to Japan's KDDI before (called vRAN 1.0) but its supply to Verizon is the first time it is offering virtualized distributed unit as well. Samsung is expected to take away shares from Nokia within Verizon's supply chain this year. Last year, it signed a US\$6.64 billion deal with the carrier to supply 4G and 5G equipment. </p> <p data-bbox="653 1081 1409 1110">출처 : THE ELEC, Korea Electronics Industry Media(<a href="http://thelec.net">http://thelec.net</a>)</p> <p data-bbox="665 1138 1415 1170"><a href="https://www.thelec.net/news/articleView.html?idxno=2254">https://www.thelec.net/news/articleView.html?idxno=2254</a></p> |

| Claim 14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <p>[14d] providing the third coverage configuration includes transmitting a third beam of the first network that is narrower than the first beam and is configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network, and providing coverage by the second network to at least a plurality of interval use devices of the group.</p> | <p>Each Accused Instrumentality practices a method that includes providing the third coverage configuration includes transmitting a third beam of the first network that is narrower than the first beam and is configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network, and providing coverage by the second network to at least a plurality of interval use devices of the group.</p> <p>For example, the third coverage area provides coverage to SU-MIMO service to devices using a beam that is narrower than the first beam. Devices in SU-MIMO mode receive high data rates that can support services such as video streaming. The second network (LTE) provides coverage to devices using services requiring lower data rates.</p> <p><i>See, e.g.:</i></p> <p style="text-align: center;"><b>5G Beams Types: Broadcast &amp; <u>Traffic Beams</u> – SSB, CSI-RS, <u>PMI &amp; SRS</u></b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p>The Broadcast beams are mainly the common channel beams that are used to transmit SSB. The same beams are also used for other broadcast channels like CSI resources. <u>Then we have traffic beams which are mostly based on PMI or SRS.</u> If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– SSB Beams are Broadcast Type beams and cover larger areas</li> <li>– <u>PMI based Beams are more focused and narrower. They are Traffic Type Beams.</u></li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|          | <p><b><u>Multiuser MIMO</u></b></p> <p>Main difference in MU-MIMO and <u>SU-MIMO</u> is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p>MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</p> <p><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p> |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p>For consumers, some of the most exciting prospects of 5G's widespread adoption are the Enhanced Mobile Broadband (eMBB) services that are coming with it. 5G's high bandwidth and exceptional speeds are supercharging services like high-definition (HD) <u>video streaming</u>, virtual reality (VR) and augmented reality (AR) and enabling mobile device users to stay connected like never before. <u>Whereas with 4G, at a speed of 500Mbps (Megabits per second), a 15GB HD movie file would take roughly four minutes to download, with 20Gbps 5G, it would take just six seconds.</u> eMBB will also enable high-traffic venues like airports and stadiums to support seamless HD streaming services and allow users to enjoy data speeds of at least 100Mbps in areas where cellular signals are weak.</p> <p>5G: New era of connectivity, <a href="https://semiconductor.samsung.com/insights/topic/5g/">https://semiconductor.samsung.com/insights/topic/5g/</a></p>  |

| Claim 14 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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|          | <p data-bbox="680 272 1606 316">Samsung supplies DDS tech for Verizon's 5G network</p>  <p data-bbox="651 600 1829 1039"> Samsung Electronics on Tuesday said it has supplied its dynamic spectrum sharing (DSS) technology to Verizon's network. DSS allows for <u>4G base stations</u> to process 5G signals. It allows carriers to use spectrum they used in 4G for 5G. Verizon launched its 5G nationwide service that uses DSS technology in October last year. The carrier timed it with Apple's launch of iPhone 12, which supports 5G. Ericsson and Nokia had supplied their DSS technology then. Verizon's 5G network at the time covered 200 million people, according to the company. Last month, Verizon said it has expanded its coverage by 24 million people. Samsung's DSS supply comes two months later than its European rivals. The South Korean tech company's equipment covers around 10% of Verizon's 5G coverage to 230 million people. Samsung's kits are being used in central Texas, Tulsa, Oklahoma, upstate New York and New England. Samsung Network used vRAN 2.0 to supply the DSS technology. vRAN 2.0 uses both virtualized distributed unit and core unit. Samsung has supplied virtualized core unit to Japan's KDDI before (called vRAN 1.0) but its supply to Verizon is the first time it is offering virtualized distributed unit as well. Samsung is expected to take away shares from Nokia within Verizon's supply chain this year. Last year, it signed a US\$6.64 billion deal with the carrier to supply 4G and 5G equipment. </p> <p data-bbox="651 1079 1409 1112">출처 : THE ELEC, Korea Electronics Industry Media(<a href="http://thelec.net">http://thelec.net</a>)</p> <p data-bbox="665 1136 1415 1169"><a href="https://www.thelec.net/news/articleView.html?idxno=2254">https://www.thelec.net/news/articleView.html?idxno=2254</a></p> |

**Claim 17:**

| Claim 17                                                                                                                                                      | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| <p>[17] A machine readable non-transitory medium having stored therein instructions that, when executed, cause a device to provide a network coverage by:</p> | <p>To the extent the preamble is construed to be a limitation, each Accused Instrumentality includes a machine readable non-transitory medium having stored therein instructions that, when executed, cause a device to provide a network coverage.</p> <p>For example, each Accused Instrumentality practices the claimed apparatus by providing simultaneous 5G and LTE coverage for a group of devices (gNB/eNB). The base stations comprise processors to execute physical and MAC layer protocols of LTE and 5G standards. The processors require a readable non-transitory medium (memory) subsystem to store executable programs to execute the protocols.</p> <p><i>See, e.g.:</i></p> <p><b>Universal Support for 5G Commercial Strategies</b></p> <p><u>Expanding network coverage will be one of the key concerns for operators with the advent of 5G.</u></p> <p>Samsung's complete radio portfolio can facilitate a fast and smooth 5G deployment.</p> <p>Samsung's radio solutions provide a wide range of products that support various frequencies, output powers and antenna configurations.</p> <p><b>Future-proof Solutions with Simultaneous LTE-5G Operations</b></p> <p><u>Samsung's solution enables a gradual and smooth migration to 5G through software feature upgrades in frequencies that are currently being used for LTE while keeping the existing hardware.</u> For example, the 8T8R radio can operate in a split mode, to be used to support a 4T4R LTE cell and a 4T4R 5G cell simultaneously. The dual band radio, which supports two carriers in one unit, can also support flexible LTE/5G simultaneous operation with one carrier supporting LTE and the other 5G. Dynamic Spectrum Sharing(DSS) will give more room for operators to adjust between LTE and 5G by operating the two technologies in the same frequency and dynamically switching between the two technologies depending on traffic.</p> <p><a href="https://www.samsung.com/global/business/networks/products/radio-access/radio/">https://www.samsung.com/global/business/networks/products/radio-access/radio/</a></p> |

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p>Mobile network operators (MNOs) continue to find ways to provide better services for their subscribers. Some of the techniques focus on increasing data capacity, while other solutions improve coverage. And with these enhanced services, subscribers' performance expectations continue to rise, too. One of the keys to this success is M-MIMO.</p> <p>M-MIMO is one of the techniques that achieve both increased data capacity and better coverage. By increasing the number of data paths to the end-user, the cell site sends more data to the user at the same time, resulting in faster connections. By adding more data paths, massive MIMO and beamforming, which is an intelligent antenna technology that focuses radio signal or transmission energy in the direction of the mobile user, taking these improvements up</p> <p>...</p> <p><b>Samsung Massive MIMO Unit (MMU):</b> The key product in the solution is the Samsung Massive MIMO Unit (MMU), which is operating in the 2.5 GHz and CBRS (3.5 GHz) spectrum bands. This product also supports the following RAN technologies:</p> <ul style="list-style-type: none"> <li>• 4G LTE</li> <li>• 5G NR</li> <li>• Co-deploy 4G LTE and 5G NR.</li> </ul> <p>A key differentiator of Samsung's MMU is its ability to support LTE and 5G NR simultaneously. The "split mode" configuration allocates 32 of the 64 transmit-receiver pairs to each of the RAN technologies. This unique capability reduces the CAPEX spend by MNOs for co-deployment of LTE and 5G in those sites, as the existing equipment supports both technologies in the existing footprint.</p> <p>...</p> |

| Claim 17                                                                                                                                                                  | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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|                                                                                                                                                                           | <p><b>MIMO and MU-MIMO:</b> In addition to supports 2x2 and 4x4 single-user MIMO, the MMU supports multi-user MIMO with by allowing up to 16 layers, or independent streams, of downlink transmission for up to 16 users. For 2.5 GHz deployments, the MMU supports up to 2 layers for uplink MU-MIMO transmissions for multi-user MIMO, while the CBRS solution in the 3.5 GHz spectrum allows up to 8 layers for uplink transmissions.</p> <p>Samsung Delivers the Promises of Massive MIMO, <i>available at</i> <a href="https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf">https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf</a></p> |
| <p>[17a] cycling over time through a coverage sequence that includes providing a first coverage configuration and providing a second coverage configuration, wherein:</p> | <p>Each Accused Instrumentality practices cycling over time through a coverage sequence that includes providing a first coverage configuration and providing a second coverage configuration.</p> <p>For example, each Accused Instrumentality has beamforming capabilities to provide different coverage configurations as described below. LTE and 5G provide at least a first and a second coverage areas for broadcast channel PBCH and control channel PDCCH, and for PDSCH channels. The SU-MIMO and MU-MIMO also comprise different coverage areas.</p> <p><i>See, e.g.:</i></p>                                                                                                                                                                                                                                                                                                                                            |

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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|          | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- <u>Physical Downlink Shared Channel, PDSCH</u></li> <li>- <u>Physical Broadcast Channel, PBCH</u></li> <li>- <u>Physical Downlink Control Channel, PDCCH.</u></li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- Antenna ports starting with 2000 for PDCCH</li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- Antenna ports starting with 4000 for SS/PBCH block transmission</li> </ul> <p>The UE shall not assume that two antenna ports are quasi co-located with respect to any QCL type unless specified otherwise.</p> <p>TS 38.211 V15.8.0</p> |

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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|          | <p><b><u>Multiuser MIMO</u></b></p> <p>Main difference in <u>MU-MIMO</u> and <u>SU-MIMO</u> is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p>MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</p> <p><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p><br><p><b>7.3.1.3 Layer mapping</b></p> <p>The UE shall assume that complex-valued modulation symbols for each of the codewords to be transmitted are mapped onto one or several layers according to Table 7.3.1.3-1. Complex-valued modulation symbols <math>d^{(q)}(0), \dots, d^{(q)}(M_{\text{symb}}^{(q)} - 1)</math> for codeword <math>q</math> shall be mapped onto the layers <math>x(i) = [x^{(0)}(i) \quad \dots \quad x^{(v-1)}(i)]^T, i = 0, 1, \dots, M_{\text{symb}}^{\text{layer}} - 1</math> where <math>v</math> is the number of layers and <math>M_{\text{symb}}^{\text{layer}}</math> is the number of modulation symbols per layer.</p> |

Table 7.3.1.3-1: Codeword-to-layer mapping for spatial multiplexing.

| Number of layers | Number of codewords | Codeword-to-layer mapping<br>$i = 0, 1, \dots, M_{\text{symb}}^{\text{layer}} - 1$                                                                                                                                                                       |                                                                                          |
|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1                | 1                   | $x^{(0)}(i) = d^{(0)}(i)$                                                                                                                                                                                                                                | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)}$                                 |
| 2                | 1                   | $x^{(0)}(i) = d^{(0)}(2i)$<br>$x^{(1)}(i) = d^{(0)}(2i+1)$                                                                                                                                                                                               | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 2$                             |
| 3                | 1                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$                                                                                                                                                               | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3$                             |
| 4                | 1                   | $x^{(0)}(i) = d^{(0)}(4i)$<br>$x^{(1)}(i) = d^{(0)}(4i+1)$<br>$x^{(2)}(i) = d^{(0)}(4i+2)$<br>$x^{(3)}(i) = d^{(0)}(4i+3)$                                                                                                                               | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 4$                             |
| 5                | 2                   | $x^{(0)}(i) = d^{(0)}(2i)$<br>$x^{(1)}(i) = d^{(0)}(2i+1)$<br>$x^{(2)}(i) = d^{(1)}(3i)$<br>$x^{(3)}(i) = d^{(1)}(3i+1)$<br>$x^{(4)}(i) = d^{(1)}(3i+2)$                                                                                                 | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 2 = M_{\text{symb}}^{(1)} / 3$ |
| 6                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$<br>$x^{(3)}(i) = d^{(1)}(3i)$<br>$x^{(4)}(i) = d^{(1)}(3i+1)$<br>$x^{(5)}(i) = d^{(1)}(3i+2)$                                                                 | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3 = M_{\text{symb}}^{(1)} / 3$ |
| 7                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i+1)$<br>$x^{(2)}(i) = d^{(0)}(3i+2)$<br>$x^{(3)}(i) = d^{(1)}(4i)$<br>$x^{(4)}(i) = d^{(1)}(4i+1)$<br>$x^{(5)}(i) = d^{(1)}(4i+2)$<br>$x^{(6)}(i) = d^{(1)}(4i+3)$                                 | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3 = M_{\text{symb}}^{(1)} / 4$ |
| 8                | 2                   | $x^{(0)}(i) = d^{(0)}(4i)$<br>$x^{(1)}(i) = d^{(0)}(4i+1)$<br>$x^{(2)}(i) = d^{(0)}(4i+2)$<br>$x^{(3)}(i) = d^{(0)}(4i+3)$<br>$x^{(4)}(i) = d^{(1)}(4i)$<br>$x^{(5)}(i) = d^{(1)}(4i+1)$<br>$x^{(6)}(i) = d^{(1)}(4i+2)$<br>$x^{(7)}(i) = d^{(1)}(4i+3)$ | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 4 = M_{\text{symb}}^{(1)} / 4$ |

TS 38.211 V15.8.

See also elements [1b]-[1c] below

| Claim 17                                                                                                                                                                           | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>[17b] providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for the group of devices; and</p> | <p>Each Accused Instrumentality practices providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for the group of devices.</p> <p>For example, each Accused Instrumentality provides wide-beam channels configured to provide coverage for the group of devices, as shown below. On beam type if used to provide coverage to broadcast channels and another beam type is used to provide coverage to traffic channels, SU-MIMO and MU-MIMO transmission modes.</p> <p><i>See, e.g.:</i></p> |

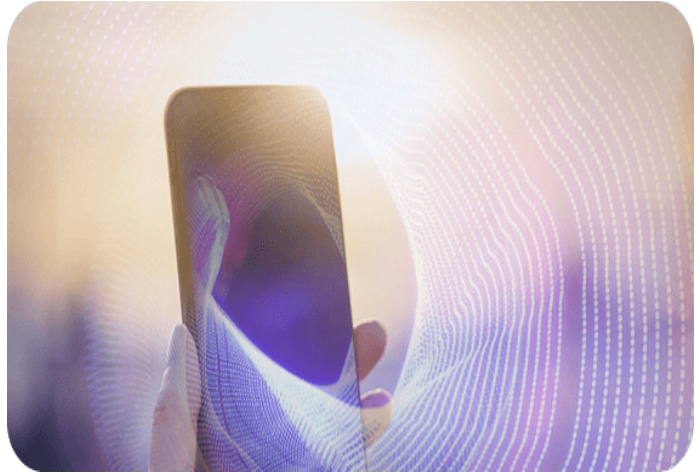
| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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|          | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- Physical Downlink Shared Channel, PDSCH</li> <li>- <u>Physical Broadcast Channel, PBCH</u></li> <li>- <u>Physical Downlink Control Channel, PDCCH.</u></li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- <u>Antenna ports starting with 2000 for PDCCH</u></li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- <u>Antenna ports starting with 4000 for SS/PBCH block transmission</u></li> </ul> <p><u>The UE shall not assume that two antenna ports are quasi co-located with respect to any OCL type unless specified otherwise.</u></p> |

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p><i><b>Introduction</b></i></p> <p>NR connected to 5GC provides support for <i>Public Warning Systems</i> (PWS) by means of system information broadcasting.</p> <p>NR is responsible for scheduling and broadcasting of the warning messages.</p> <p>NR is also responsible for paging the UE to provide indication that the warning message is being broadcasted.</p> <p>...</p> <p><i><b>Commercial Mobile Alert System</b></i> (CMAS) is a public warning system developed for the delivery of multiple, concurrent warning notifications. These messages include CMAS Presidential Level Alerts, CMAS Child Abduction Emergency (e.g. AMBER), Imminent Threat, Public Safety etc...</p> <p>Paging is used to inform UEs about ETWS and CMAS indications. UE monitors ETWS/CMAS indications in its own paging occasion for RRC_IDLE and RRC_INACTIVE and in any paging occasion for RRC_CONNECTED.</p> <p>Paging indicating ETWS/CMAS notification triggers acquisition of system information (without delaying until the next modification period).</p> <p><a href="http://howtestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html">http://howtestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html</a></p> |

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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|          | <p>For paging CORESET configuration, we reuse the same configuration as for SIB1 CORESET indicated in PBCH.</p> <p><b>6.4.1 Paging Mechanism</b></p> <p>Paging scheduling DCI and paging Message may be sent in the same slot. NR supports <u>paging mechanism sending short messages, e.g., systemInfoModification, etwsAndCmas-Indication.</u> Short messages can be transmitted on PDCCH using P-RNTI with or without associated paging message using short message field (8-bits) in DCI format 1_0.</p> <p>In Release 15, 2-bits are designated for indicating</p> <p><u>systemInfoModification, i.e., indication of a BCCH modification other than SIB6, SIB7, and SIB8, and etwsAndCmasIndication, i.e., indication of an earthquake and tsunami warning system (ETWS) primary notification and/or an ETWS secondary notification and/or a commercial mobile alert system (CMAS) notification.</u></p> <p><b>6.4.2 Other Paging Characteristics</b></p> <p><u><b>QCL Assumptions</b> The UE may assume QCL between SSBs, Paging DCIs and Paging Messages. UEs are not</u></p> <p><a href="#">Fundamentals of 5G Communications: Connectivity for Enhanced Mobile and Beyond (5G Book) (page 143)</a></p> |

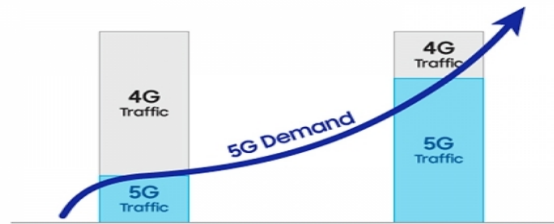
| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p><b>5G Beams Types: <u>Broadcast &amp; Traffic Beams</u> – <u>SSB</u>, CSI-RS, PMI &amp; SRS</b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p><u>The Broadcast beams are mainly the common channel beams that are used to transmit SSB.</u> The same beams are also used for other broadcast channels like CSI resources. Then we have traffic beams which are mostly based on PMI or SRS. If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– <u>SSB Beams are Broadcast Type beams and cover larger areas</u></li> <li>– PMI based Beams are more focused and narrower. They are Traffic Type Beams.</li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

| Claim 17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| <p>[17c] providing the second coverage configuration includes transmitting a second beam of the first network that is narrower than the first beam and configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network and providing coverage by a second network to a plurality of interval use devices of the group of devices;</p> | <p>Each Accused Instrumentality practices providing the second coverage configuration includes transmitting a second beam of the first network that is narrower than the first beam and configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network, and providing coverage by a second network to a plurality of interval use devices of the group of devices.</p> <p>For example, each Accused Instrumentality provides narrow beams focusing energy on each client device to provide high data rates and provides coverage to lower data rate requirement devices using a second network, <i>e.g.</i> a 5G network.</p> <p><i>See, e.g.:</i></p> <p><b>5G Beams Types: Broadcast &amp; <u>Traffic Beams</u> – SSB, CSI-RS, <u>PMI &amp; SRS</u></b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p>The Broadcast beams are mainly the common channel beams that are used to transmit SSB. The same beams are also used for other broadcast channels like CSI resources. <u>Then we have traffic beams which are mostly based on PMI or SRS.</u> If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– SSB Beams are Broadcast Type beams and cover larger areas</li> <li>– <u>PMI based Beams are more focused and narrower.</u> <u>They are Traffic Type Beams.</u></li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|          | <p>For consumers, some of the most exciting prospects of 5G's widespread adoption are the Enhanced Mobile Broadband (eMBB) services that are coming with it. 5G's high bandwidth and <u>exceptional speeds are supercharging services like high-definition (HD) video streaming, virtual reality (VR) and augmented reality (AR) and enabling mobile device users to stay connected like never before.</u> Whereas with 4G, at a speed of 500Mbps (Megabits per second), a 15GB HD movie file would take roughly four minutes to download, with 20Gbps 5G, it would take just six seconds. eMBB will also enable high-traffic venues like airports and stadiums to support seamless HD streaming services and allow users to enjoy data speeds of at least 100Mbps in areas where cellular signals are weak.</p> <p>5G: New era of connectivity, <a href="https://semiconductor.samsung.com/insights/topic/5g/">https://semiconductor.samsung.com/insights/topic/5g/</a></p> <p style="text-align: center;"><b>Different Modems for Different Needs</b></p> <p><i>Samsung has developed two types of modems for 5G base stations.</i> The first modem helps a smooth LTE migration and introduction of 5G NR. It supports both <u>4G</u> and <u>5G</u> to enable backward compatibility with previous LTE products while supporting the latest Massive MIMO and 5G standards. The new modem is placed in expandable channel cards and has been developed to be deployed in environments with high-capacity requirements. The second modem has been developed based on years of research experience in the mmWave spectrum. The modem supports high performance but runs on low power and is optimal for compact mmWave base stations.</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/technology/">https://www.samsung.com/global/business/networks/solutions/technology/</a></p>  |

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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|          | <p><b>Montreal, Canada - December 13, 2019</b> - Samsung Electronics today announced that it will provide 4G LTE-Advanced (LTE-A) and 5G radio access networks solutions to Videotron, a Canadian telecommunications operator. This is the first time Samsung is delivering network solutions in Canada.</p> <p>After many successful decades in the cable television and internet access business, Videotron deployed its wireless operation in 2010 and has been the fastest growing new operator since then. Currently providing 4G LTE service, Videotron plans to launch commercial LTE-A and 5G services in late 2020.</p> <p><u>Starting in early 2020, Samsung will deliver 4G LTE-A solutions across Quebec and Ottawa in which the solutions from Samsung include Massive MIMO and Dual-band base stations, supporting the operator's 4G LTE frequencies, and 5G solutions for both 3.5GHz and 28GHz spectrum.</u></p> <p>Providing commercially proven <u>4G LTE-A solutions</u> and combined with <u>5G commercial solutions</u> from global markets, Samsung will increase efficiency in accelerating expansion of 5G service coverage to match pace with Canada's 5G commercial launch, which is expected to take place in late 2020.</p> <p>"We have been all over the world to find the best supplier suited to meet the evolving needs of our customers. This partnership will allow us to deliver the most advanced telecommunications solutions to Quebecers. While 4G technology has profoundly transformed telecommunications in the world, LTE Advanced and 5G will undoubtedly revolutionize the way we interact with our loved ones and the environment around us," said Jean François Pruneau, President and Chief Executive Officer of Videotron. "We want to be with our customers through these major changes and the choice of Samsung as a supplier is not a coincidence, we are convinced that they represent the best option to achieve this objective.</p> <p><a href="https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/">https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/</a></p> |

## Samsung supplies DDS tech for Verizon's 5G network



Samsung Electronics on Tuesday said it has supplied its dynamic spectrum sharing (DSS) technology to Verizon's network

DSS allows for 4G base stations to process 5G signals. It allows carriers to use spectrum they used in 4G for 5G. Verizon launched its 5G nationwide service that uses DSS technology in October last year. The carrier timed it with Apple's launch of iPhone 12, which supports 5G.

Ericsson and Nokia had supplied their DSS technology then. Verizon's 5G network at the time covered 200 million people, according to the company.

Last month, Verizon said it has expanded its coverage by 24 million people. Samsung's DSS supply comes two months later than its European rivals.

The South Korean tech company's equipment covers around 10% of Verizon's 5G coverage to 230 million people.

Samsung's kits are being used in central Texas, Tulsa, Oklahoma, upstate New York and New England.

Samsung Network used vRAN 2.0 to supply the DSS technology.

vRAN 2.0 uses both virtualized distributed unit and core unit. Samsung has supplied virtualized core unit to Japan's KDDI before (called vRAN 1.0) but its supply to Verizon is the first time it is offering virtualized distributed unit as well.

Samsung is expected to take away shares from Nokia within Verizon's supply chain this year. Last year, it signed a US\$6.64 billion deal with the carrier to supply 4G and 5G equipment.

출처 : THE ELEC, Korea Electronics Industry Media(<http://thelec.net>)

<https://www.thelec.net/news/articleView.html?idxno=2254>

| Claim 17 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p style="text-align: center;"><b>One Spectrum, Two Technologies</b></p> <p>Samsung's Dynamic Spectrum Sharing (DSS) offers a unique solution for an easy, uninterrupted transition to 5G. This advanced technology can be leveraged to deploy 5G networks in LTE spectrum bands, minimizing the impact on existing services. With DSS, mobile network operators can reuse their existing LTE hardware and infrastructure and enable 5G with software upgrade. However, spectrum resource limitation may be caused as two different systems need to share finite resources and overhead from LTE and NR signal transmission impacts overall capacity of the network. Samsung's DSS solution dynamically assigns resources to LTE and 5G based on the traffic demands for each technology, allowing optimal resource utilization.</p> <p><b>Facilitating a Smooth Shift to 5G</b></p> <p>Today, low spectrum bands are largely dominated by LTE. Therefore, operators who deploy 5G in low spectrum bands want a way for smooth migration minimizing the impact on LTE networks. One way to solve this is with LTE-NR dynamic spectrum sharing. By utilizing this feature, service providers can deploy LTE and NR in the same bands. Within one carrier network, LTE users access the network using LTE cells while 5G users are connected using 5G cells. Samsung's DSS supports a variety of deployment options, increasing flexibility for operators. Our solution can run on both virtualized and physical RAN platforms. Customers can choose to rollout new hardware, but they can also reuse legacy. Samsung's DSS solution can also co-exist with 2G, 3G and LTE vertical services such as eMTC and NB-IoT, enabling a 5G launch without negatively impacting legacy systems</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/">https://www.samsung.com/global/business/networks/solutions/dynamic-spectrum-sharing/</a></p> |

**Claim 18:**

| Claim 18                                                                                                                                                                                                                                                                  | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <p>[18] The machine readable non-transitory medium of claim 17, wherein the first network and the second network are the same network types, and wherein the at least one active device is allowed access to the second beam based on an admission control parameter.</p> | <p>The Accused Instrumentalities include a machine readable non-transitory medium wherein the first network and the second network are the same network types, and wherein the at least one active device is allowed access to the second beam based on an admission control parameter..</p> <p>For example, Samsung has 5G solutions for both 3.5 and 28 GHz mmWave bands. The 28 GHz band provides high data rates but has short coverage. The 3.5 GHz band has larger coverage area than the 28 GHz band, and the device would operate on 3.5 GHz band when there is poor coverage on the 28 GHz band. Active devices are assigned resources for data transmission using the PDCCH control channel and the Downlink Control Information (DCI) to schedule resources to the device.</p> <p><b>Montreal, Canada - December 13, 2019</b> - Samsung Electronics today announced that it will provide 4G LTE-Advanced (LTE-A) and 5G radio access networks solutions to Videotron, a Canadian telecommunications operator. This is the first time Samsung is delivering network solutions in Canada.</p> <p>After many successful decades in the cable television and internet access business, Videotron deployed its wireless operation in 2010 and has been the fastest growing new operator since then. Currently providing 4G LTE service, Videotron plans to launch commercial LTE-A and 5G services in late 2020.</p> <p>Starting in early 2020, Samsung will deliver 4G LTE-A solutions across Quebec and Ottawa in which the solutions from Samsung include Massive MIMO and <u>Dual-band base stations</u>, supporting the operator's 4G LTE frequencies, and <u>5G solutions for both 3.5GHz and 28GHz spectrum</u>.</p> <p>Providing commercially proven 4G LTE-A solutions and combined with 5G commercial solutions from global markets, Samsung will increase efficiency in accelerating expansion of 5G service coverage to match pace with Canada's 5G commercial launch, which is expected to take place in late 2020.</p> <p>"We have been all over the world to find the best supplier suited to meet the evolving needs of our customers. This partnership will allow us to deliver the most advanced telecommunications solutions to Quebecers. While 4G technology has profoundly transformed telecommunications in the world, LTE Advanced and 5G will undoubtedly revolutionize the way we interact with our loved ones and the environment around us," said Jean François Pruneau, President and Chief Executive Officer of Videotron. "We want to be with our customers through these major changes and the choice of Samsung as a supplier is not a coincidence, we are convinced that they represent the best option to achieve this objective.</p> <p><a href="https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/">https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/</a></p> |

| Claim 18 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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|          | <p>10.2 Downlink Scheduling</p> <p>In the downlink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible assignments when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.</p> <p>The gNB may pre-empt an ongoing PDSCH transmission to one UE with a latency-critical transmission to another UE. The gNB can configure UEs to monitor interrupted transmission indications using INT-RNTI on a PDCCH. If a UE receives the interrupted transmission indication, the UE may assume that no useful information to that UE was carried by the resource elements included in the indication, even if some of those resource elements were already scheduled to this UE.</p> <p>In addition, with Semi-Persistent Scheduling (SPS), the gNB can allocate downlink resources for the initial HARQ transmissions to UEs: RRC defines the periodicity of the configured downlink assignments while PDCCH addressed to CS-RNTI can either signal and activate the configured downlink assignment, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the downlink assignment can be implicitly reused according to the periodicity defined by RRC, until deactivated.</p> <p>NOTE: When required, retransmissions are explicitly scheduled on PDCCH(s).</p> <p>The dynamically allocated downlink reception overrides the configured downlink assignment in the same serving cell, if they overlap in time. Otherwise a downlink reception according to the configured downlink assignment is assumed, if activated.</p> <p>The UE may be configured with up to 8 active configured downlink assignments for a given BWP of a serving cell. When more than one is configured:</p> <ul style="list-style-type: none"> <li>- The network decides which of these configured downlink assignments are active at a time (including all of them); and</li> <li>- <u>Each configured downlink assignment is activated separately using a DCI command and deactivation of configured downlink assignments is done using a DCI command, which can either deactivate a single configured downlink assignment or multiple configured downlink assignments jointly.</u></li> </ul> <p>TS 38.300 version 16.2.0</p> |

**Claim 20:**

| Claim 20                                                                                                                                 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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| [20pre] A device comprising:                                                                                                             | To the extent the preamble is construed to be a limitation, each Accused Instrumentality practices the claimed device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| [20a] a machine readable medium having stored therein instructions that, when executed, cause the device to provide network coverage by: | <p>For example, each Accused Instrumentality comprises machine readable instructions that cause the device to provide simultaneous 5G and LTE coverage for a group of devices (gNB/eNB). The base stations comprise processors to execute physical and MAC layer protocols of LTE and 5G standards. The processors require access (coupled to) a memory subsystem to store executable programs and execute the protocols.</p> <p><i>See, e.g.:</i></p> <p><b>Universal Support for 5G Commercial Strategies</b></p> <p><u>Expanding network coverage will be one of the key concerns for operators with the advent of 5G.</u></p> <p>Samsung's complete radio portfolio can facilitate a fast and smooth 5G deployment.</p> <p>Samsung's radio solutions provide a wide range of products that support various frequencies, output powers and antenna configurations.</p> <p><b>Future-proof Solutions with Simultaneous LTE-5G Operations</b></p> <p><u>Samsung's solution enables a gradual and smooth migration to 5G through software feature upgrades in frequencies that are currently being used for LTE while keeping the existing hardware.</u> For example, the 8T8R radio can operate in a split mode, to be used to support a 4T4R LTE cell and a 4T4R 5G cell simultaneously. The dual band radio, which supports two carriers in one unit, can also support flexible LTE/5G simultaneous operation with one carrier supporting LTE and the other 5G. Dynamic Spectrum Sharing(DSS) will give more room for operators to adjust between LTE and 5G by operating the two technologies in the same frequency and dynamically switching between the two technologies depending on traffic.</p> <p><a href="https://www.samsung.com/global/business/networks/products/radio-access/radio/">https://www.samsung.com/global/business/networks/products/radio-access/radio/</a></p> |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p>Mobile network operators (MNOs) continue to find ways to provide better services for their subscribers. Some of the techniques focus on increasing data capacity, while other solutions improve coverage. And with these enhanced services, subscribers' performance expectations continue to rise, too. One of the keys to this success is M-MIMO.</p> <p>M-MIMO is one of the techniques that achieve both increased data capacity and better coverage. By increasing the number of data paths to the end-user, the cell site sends more data to the user at the same time, resulting in faster connections. By adding more data paths, massive MIMO and beamforming, which is an intelligent antenna technology that focuses radio signal or transmission energy in the direction of the mobile user, taking these improvements up</p> <p>...</p> <p><b>Samsung Massive MIMO Unit (MMU):</b> The key product in the solution is the Samsung Massive MIMO Unit (MMU), which is operating in the 2.5 GHz and CBRS (3.5 GHz) spectrum bands. This product also supports the following RAN technologies:</p> <ul style="list-style-type: none"> <li>• 4G LTE</li> <li>• 5G NR</li> <li>• Co-deploy 4G LTE and 5G NR.</li> </ul> <p>A key differentiator of Samsung's MMU is its ability to support LTE and 5G NR simultaneously. The "split mode" configuration allocates 32 of the 64 transmit-receiver pairs to each of the RAN technologies. This unique capability reduces the CAPEX spend by MNOs for co-deployment of LTE and 5G in those sites, as the existing equipment supports both technologies in the existing footprint.</p> <p>...</p> |

| Claim 20                                                                                                                                                                  | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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|                                                                                                                                                                           | <p><b>MIMO and MU-MIMO:</b> In addition to supports 2x2 and 4x4 single-user MIMO, the MMU supports multi-user MIMO with by allowing up to 16 layers, or independent streams, of downlink transmission for up to 16 users. For 2.5 GHz deployments, the MMU supports up to 2 layers for uplink MU-MIMO transmissions for multi-user MIMO, while the CBRS solution in the 3.5 GHz spectrum allows up to 8 layers for uplink transmissions.</p> <p>Samsung Delivers the Promises of Massive MIMO, <i>available at</i> <a href="https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf">https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-delivers-the-promises-of-massive-mimo/Samsung-Delivers-the-Promises-of-Massive-MIMO.pdf</a></p> |
| <p>[20b] cycling over time through a coverage sequence that includes providing a first coverage configuration and providing a second coverage configuration, wherein:</p> | <p>Each Accused Instrumentality practices cycling over time through a coverage sequence that includes providing a first coverage configuration and providing a second coverage configuration.</p> <p>For example, each Accused Instrumentality has beamforming capabilities to provide different coverage configurations as described below.</p> <p><i>See, e.g.:</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|          | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- <a href="#">Physical Downlink Shared Channel, PDSCH</a></li> <li>- <a href="#">Physical Broadcast Channel, PBCH</a></li> <li>- <a href="#">Physical Downlink Control Channel, PDCCH</a>.</li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- Antenna ports starting with 2000 for PDCCH</li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- Antenna ports starting with 4000 for SS/PBCH block transmission</li> </ul> <p>The UE shall not assume that two antenna ports are quasi co-located with respect to any QCL type unless specified otherwise.</p> <p>TS 38.211 V15.8.0</p> |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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|          | <p data-bbox="669 402 913 435"><b><u>Multiuser MIMO</u></b></p> <p data-bbox="669 472 1892 686">Main difference in <u>MU-MIMO</u> and <u>SU-MIMO</u> is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p data-bbox="669 724 1892 828">MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</p> <p data-bbox="669 865 1640 898"><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p> <p data-bbox="646 987 1110 1031"><b>7.3.1.3 Layer mapping</b></p> <p data-bbox="646 1049 1871 1271">The UE shall assume that complex-valued modulation symbols for each of the codewords to be transmitted are mapped onto one or several layers according to Table 7.3.1.3-1. Complex-valued modulation symbols <math>d^{(q)}(0), \dots, d^{(q)}(M_{\text{symb}}^{(q)} - 1)</math> for codeword <math>q</math> shall be mapped onto the layers <math>x(i) = [x^{(0)}(i) \dots x^{(v-1)}(i)]^T, i = 0, 1, \dots, M_{\text{symb}}^{\text{layer}} - 1</math> where <math>v</math> is the number of layers and <math>M_{\text{symb}}^{\text{layer}}</math> is the number of modulation symbols per layer.</p> |

Table 7.3.1.3-1: Codeword-to-layer mapping for spatial multiplexing.

| Number of layers | Number of codewords | Codeword-to-layer mapping<br>$i = 0, 1, \dots, M_{\text{symb}}^{\text{layer}} - 1$                                                                                                                                                                                   |                                                                                          |
|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1                | 1                   | $x^{(0)}(i) = d^{(0)}(i)$                                                                                                                                                                                                                                            | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)}$                                 |
| 2                | 1                   | $x^{(0)}(i) = d^{(0)}(2i)$<br>$x^{(1)}(i) = d^{(0)}(2i + 1)$                                                                                                                                                                                                         | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 2$                             |
| 3                | 1                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i + 1)$<br>$x^{(2)}(i) = d^{(0)}(3i + 2)$                                                                                                                                                                       | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3$                             |
| 4                | 1                   | $x^{(0)}(i) = d^{(0)}(4i)$<br>$x^{(1)}(i) = d^{(0)}(4i + 1)$<br>$x^{(2)}(i) = d^{(0)}(4i + 2)$<br>$x^{(3)}(i) = d^{(0)}(4i + 3)$                                                                                                                                     | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 4$                             |
| 5                | 2                   | $x^{(0)}(i) = d^{(0)}(2i)$<br>$x^{(1)}(i) = d^{(0)}(2i + 1)$<br>$x^{(2)}(i) = d^{(1)}(3i)$<br>$x^{(3)}(i) = d^{(1)}(3i + 1)$<br>$x^{(4)}(i) = d^{(1)}(3i + 2)$                                                                                                       | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 2 = M_{\text{symb}}^{(1)} / 3$ |
| 6                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i + 1)$<br>$x^{(2)}(i) = d^{(0)}(3i + 2)$<br>$x^{(3)}(i) = d^{(1)}(3i)$<br>$x^{(4)}(i) = d^{(1)}(3i + 1)$<br>$x^{(5)}(i) = d^{(1)}(3i + 2)$                                                                     | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3 = M_{\text{symb}}^{(1)} / 3$ |
| 7                | 2                   | $x^{(0)}(i) = d^{(0)}(3i)$<br>$x^{(1)}(i) = d^{(0)}(3i + 1)$<br>$x^{(2)}(i) = d^{(0)}(3i + 2)$<br>$x^{(3)}(i) = d^{(1)}(4i)$<br>$x^{(4)}(i) = d^{(1)}(4i + 1)$<br>$x^{(5)}(i) = d^{(1)}(4i + 2)$<br>$x^{(6)}(i) = d^{(1)}(4i + 3)$                                   | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 3 = M_{\text{symb}}^{(1)} / 4$ |
| 8                | 2                   | $x^{(0)}(i) = d^{(0)}(4i)$<br>$x^{(1)}(i) = d^{(0)}(4i + 1)$<br>$x^{(2)}(i) = d^{(0)}(4i + 2)$<br>$x^{(3)}(i) = d^{(0)}(4i + 3)$<br>$x^{(4)}(i) = d^{(1)}(4i)$<br>$x^{(5)}(i) = d^{(1)}(4i + 1)$<br>$x^{(6)}(i) = d^{(1)}(4i + 2)$<br>$x^{(7)}(i) = d^{(1)}(4i + 3)$ | $M_{\text{symb}}^{\text{layer}} = M_{\text{symb}}^{(0)} / 4 = M_{\text{symb}}^{(1)} / 4$ |

TS 38.211 V15.8.0

See also elements [1b]-[1c] below

| Claim 20                                                                                                                                                                           | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <p>[20b] providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for the group of devices; and</p> | <p>Each Accused Instrumentality practices providing the first coverage configuration includes transmitting a first beam of a first network that is configured to provide coverage for the group of devices.</p> <p>For example, each Accused Instrumentality provides wide-beam channels configured to provide coverage for the group of devices, as shown below. On beam type if used to provide coverage to broadcast channels and another beam type is used to provide coverage to traffic channels, SU-MIMO and MU-MIMO transmission modes.</p> <p><i>See, e.g.:</i></p> |

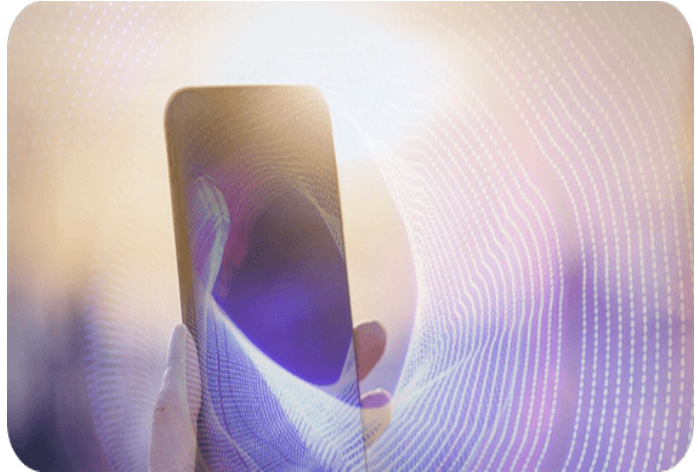
| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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|          | <p><b>7.1.1 Overview of physical channels</b></p> <p>A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following downlink physical channels are defined:</p> <ul style="list-style-type: none"> <li>- Physical Downlink Shared Channel, PDSCH</li> <li>- <u>Physical Broadcast Channel, PBCH</u></li> <li>- <u>Physical Downlink Control Channel, PDCCH.</u></li> </ul> <p><b>7.1.2 Overview of physical signals</b></p> <p>A downlink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.</p> <p>The following downlink physical signals are defined:</p> <ul style="list-style-type: none"> <li>- Demodulation reference signals, DM-RS</li> <li>- Phase-tracking reference signals, PT-RS</li> <li>- Channel-state information reference signal, CSI-RS</li> <li>- Primary synchronization signal, PSS</li> <li>- Secondary synchronization signal, SSS</li> </ul> <p><b>7.2 Physical resources</b></p> <p>The frame structure and physical resources the UE shall assume when receiving downlink transmissions are defined in Clause 4.</p> <p>The following antenna ports are defined for the downlink:</p> <ul style="list-style-type: none"> <li>- Antenna ports starting with 1000 for PDSCH</li> <li>- <u>Antenna ports starting with 2000 for PDCCH</u></li> <li>- Antenna ports starting with 3000 for channel-state information reference signals</li> <li>- <u>Antenna ports starting with 4000 for SS/PBCH block transmission</u></li> </ul> <p><u>The UE shall not assume that two antenna ports are quasi co-located with respect to any OCL type unless specified otherwise.</u></p> |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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|          | <p><b><i>Introduction</i></b></p> <p>NR connected to 5GC provides support for <i>Public Warning Systems</i> (PWS) by means of system information broadcasting.</p> <p>NR is responsible for scheduling and broadcasting of the warning messages.</p> <p>NR is also responsible for paging the UE to provide indication that the warning message is being broadcasted.</p> <p>...</p> <p><b><i>Commercial Mobile Alert System</i></b> (CMAS) is a public warning system developed for the delivery of multiple, concurrent warning notifications. These messages include CMAS Presidential Level Alerts, CMAS Child Abduction Emergency (e.g. AMBER), Imminent Threat, Public Safety etc...</p> <p>Paging is used to inform UEs about ETWS and CMAS indications. UE monitors ETWS/CMAS indications in its own paging occasion for RRC_IDLE and RRC_INACTIVE and in any paging occasion for RRC_CONNECTED.</p> <p>Paging indicating ETWS/CMAS notification triggers acquisition of system information (without delaying until the next modification period).</p> <p><a href="http://howltestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html">http://howltestuffworks.blogspot.com/2019/10/5g-nr-sib6-sib7-and-sib8.html</a></p> |

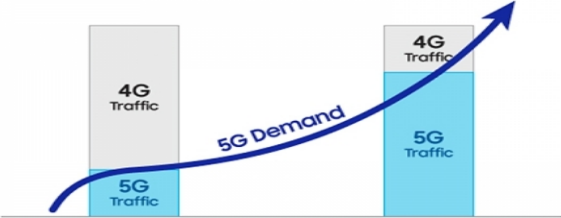
| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|          | <p>For paging CORESET configuration, we reuse the same configuration as for SIB1 CORESET indicated in PBCH.</p> <p><b>6.4.1 Paging Mechanism</b></p> <p>Paging scheduling DCI and paging Message may be sent in the same slot. NR supports <u>paging mechanism sending short messages, e.g., systemInfoModification, etwsAndCmas-Indication.</u> Short messages can be transmitted on PDCCH using P-RNTI with or without associated paging message using short message field (8-bits) in DCI format 1_0.</p> <p>In Release 15, 2-bits are designated for indicating</p> <p><u>systemInfoModification, i.e., indication of a BCCH modification other than SIB6, SIB7, and SIB8, and etwsAndCmasIndication, i.e., indication of an earthquake and tsunami warning system (ETWS) primary notification and/or an ETWS secondary notification and/or a commercial mobile alert system (CMAS) notification.</u></p> <p><b>6.4.2 Other Paging Characteristics</b></p> <p><u><b>QCL Assumptions</b> The UE may assume QCL between SSBs, Paging DCIs and Paging Messages. UEs are not</u></p> <p><a href="#">Fundamentals of 5G Communications: Connectivity for Enhanced Mobile and Beyond (5G Book) (Pages 143)</a></p> |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|          | <p><b>5G Beams Types: <u>Broadcast</u> &amp; Traffic Beams – <u>SSB</u>, CSI-RS, PMI &amp; SRS</b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p><u>The Broadcast beams are mainly the common channel beams that are used to transmit SSB.</u> The same beams are also used for other broadcast channels like CSI resources. Then we have traffic beams which are mostly based on PMI or SRS. If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– <u>SSB Beams are Broadcast Type beams and cover larger areas</u></li> <li>– PMI based Beams are more focused and narrower. They are Traffic Type Beams.</li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

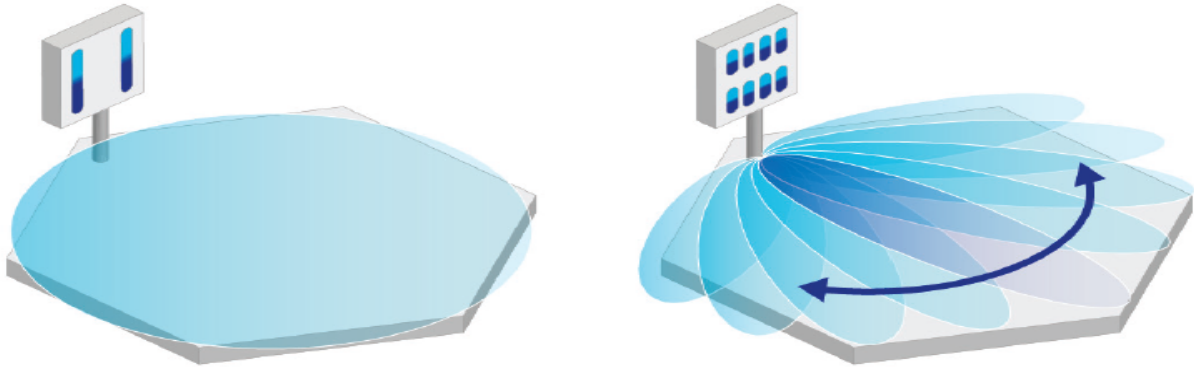
| Claim 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| <p>[20c] providing the second coverage configuration includes transmitting a second beam of the first network that is narrower than the first beam and configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network and providing coverage by a second network to a plurality of interval use devices of the group of devices.</p> | <p>Each Accused Instrumentality practices providing the second coverage configuration includes transmitting a second beam of the first network that is narrower than the first beam and configured to provide coverage to at least one continuous use device of the group of devices, the at least one continuous use device being actively involved in a substantially continuous service with the network, and providing coverage by a second network to a plurality of interval use devices of the group of devices.</p> <p>For example, each Accused Instrumentality provides narrow beams focusing energy on each client device to provide high data rates and provides coverage to lower data rate requirement devices using a second network, <i>e.g.</i> a 5G network.</p> <p><i>See, e.g.:</i></p> <p><b>5G Beams Types: Broadcast &amp; <u>Traffic Beams</u> – SSB, CSI-RS, <u>PMI &amp; SRS</u></b></p> <p>In this post, we will have a look at 5G Beams Types: Broadcast &amp; Traffic Beams – SSB, CSI-RS, PMI &amp; SRS.</p> <p>In 5G, there are multiple types of beams that are used to transmit different types of information. For instance, we have broadcast beams and traffic beams.</p> <p>The Broadcast beams are mainly the common channel beams that are used to transmit SSB. The same beams are also used for other broadcast channels like CSI resources. <u>Then we have traffic beams which are mostly based on PMI or SRS.</u> If the PMI based beams are used, then those beams depend on CSI resources and configuration as the UE decodes the CSI resources to generate CSI feedback which carries the PMIs. If the SRS based beams are used, then those depend on the UE's uplink coverage and the gNB uses the SRS to estimate the optimal beam candidate for the UE.</p> <p>In a nutshell, below are 5G Beams Types.</p> <ul style="list-style-type: none"> <li>– SSB Beams are Broadcast Type beams and cover larger areas</li> <li>– <u>PMI based Beams are more focused and narrower.</u> <u>They are Traffic Type Beams.</u></li> <li>– SRS Based Beams can be even more focused, and they are also Traffic Type Beams.</li> </ul> <p><a href="https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/">https://ourtechplanet.com/5g-beams-types-broadcast-traffic-beams-ssb-csi-rs-pmi-srs/</a></p> |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|          | <p>For consumers, some of the most exciting prospects of 5G's widespread adoption are the Enhanced Mobile Broadband (eMBB) services that are coming with it. 5G's high bandwidth and <u>exceptional speeds are supercharging services like high-definition (HD) video streaming, virtual reality (VR) and augmented reality (AR) and enabling mobile device users to stay connected like never before.</u> Whereas with 4G, at a speed of 500Mbps (Megabits per second), a 15GB HD movie file would take roughly four minutes to download, with 20Gbps 5G, it would take just six seconds. eMBB will also enable high-traffic venues like airports and stadiums to support seamless HD streaming services and allow users to enjoy data speeds of at least 100Mbps in areas where cellular signals are weak.</p> <p>5G: New era of connectivity, <a href="https://semiconductor.samsung.com/insights/topic/5g/">https://semiconductor.samsung.com/insights/topic/5g/</a></p> <p style="text-align: center;"><b>Different Modems for Different Needs</b></p> <p><i>Samsung has developed two types of modems for 5G base stations.</i> The first modem helps a smooth LTE migration and introduction of 5G NR. It supports both <u>4G</u> and <u>5G</u> to enable backward compatibility with previous LTE products while supporting the latest Massive MIMO and 5G standards. The new modem is placed in expandable channel cards and has been developed to be deployed in environments with high-capacity requirements. The second modem has been developed based on years of research experience in the mmWave spectrum. The modem supports high performance but runs on low power and is optimal for compact mmWave base stations.</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/technology/">https://www.samsung.com/global/business/networks/solutions/technology/</a></p>  |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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|          | <p><b>Montreal, Canada - December 13, 2019</b> - Samsung Electronics today announced that it will provide 4G LTE-Advanced (LTE-A) and 5G radio access networks solutions to Videotron, a Canadian telecommunications operator. This is the first time Samsung is delivering network solutions in Canada.</p> <p>After many successful decades in the cable television and internet access business, Videotron deployed its wireless operation in 2010 and has been the fastest growing new operator since then. Currently providing 4G LTE service, Videotron plans to launch commercial LTE-A and 5G services in late 2020.</p> <p><u>Starting in early 2020, Samsung will deliver 4G LTE-A solutions across Quebec and Ottawa in which the solutions from Samsung include Massive MIMO and Dual-band base stations, supporting the operator's 4G LTE frequencies, and 5G solutions for both 3.5GHz and 28GHz spectrum.</u></p> <p>Providing commercially proven <u>4G LTE-A solutions</u> and combined with 5G commercial solutions from global markets, Samsung will increase efficiency in accelerating expansion of 5G service coverage to match pace with Canada's 5G commercial launch, which is expected to take place in late 2020.</p> <p>"We have been all over the world to find the best supplier suited to meet the evolving needs of our customers. This partnership will allow us to deliver the most advanced telecommunications solutions to Quebecers. While 4G technology has profoundly transformed telecommunications in the world, LTE Advanced and 5G will undoubtedly revolutionize the way we interact with our loved ones and the environment around us," said Jean François Pruneau, President and Chief Executive Officer of Videotron. "We want to be with our customers through these major changes and the choice of Samsung as a supplier is not a coincidence, we are convinced that they represent the best option to achieve this objective.</p> <p><a href="https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/">https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/</a></p> |

| Claim 20 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|          | <p data-bbox="680 313 1606 354">Samsung supplies DDS tech for Verizon's 5G network</p>  <p data-bbox="651 641 1829 1078">       Samsung Electronics on Tuesday said it has supplied its dynamic spectrum sharing (DSS) technology to Verizon's network. DSS allows for <u>4G base stations</u> to process 5G signals. It allows carriers to use spectrum they used in 4G for 5G. Verizon launched its 5G nationwide service that uses DSS technology in October last year. The carrier timed it with Apple's launch of iPhone 12, which supports 5G. Ericsson and Nokia had supplied their DSS technology then. Verizon's 5G network at the time covered 200 million people, according to the company. Last month, Verizon said it has expanded its coverage by 24 million people. Samsung's DSS supply comes two months later than its European rivals. The South Korean tech company's equipment covers around 10% of Verizon's 5G coverage to 230 million people. Samsung's kits are being used in central Texas, Tulsa, Oklahoma, upstate New York and New England. Samsung Network used vRAN 2.0 to supply the DSS technology. vRAN 2.0 uses both virtualized distributed unit and core unit. Samsung has supplied virtualized core unit to Japan's KDDI before (called vRAN 1.0) but its supply to Verizon is the first time it is offering virtualized distributed unit as well. Samsung is expected to take away shares from Nokia within Verizon's supply chain this year. Last year, it signed a US\$6.64 billion deal with the carrier to supply 4G and 5G equipment.     </p> <p data-bbox="651 1118 1409 1149">출처 : THE ELEC, Korea Electronics Industry Media(<a href="http://thelec.net">http://thelec.net</a>)</p> <p data-bbox="634 1187 1390 1218"><a href="https://www.thelec.net/news/articleView.html?idxno=2254">https://www.thelec.net/news/articleView.html?idxno=2254</a></p> |

| Claim 20                                                                                         | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| <p>[20d] a processor coupled to the machine readable medium to execute the instructions; and</p> | <p>Each accused Instrumentality practices a processor coupled to the machine readable medium to execute the instructions.</p> <p>For example, each Accused Instrumentality practices the claimed apparatus by providing simultaneous 5G and LTE coverage for a group of devices (gNB/eNB). The base stations comprise processors to execute physical and MAC layer protocols of LTE and 5G standards. The processors require access (coupled to) a memory subsystem to store executable programs and execute the protocols.</p> <p style="text-align: center;"><b>Different Modems for Different Needs</b></p> <p><i>Samsung has developed two types of modems for 5G base stations.</i> The first modem helps a smooth LTE migration and introduction of 5G NR. It supports both 4G and 5G to enable backward compatibility with previous LTE products while supporting the latest Massive MIMO and 5G standards. The new modem is placed in expandable channel cards and has been developed to be deployed in environments with high-capacity requirements. The second modem has been developed based on years of research experience in the mmWave spectrum. The modem supports high performance but runs on low power and is optimal for compact mmWave base stations.</p> <p><a href="https://www.samsung.com/global/business/networks/solutions/technology/">https://www.samsung.com/global/business/networks/solutions/technology/</a></p> |

| Claim 20                                                                                    | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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| <p>[20e] an adaptive antenna configured to transmit the first beam and the second beam.</p> | <p>Each accused Instrumentality practices an adaptive antenna configured to transmit the first beam and the second beam.</p> <p>For example, in massive MIMO an active (“adaptive”) antenna generates multiple beams that can form beams for the different physical channels and toward multiple users in MU-MIMO.</p> <h2 data-bbox="688 459 1440 505">Overview of Massive MIMO</h2> <h3 data-bbox="688 529 1104 561">What is Massive MIMO?</h3> <div data-bbox="699 586 1885 1008">  <div style="display: flex; justify-content: space-around; margin-top: 10px;"> (a) Legacy passive antenna system (b) Active antenna system </div> </div> <p data-bbox="1003 1016 1587 1040" style="text-align: center;">Figure 1. Comparison for beam patterns of cellular systems</p> <p data-bbox="688 1089 1911 1227">The passive antenna beam pattern of legacy cellular systems is fixed and shaped to transmit its signal uniformly within the coverage direction. On the contrary, <u>an active antenna system (AAS) consisting of multiple antenna elements is able to transmit and receive the signal through beams of a narrow beamwidth and high gain as shown in Figure 1.</u> In addition, it can adjust the amplitude and phase of each transmit/receive radio frequency (RF) chain and dynamically control the beam direction toward the location of a desired user.</p> <p data-bbox="634 1300 1890 1365"><a href="https://images.samsung.com/is/content/samsung/assets/global/business/networks/insights/white-papers/1208_massive-mimo-for-new-radio/MassiveMIMOforNRTechnicalWhitePaper-v1.2.0.pdf">https://images.samsung.com/is/content/samsung/assets/global/business/networks/insights/white-papers/1208_massive-mimo-for-new-radio/MassiveMIMOforNRTechnicalWhitePaper-v1.2.0.pdf</a></p> |

**Claim 21:**

| Claim 21                                                                                                                                                                                                                                                                                                                     | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <p>[21] The device of claim 20, wherein the first network and the second network are the same network types, the at least one active device is allowed access to the second beam based on an admission control parameter, and the adaptive antenna is further configured to transmit a third beam of the second network.</p> | <p>In the Accused Instrumentalities, the first network and the second network are the same network types, the at least one active device is allowed access to the second beam based on an admission control parameter, and the adaptive antenna is further configured to transmit a third beam of the second network.</p> <p>For example, Samsung has 5G solutions for both 3.5 and 28 GHz mmWave bands. The 28 GHz band provides high data rates but has short coverage. The 3.5 GHz band has larger coverage area than the 28 GHz band, and the device would operate on 3.5 GHz band when there is poor coverage on the 28 GHz band. Active devices are assigned resources for data transmission using the PDCCH control channel and the Downlink Control Information (DCI) to schedule resources to the device. Massive MIMO solutions in midband (3.5 GHz) frequencies such as Samsung's 64 element antenna solution can support up to 16 users on up to 16 beams.</p> <p><b>Montreal, Canada - December 13, 2019</b> - Samsung Electronics today announced that it will provide 4G LTE-Advanced (LTE-A) and 5G radio access networks solutions to Videotron, a Canadian telecommunications operator. This is the first time Samsung is delivering network solutions in Canada.</p> <p>After many successful decades in the cable television and internet access business, Videotron deployed its wireless operation in 2010 and has been the fastest growing new operator since then. Currently providing 4G LTE service, Videotron plans to launch commercial LTE-A and 5G services in late 2020.</p> <p>Starting in early 2020, Samsung will deliver 4G LTE-A solutions across Quebec and Ottawa in which the solutions from Samsung include Massive MIMO and <u>Dual-band base stations</u>, supporting the operator's 4G LTE frequencies, and <u>5G solutions for both 3.5GHz and 28GHz spectrum</u>.</p> <p>Providing commercially proven 4G LTE-A solutions and combined with 5G commercial solutions from global markets, Samsung will increase efficiency in accelerating expansion of 5G service coverage to match pace with Canada's 5G commercial launch, which is expected to take place in late 2020.</p> <p>"We have been all over the world to find the best supplier suited to meet the evolving needs of our customers. This partnership will allow us to deliver the most advanced telecommunications solutions to Quebecers. While 4G technology has profoundly transformed telecommunications in the world, LTE Advanced and 5G will undoubtedly revolutionize the way we interact with our loved ones and the environment around us," said Jean François Pruneau, President and Chief Executive Officer of Videotron. "We want to be with our customers through these major changes and the choice of Samsung as a supplier is not a coincidence, we are convinced that they represent the best option to achieve this objective.</p> <p><a href="https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/">https://www.samsung.com/global/business/networks/insights/press-release/samsung-selected-as-4g-lte-a-and-5g-network-solution-provider-by-videotron-in-canada/</a></p> |

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|          | <p><b>10.2 Downlink Scheduling</b></p> <p>In the downlink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible assignments when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.</p> <p>The gNB may pre-empt an ongoing PDSCH transmission to one UE with a latency-critical transmission to another UE. The gNB can configure UEs to monitor interrupted transmission indications using INT-RNTI on a PDCCH. If a UE receives the interrupted transmission indication, the UE may assume that no useful information to that UE was carried by the resource elements included in the indication, even if some of those resource elements were already scheduled to this UE.</p> <p>In addition, with Semi-Persistent Scheduling (SPS), the gNB can allocate downlink resources for the initial HARQ transmissions to UEs: RRC defines the periodicity of the configured downlink assignments while PDCCH addressed to CS-RNTI can either signal and activate the configured downlink assignment, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the downlink assignment can be implicitly reused according to the periodicity defined by RRC, until deactivated.</p> <p>NOTE: When required, retransmissions are explicitly scheduled on PDCCH(s).</p> <p>The dynamically allocated downlink reception overrides the configured downlink assignment in the same serving cell, if they overlap in time. Otherwise a downlink reception according to the configured downlink assignment is assumed, if activated.</p> <p>The UE may be configured with up to 8 active configured downlink assignments for a given BWP of a serving cell. When more than one is configured:</p> <ul style="list-style-type: none"> <li>- The network decides which of these configured downlink assignments are active at a time (including all of them); and</li> <li>- <u>Each configured downlink assignment is activated separately using a DCI command and deactivation of configured downlink assignments is done using a DCI command, which can either deactivate a single configured downlink assignment or multiple configured downlink assignments jointly.</u></li> </ul> <p>TS 38.300 version 16.2.0</p> |

### **Samsung Unveils New C-Band Solution, Advancing 5G in the Mid-Band Spectrum**

**SEOUL, Korea – October 27, 2020** – Samsung Electronics Co., Ltd. today announced its C-Band Massive MIMO radio solution at GSMA Thrive North America. The new solution will enable mobile operators to increase coverage range, boost data speeds and ultimately offer enriched 5G experiences to users in the U.S. It is based on Samsung’s field-proven Massive MIMO technologies that are used to provide nationwide 5G services in Korea.

‘C-Band’ is a mid-band spectrum ranging from 3.7 to 4.2 GHz – a range that can offer the right balance of high performance and broad 5G coverage to users in U.S. It is considered a vital frequency range that will allow mobile network operators to improve 5G-powered user experiences. Samsung’s 3.5GHz Massive MIMO radio in the mid-band spectrum was a key driver behind one of the world’s first 5G services in Korea, where it currently has the highest 5G penetration rate. This played an integral part in the successful development of the new C-Band solution.

Samsung’s C-Band Massive MIMO radio utilizes 64 antennas, supports up to 280MHz bandwidth, and delivers a 200W output power. The new solution will be available globally later this year.

“Through our technical leadership in commercializing 5G Massive MIMO radio solutions for various mid-band spectrums, Samsung is helping users gain the full benefits of the C-Band spectrum,” said Jaeho Jeon, Executive Vice President and Head of R&D, Networks Business at Samsung Electronics. “With this new solution, Samsung looks forward to supporting operators in exploring the new possibilities of C-Band and connecting more people to 5G-powered experiences.”

Samsung Networks is a pioneer in the successful delivery of 5G end-to-end solutions including commercializing CBRS and 2.5GHz bands with its Massive MIMO solutions, as well as chipset, radio, and core network technologies. The company has supported 5G commercial service in leading markets, including Korea and the U.S., where the majority of worldwide 5G subscribers are located, and it is supporting the expansion of 5G in Japan. In addition, the company is rapidly expanding its global footprint to new markets, including Canada and New Zealand.

For further information on Samsung’s Massive MIMO radio, please visit [here](#). For more information on Samsung’s C-Band initiatives, read our blog [here](#).

<https://www.samsung.com/global/business/networks/insights/press-release/samsung-unveils-new-c-band-solution-advancing-5g-in-the-mid-band-spectrum/>

| Claim 21 | Public Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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|          | <p><b><u>Multiuser MIMO</u></b></p> <p>Main difference in <u>MU-MIMO</u> and SU-MIMO is that MU-MIMO improve cell throughput by utilizing same DL resources (OFDM Frequency and time resources or the RBs) shared between multiple users in same beam direction where the case of less throughput required per user. So the Cell throughput will be improved by sending more data to more users in same TTI. This technique will improve spectrum efficiency also. In SU-MIMO, all resources was allocated to single user and will improve single user throughput.</p> <p><u>MU-MIMO also supports up to four layers per user and maximum 16 layers per cell means four users with four layers can be paired at a time or eight users with two layers or 16 users with single layer pairings are possible.</u></p> <p><a href="https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g">https://www.5gworldpro.com/blog/2020/12/11/su-mimo-vs-mu-mimo-in-5g</a></p> |