**3GPP TSG-RAN WG1 Meeting #118 R1-24xxxxx**

**Maastricht, The Netherlands, August 19 - 23, 2024**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.211** | **CR** | **xxxx** | **rev** | **-** | **Current version:** | **18.3.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Alignment of parameter names | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh2-Core, NR\_MIMO\_evo\_DL\_UL, NR\_DSS\_enh-Core, NR\_Mob\_enh2-Core | | | | |  | ***Date:*** | | | 2024-08-26 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | * Misalignment of a few RRC parameter names between 38.211 and 38.331 * The port indices for PDSCH DMRS type 2 are not correctly captured. (R1-2406550) * Ambiguous description of the usage of restricted sets for LTM. * Inconsistencies in the usage of higher-layer parameters for SRS frequency hopping. (R1-2407257) * Misalignment with 38.321 with the usage of ‘Multicast-MCC-RNTI’ (R1-2407165) | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * Aligning RRC parameter names with 38.331 * Updating the port indices for PDSCH DMRS type 2 in Table 7.4.1.1.2-2. * Clarified the restricted set configuration for LTM. * Alignment of higher-layer parameter names for SRS frequency hopping. * Correcting the name to ‘Multicast-MCC-RNTI’ | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | * Inconsistent parameter names across specifications. * Incorrect port indices. * Ambigous LTM operation. * Inconsistent description of SRS frequency hopping. * Misalignment between 38.211 and 38.321 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.4.6, 6.3.3.1, 6.4.1.4.1, 6.4.1.4.3, 6.4.1.4.4, 7.3.1.1, 7.3.1.5, 7.3.1.6, 7.3.2.2, 7.4.1.1.1, 7.4.1.1.2, 7.4.1.5.1, 7.4.1.5.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

### 4.4.6 Common MBS frequency resource

A common MBS frequency resource is a contiguous set of common resource blocks. The starting position of the common MBS frequency resource is defined relative to point A and the size of the common MBS frequency resource is given by . Resource blocks in a common MBS frequency resource are numbered in the same way as resource blocks in clause 4.4.4.4 with and replaced by and , respectively.

A UE is not expected to receive PDSCH or PDCCH associated with MBS transmissions scheduled with G-RNTI, G-CS-RNTI, MCCH-RNTI, or Multicast-MCCH-RNTI outside the common MBS frequency resource.

#### 6.3.3.1 Sequence generation

The set of random-access preambles  shall be generated according to



from which the frequency-domain representation shall be generated according to



where , , , or depending on the PRACH preamble format as given by Tables 6.3.3.1-1 and 6.3.3.1-2.

There are 64 preambles defined in each time-frequency PRACH occasion, enumerated in increasing order of first increasing cyclic shift  of a logical root sequence, and then in increasing order of the logical root sequence index, starting with the index obtained from the higher-layer parameter *prach-RootSequenceIndex* or *rootSequenceIndex-BFR* or by *msgA-PRACH-RootSequenceIndex* if configured and a type-2 random-access procedure is initiated as described in clause 8.1 of [5, TS 38.213]. Additional preamble sequences, in case 64 preambles cannot be generated from a single root Zadoff-Chu sequence, are obtained from the root sequences with the consecutive logical indexes until all the 64 sequences are found. The logical root sequence order is cyclic; the logical index 0 is consecutive to . The sequence number  is obtained from the logical root sequence index according to Tables 6.3.3.1-3 to 6.3.3.1-4B.

The cyclic shift  is given by



where  is given by Tables 6.3.3.1-5 to 6.3.3.1-7. The type of restricted sets (unrestricted, restricted type A, restricted type B) is given by

- the higher-layer parameter *msgA-RestrictedSetConfig*, if provided;

- the higher-layer parameter *ltm-RestrictedSetConfig* associated with a candidate cell indicated in the cell indicator field of a PDCCH order, if provided;

- otherwise, the higher-layer parameter *restrictedSetConfig*.

Tables 6.3.3.1-1 and 6.3.3.1-2 indicate the type of restricted sets supported for the different preamble formats.

The variable  is given by



where  is the smallest non-negative integer that fulfils . The parameters for restricted sets of cyclic shifts depend on .

For restricted set type A, the parameters are given by:

- for 



- for 



For restricted set type B, the parameters are given by:

- for 



- for 



- for 



- for 



- for 



- for 



For all other values of , there are no cyclic shifts in the restricted set.

Table 6.3.3.1-1: PRACH preamble formats for  and kHz.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Format |  |  |  |  | Support for restricted sets |
| 0 | 839 | 1.25 kHz |  |  | Type A, Type B |
| 1 | 839 | 1.25 kHz |  |  | Type A, Type B |
| 2 | 839 | 1.25 kHz |  |  | Type A, Type B |
| 3 | 839 | 5 kHz |  |  | Type A, Type B |

Table 6.3.3.1-2: Preamble formats for and kHz where .

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Format |  | | |  |  |  | Support for restricted sets |
|  |  |  |
| A1 | 139 | 1151 | 571 |  |  |  | - |
| A2 | 139 | 1151 | 571 |  |  |  | - |
| A3 | 139 | 1151 | 571 |  |  |  | - |
| B1 | 139 | 1151 | 571 |  |  |  | - |
| B2 | 139 | 1151 | 571 |  |  |  | - |
| B3 | 139 | 1151 | 571 |  |  |  | - |
| B4 | 139 | 1151 | 571 |  |  |  | - |
| C0 | 139 | 1151 | 571 |  |  |  | - |
| C2 | 139 | 1151 | 571 |  |  |  |  |

Table 6.3.3.1-3: Mapping from *logical index*  to sequence number  for preamble formats with .

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence number in increasing order of | | | | | | | | | | | | | | | | | | | |
| 0 – 19 | 129 | 710 | 140 | 699 | 120 | 719 | 210 | 629 | 168 | 671 | 84 | 755 | 105 | 734 | 93 | 746 | 70 | 769 | 60 | 779 |
| 20 – 39 | 2 | 837 | 1 | 838 | 56 | 783 | 112 | 727 | 148 | 691 | 80 | 759 | 42 | 797 | 40 | 799 | 35 | 804 | 73 | 766 |
| 40 – 59 | 146 | 693 | 31 | 808 | 28 | 811 | 30 | 809 | 27 | 812 | 29 | 810 | 24 | 815 | 48 | 791 | 68 | 771 | 74 | 765 |
| 60 – 79 | 178 | 661 | 136 | 703 | 86 | 753 | 78 | 761 | 43 | 796 | 39 | 800 | 20 | 819 | 21 | 818 | 95 | 744 | 202 | 637 |
| 80 – 99 | 190 | 649 | 181 | 658 | 137 | 702 | 125 | 714 | 151 | 688 | 217 | 622 | 128 | 711 | 142 | 697 | 122 | 717 | 203 | 636 |
| 100 – 119 | 118 | 721 | 110 | 729 | 89 | 750 | 103 | 736 | 61 | 778 | 55 | 784 | 15 | 824 | 14 | 825 | 12 | 827 | 23 | 816 |
| 120 – 139 | 34 | 805 | 37 | 802 | 46 | 793 | 207 | 632 | 179 | 660 | 145 | 694 | 130 | 709 | 223 | 616 | 228 | 611 | 227 | 612 |
| 140 – 159 | 132 | 707 | 133 | 706 | 143 | 696 | 135 | 704 | 161 | 678 | 201 | 638 | 173 | 666 | 106 | 733 | 83 | 756 | 91 | 748 |
| 160 – 179 | 66 | 773 | 53 | 786 | 10 | 829 | 9 | 830 | 7 | 832 | 8 | 831 | 16 | 823 | 47 | 792 | 64 | 775 | 57 | 782 |
| 180 – 199 | 104 | 735 | 101 | 738 | 108 | 731 | 208 | 631 | 184 | 655 | 197 | 642 | 191 | 648 | 121 | 718 | 141 | 698 | 149 | 690 |
| 200 – 219 | 216 | 623 | 218 | 621 | 152 | 687 | 144 | 695 | 134 | 705 | 138 | 701 | 199 | 640 | 162 | 677 | 176 | 663 | 119 | 720 |
| 220 – 239 | 158 | 681 | 164 | 675 | 174 | 665 | 171 | 668 | 170 | 669 | 87 | 752 | 169 | 670 | 88 | 751 | 107 | 732 | 81 | 758 |
| 240 – 259 | 82 | 757 | 100 | 739 | 98 | 741 | 71 | 768 | 59 | 780 | 65 | 774 | 50 | 789 | 49 | 790 | 26 | 813 | 17 | 822 |
| 260 – 279 | 13 | 826 | 6 | 833 | 5 | 834 | 33 | 806 | 51 | 788 | 75 | 764 | 99 | 740 | 96 | 743 | 97 | 742 | 166 | 673 |
| 280 – 299 | 172 | 667 | 175 | 664 | 187 | 652 | 163 | 676 | 185 | 654 | 200 | 639 | 114 | 725 | 189 | 650 | 115 | 724 | 194 | 645 |
| 300 – 319 | 195 | 644 | 192 | 647 | 182 | 657 | 157 | 682 | 156 | 683 | 211 | 628 | 154 | 685 | 123 | 716 | 139 | 700 | 212 | 627 |
| 320 – 339 | 153 | 686 | 213 | 626 | 215 | 624 | 150 | 689 | 225 | 614 | 224 | 615 | 221 | 618 | 220 | 619 | 127 | 712 | 147 | 692 |
| 340 – 359 | 124 | 715 | 193 | 646 | 205 | 634 | 206 | 633 | 116 | 723 | 160 | 679 | 186 | 653 | 167 | 672 | 79 | 760 | 85 | 754 |
| 360 – 379 | 77 | 762 | 92 | 747 | 58 | 781 | 62 | 777 | 69 | 770 | 54 | 785 | 36 | 803 | 32 | 807 | 25 | 814 | 18 | 821 |
| 380 – 399 | 11 | 828 | 4 | 835 | 3 | 836 | 19 | 820 | 22 | 817 | 41 | 798 | 38 | 801 | 44 | 795 | 52 | 787 | 45 | 794 |
| 400 – 419 | 63 | 776 | 67 | 772 | 72 | 767 | 76 | 763 | 94 | 745 | 102 | 737 | 90 | 749 | 109 | 730 | 165 | 674 | 111 | 728 |
| 420 – 439 | 209 | 630 | 204 | 635 | 117 | 722 | 188 | 651 | 159 | 680 | 198 | 641 | 113 | 726 | 183 | 656 | 180 | 659 | 177 | 662 |
| 440 – 459 | 196 | 643 | 155 | 684 | 214 | 625 | 126 | 713 | 131 | 708 | 219 | 620 | 222 | 617 | 226 | 613 | 230 | 609 | 232 | 607 |
| 460 – 479 | 262 | 577 | 252 | 587 | 418 | 421 | 416 | 423 | 413 | 426 | 411 | 428 | 376 | 463 | 395 | 444 | 283 | 556 | 285 | 554 |
| 480 – 499 | 379 | 460 | 390 | 449 | 363 | 476 | 384 | 455 | 388 | 451 | 386 | 453 | 361 | 478 | 387 | 452 | 360 | 479 | 310 | 529 |
| 500 – 519 | 354 | 485 | 328 | 511 | 315 | 524 | 337 | 502 | 349 | 490 | 335 | 504 | 324 | 515 | 323 | 516 | 320 | 519 | 334 | 505 |
| 520 – 539 | 359 | 480 | 295 | 544 | 385 | 454 | 292 | 547 | 291 | 548 | 381 | 458 | 399 | 440 | 380 | 459 | 397 | 442 | 369 | 470 |
| 540 – 559 | 377 | 462 | 410 | 429 | 407 | 432 | 281 | 558 | 414 | 425 | 247 | 592 | 277 | 562 | 271 | 568 | 272 | 567 | 264 | 575 |
| 560 – 579 | 259 | 580 | 237 | 602 | 239 | 600 | 244 | 595 | 243 | 596 | 275 | 564 | 278 | 561 | 250 | 589 | 246 | 593 | 417 | 422 |
| 580 – 599 | 248 | 591 | 394 | 445 | 393 | 446 | 370 | 469 | 365 | 474 | 300 | 539 | 299 | 540 | 364 | 475 | 362 | 477 | 298 | 541 |
| 600 – 619 | 312 | 527 | 313 | 526 | 314 | 525 | 353 | 486 | 352 | 487 | 343 | 496 | 327 | 512 | 350 | 489 | 326 | 513 | 319 | 520 |
| 620 – 639 | 332 | 507 | 333 | 506 | 348 | 491 | 347 | 492 | 322 | 517 | 330 | 509 | 338 | 501 | 341 | 498 | 340 | 499 | 342 | 497 |
| 640 – 659 | 301 | 538 | 366 | 473 | 401 | 438 | 371 | 468 | 408 | 431 | 375 | 464 | 249 | 590 | 269 | 570 | 238 | 601 | 234 | 605 |
| 660 – 679 | 257 | 582 | 273 | 566 | 255 | 584 | 254 | 585 | 245 | 594 | 251 | 588 | 412 | 427 | 372 | 467 | 282 | 557 | 403 | 436 |
| 680 – 699 | 396 | 443 | 392 | 447 | 391 | 448 | 382 | 457 | 389 | 450 | 294 | 545 | 297 | 542 | 311 | 528 | 344 | 495 | 345 | 494 |
| 700 – 719 | 318 | 521 | 331 | 508 | 325 | 514 | 321 | 518 | 346 | 493 | 339 | 500 | 351 | 488 | 306 | 533 | 289 | 550 | 400 | 439 |
| 720 – 739 | 378 | 461 | 374 | 465 | 415 | 424 | 270 | 569 | 241 | 598 | 231 | 608 | 260 | 579 | 268 | 571 | 276 | 563 | 409 | 430 |
| 740 – 759 | 398 | 441 | 290 | 549 | 304 | 535 | 308 | 531 | 358 | 481 | 316 | 523 | 293 | 546 | 288 | 551 | 284 | 555 | 368 | 471 |
| 760 – 779 | 253 | 586 | 256 | 583 | 263 | 576 | 242 | 597 | 274 | 565 | 402 | 437 | 383 | 456 | 357 | 482 | 329 | 510 | 317 | 522 |
| 780 – 799 | 307 | 532 | 286 | 553 | 287 | 552 | 266 | 573 | 261 | 578 | 236 | 603 | 303 | 536 | 356 | 483 | 355 | 484 | 405 | 434 |
| 800 – 819 | 404 | 435 | 406 | 433 | 235 | 604 | 267 | 572 | 302 | 537 | 309 | 530 | 265 | 574 | 233 | 606 | 367 | 472 | 296 | 543 |
| 820 – 837 | 336 | 503 | 305 | 534 | 373 | 466 | 280 | 559 | 279 | 560 | 419 | 420 | 240 | 599 | 258 | 581 | 229 | 610 | - | - |

Table 6.3.3.1-4: Mapping from *logical index*  to sequence number  for preamble formats with .

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence number  in increasing order of | | | | | | | | | | | | | | | | | | | |
| 0 – 19 | 1 | 138 | 2 | 137 | 3 | 136 | 4 | 135 | 5 | 134 | 6 | 133 | 7 | 132 | 8 | 131 | 9 | 130 | 10 | 129 |
| 20 – 39 | 11 | 128 | 12 | 127 | 13 | 126 | 14 | 125 | 15 | 124 | 16 | 123 | 17 | 122 | 18 | 121 | 19 | 120 | 20 | 119 |
| 40 – 59 | 21 | 118 | 22 | 117 | 23 | 116 | 24 | 115 | 25 | 114 | 26 | 113 | 27 | 112 | 28 | 111 | 29 | 110 | 30 | 109 |
| 60 – 79 | 31 | 108 | 32 | 107 | 33 | 106 | 34 | 105 | 35 | 104 | 36 | 103 | 37 | 102 | 38 | 101 | 39 | 100 | 40 | 99 |
| 80 – 99 | 41 | 98 | 42 | 97 | 43 | 96 | 44 | 95 | 45 | 94 | 46 | 93 | 47 | 92 | 48 | 91 | 49 | 90 | 50 | 89 |
| 100 – 119 | 51 | 88 | 52 | 87 | 53 | 86 | 54 | 85 | 55 | 84 | 56 | 83 | 57 | 82 | 58 | 81 | 59 | 80 | 60 | 79 |
| 120 – 137 | 61 | 78 | 62 | 77 | 63 | 76 | 64 | 75 | 65 | 74 | 66 | 73 | 67 | 72 | 68 | 71 | 69 | 70 | - | - |
| 138 – 837 | N/A | | | | | | | | | | | | | | | | | | | |

Table 6.3.3.1-4A: Mapping from *logical index* to sequence number for preamble formats with .

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence number in increasing order of | | | | | | | | | | | | | | | | | | | |
| 0-19 | 1 | 1150 | 2 | 1149 | 3 | 1148 | 4 | 1147 | 5 | 1146 | 6 | 1145 | 7 | 1144 | 8 | 1143 | 9 | 1142 | 10 | 1141 |
| 20-39 | 11 | 1140 | 12 | 1139 | 13 | 1138 | 14 | 1137 | 15 | 1136 | 16 | 1135 | 17 | 1134 | 18 | 1133 | 19 | 1132 | 20 | 1131 |
| 40-59 | 21 | 1130 | 22 | 1129 | 23 | 1128 | 24 | 1127 | 25 | 1126 | 26 | 1125 | 27 | 1124 | 28 | 1123 | 29 | 1122 | 30 | 1121 |
| 60-79 | 31 | 1120 | 32 | 1119 | 33 | 1118 | 34 | 1117 | 35 | 1116 | 36 | 1115 | 37 | 1114 | 38 | 1113 | 39 | 1112 | 40 | 1111 |
| 80-99 | 41 | 1110 | 42 | 1109 | 43 | 1108 | 44 | 1107 | 45 | 1106 | 46 | 1105 | 47 | 1104 | 48 | 1103 | 49 | 1102 | 50 | 1101 |
| 100-119 | 51 | 1100 | 52 | 1099 | 53 | 1098 | 54 | 1097 | 55 | 1096 | 56 | 1095 | 57 | 1094 | 58 | 1093 | 59 | 1092 | 60 | 1091 |
| 120-139 | 61 | 1090 | 62 | 1089 | 63 | 1088 | 64 | 1087 | 65 | 1086 | 66 | 1085 | 67 | 1084 | 68 | 1083 | 69 | 1082 | 70 | 1081 |
| 140-159 | 71 | 1080 | 72 | 1079 | 73 | 1078 | 74 | 1077 | 75 | 1076 | 76 | 1075 | 77 | 1074 | 78 | 1073 | 79 | 1072 | 80 | 1071 |
| 160-179 | 81 | 1070 | 82 | 1069 | 83 | 1068 | 84 | 1067 | 85 | 1066 | 86 | 1065 | 87 | 1064 | 88 | 1063 | 89 | 1062 | 90 | 1061 |
| 180-199 | 91 | 1060 | 92 | 1059 | 93 | 1058 | 94 | 1057 | 95 | 1056 | 96 | 1055 | 97 | 1054 | 98 | 1053 | 99 | 1052 | 100 | 1051 |
| 200-219 | 101 | 1050 | 102 | 1049 | 103 | 1048 | 104 | 1047 | 105 | 1046 | 106 | 1045 | 107 | 1044 | 108 | 1043 | 109 | 1042 | 110 | 1041 |
| 220-239 | 111 | 1040 | 112 | 1039 | 113 | 1038 | 114 | 1037 | 115 | 1036 | 116 | 1035 | 117 | 1034 | 118 | 1033 | 119 | 1032 | 120 | 1031 |
| 240-259 | 121 | 1030 | 122 | 1029 | 123 | 1028 | 124 | 1027 | 125 | 1026 | 126 | 1025 | 127 | 1024 | 128 | 1023 | 129 | 1022 | 130 | 1021 |
| 260-279 | 131 | 1020 | 132 | 1019 | 133 | 1018 | 134 | 1017 | 135 | 1016 | 136 | 1015 | 137 | 1014 | 138 | 1013 | 139 | 1012 | 140 | 1011 |
| 280-299 | 141 | 1010 | 142 | 1009 | 143 | 1008 | 144 | 1007 | 145 | 1006 | 146 | 1005 | 147 | 1004 | 148 | 1003 | 149 | 1002 | 150 | 1001 |
| 300-319 | 151 | 1000 | 152 | 999 | 153 | 998 | 154 | 997 | 155 | 996 | 156 | 995 | 157 | 994 | 158 | 993 | 159 | 992 | 160 | 991 |
| 320-339 | 161 | 990 | 162 | 989 | 163 | 988 | 164 | 987 | 165 | 986 | 166 | 985 | 167 | 984 | 168 | 983 | 169 | 982 | 170 | 981 |
| 340-359 | 171 | 980 | 172 | 979 | 173 | 978 | 174 | 977 | 175 | 976 | 176 | 975 | 177 | 974 | 178 | 973 | 179 | 972 | 180 | 971 |
| 360-379 | 181 | 970 | 182 | 969 | 183 | 968 | 184 | 967 | 185 | 966 | 186 | 965 | 187 | 964 | 188 | 963 | 189 | 962 | 190 | 961 |
| 380-399 | 191 | 960 | 192 | 959 | 193 | 958 | 194 | 957 | 195 | 956 | 196 | 955 | 197 | 954 | 198 | 953 | 199 | 952 | 200 | 951 |
| 400-419 | 201 | 950 | 202 | 949 | 203 | 948 | 204 | 947 | 205 | 946 | 206 | 945 | 207 | 944 | 208 | 943 | 209 | 942 | 210 | 941 |
| 420-439 | 211 | 940 | 212 | 939 | 213 | 938 | 214 | 937 | 215 | 936 | 216 | 935 | 217 | 934 | 218 | 933 | 219 | 932 | 220 | 931 |
| 440-459 | 221 | 930 | 222 | 929 | 223 | 928 | 224 | 927 | 225 | 926 | 226 | 925 | 227 | 924 | 228 | 923 | 229 | 922 | 230 | 921 |
| 460-479 | 231 | 920 | 232 | 919 | 233 | 918 | 234 | 917 | 235 | 916 | 236 | 915 | 237 | 914 | 238 | 913 | 239 | 912 | 240 | 911 |
| 480-499 | 241 | 910 | 242 | 909 | 243 | 908 | 244 | 907 | 245 | 906 | 246 | 905 | 247 | 904 | 248 | 903 | 249 | 902 | 250 | 901 |
| 500-519 | 251 | 900 | 252 | 899 | 253 | 898 | 254 | 897 | 255 | 896 | 256 | 895 | 257 | 894 | 258 | 893 | 259 | 892 | 260 | 891 |
| 520-539 | 261 | 890 | 262 | 889 | 263 | 888 | 264 | 887 | 265 | 886 | 266 | 885 | 267 | 884 | 268 | 883 | 269 | 882 | 270 | 881 |
| 540-559 | 271 | 880 | 272 | 879 | 273 | 878 | 274 | 877 | 275 | 876 | 276 | 875 | 277 | 874 | 278 | 873 | 279 | 872 | 280 | 871 |
| 560-579 | 281 | 870 | 282 | 869 | 283 | 868 | 284 | 867 | 285 | 866 | 286 | 865 | 287 | 864 | 288 | 863 | 289 | 862 | 290 | 861 |
| 580-599 | 291 | 860 | 292 | 859 | 293 | 858 | 294 | 857 | 295 | 856 | 296 | 855 | 297 | 854 | 298 | 853 | 299 | 852 | 300 | 851 |
| 600-619 | 301 | 850 | 302 | 849 | 303 | 848 | 304 | 847 | 305 | 846 | 306 | 845 | 307 | 844 | 308 | 843 | 309 | 842 | 310 | 841 |
| 620-639 | 311 | 840 | 312 | 839 | 313 | 838 | 314 | 837 | 315 | 836 | 316 | 835 | 317 | 834 | 318 | 833 | 319 | 832 | 320 | 831 |
| 640-659 | 321 | 830 | 322 | 829 | 323 | 828 | 324 | 827 | 325 | 826 | 326 | 825 | 327 | 824 | 328 | 823 | 329 | 822 | 330 | 821 |
| 660-679 | 331 | 820 | 332 | 819 | 333 | 818 | 334 | 817 | 335 | 816 | 336 | 815 | 337 | 814 | 338 | 813 | 339 | 812 | 340 | 811 |
| 680-699 | 341 | 810 | 342 | 809 | 343 | 808 | 344 | 807 | 345 | 806 | 346 | 805 | 347 | 804 | 348 | 803 | 349 | 802 | 350 | 801 |
| 700-719 | 351 | 800 | 352 | 799 | 353 | 798 | 354 | 797 | 355 | 796 | 356 | 795 | 357 | 794 | 358 | 793 | 359 | 792 | 360 | 791 |
| 720-739 | 361 | 790 | 362 | 789 | 363 | 788 | 364 | 787 | 365 | 786 | 366 | 785 | 367 | 784 | 368 | 783 | 369 | 782 | 370 | 781 |
| 740-759 | 371 | 780 | 372 | 779 | 373 | 778 | 374 | 777 | 375 | 776 | 376 | 775 | 377 | 774 | 378 | 773 | 379 | 772 | 380 | 771 |
| 760-779 | 381 | 770 | 382 | 769 | 383 | 768 | 384 | 767 | 385 | 766 | 386 | 765 | 387 | 764 | 388 | 763 | 389 | 762 | 390 | 761 |
| 780-799 | 391 | 760 | 392 | 759 | 393 | 758 | 394 | 757 | 395 | 756 | 396 | 755 | 397 | 754 | 398 | 753 | 399 | 752 | 400 | 751 |
| 800-819 | 401 | 750 | 402 | 749 | 403 | 748 | 404 | 747 | 405 | 746 | 406 | 745 | 407 | 744 | 408 | 743 | 409 | 742 | 410 | 741 |
| 820-839 | 411 | 740 | 412 | 739 | 413 | 738 | 414 | 737 | 415 | 736 | 416 | 735 | 417 | 734 | 418 | 733 | 419 | 732 | 420 | 731 |
| 840-859 | 421 | 730 | 422 | 729 | 423 | 728 | 424 | 727 | 425 | 726 | 426 | 725 | 427 | 724 | 428 | 723 | 429 | 722 | 430 | 721 |
| 860-879 | 431 | 720 | 432 | 719 | 433 | 718 | 434 | 717 | 435 | 716 | 436 | 715 | 437 | 714 | 438 | 713 | 439 | 712 | 440 | 711 |
| 880-899 | 441 | 710 | 442 | 709 | 443 | 708 | 444 | 707 | 445 | 706 | 446 | 705 | 447 | 704 | 448 | 703 | 449 | 702 | 450 | 701 |
| 900-919 | 451 | 700 | 452 | 699 | 453 | 698 | 454 | 697 | 455 | 696 | 456 | 695 | 457 | 694 | 458 | 693 | 459 | 692 | 460 | 691 |
| 920-939 | 461 | 690 | 462 | 689 | 463 | 688 | 464 | 687 | 465 | 686 | 466 | 685 | 467 | 684 | 468 | 683 | 469 | 682 | 470 | 681 |
| 940-959 | 471 | 680 | 472 | 679 | 473 | 678 | 474 | 677 | 475 | 676 | 476 | 675 | 477 | 674 | 478 | 673 | 479 | 672 | 480 | 671 |
| 960-979 | 481 | 670 | 482 | 669 | 483 | 668 | 484 | 667 | 485 | 666 | 486 | 665 | 487 | 664 | 488 | 663 | 489 | 662 | 490 | 661 |
| 980-999 | 491 | 660 | 492 | 659 | 493 | 658 | 494 | 657 | 495 | 656 | 496 | 655 | 497 | 654 | 498 | 653 | 499 | 652 | 500 | 651 |
| 1000-1019 | 501 | 650 | 502 | 649 | 503 | 648 | 504 | 647 | 505 | 646 | 506 | 645 | 507 | 644 | 508 | 643 | 509 | 642 | 510 | 641 |
| 1020-1039 | 511 | 640 | 512 | 639 | 513 | 638 | 514 | 637 | 515 | 636 | 516 | 635 | 517 | 634 | 518 | 633 | 519 | 632 | 520 | 631 |
| 1040-1059 | 521 | 630 | 522 | 629 | 523 | 628 | 524 | 627 | 525 | 626 | 526 | 625 | 527 | 624 | 528 | 623 | 529 | 622 | 530 | 621 |
| 1060-1079 | 531 | 620 | 532 | 619 | 533 | 618 | 534 | 617 | 535 | 616 | 536 | 615 | 537 | 614 | 538 | 613 | 539 | 612 | 540 | 611 |
| 1080-1099 | 541 | 610 | 542 | 609 | 543 | 608 | 544 | 607 | 545 | 606 | 546 | 605 | 547 | 604 | 548 | 603 | 549 | 602 | 550 | 601 |
| 1100-1119 | 551 | 600 | 552 | 599 | 553 | 598 | 554 | 597 | 555 | 596 | 556 | 595 | 557 | 594 | 558 | 593 | 559 | 592 | 560 | 591 |
| 1120-1139 | 561 | 590 | 562 | 589 | 563 | 588 | 564 | 587 | 565 | 586 | 566 | 585 | 567 | 584 | 568 | 583 | 569 | 582 | 570 | 581 |
| 1140-1149 | 571 | 580 | 572 | 579 | 573 | 578 | 574 | 577 | 575 | 576 | - | - | - | - | - | - | - | - | - | - |

Table 6.3.3.1-4B: Mapping from *logical index* to sequence number for preamble formats with .

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence number in increasing order of | | | | | | | | | | | | | | | | | | | |
| 0-19 | 1 | 570 | 2 | 569 | 3 | 568 | 4 | 567 | 5 | 566 | 6 | 565 | 7 | 564 | 8 | 563 | 9 | 562 | 10 | 561 |
| 20-39 | 11 | 560 | 12 | 559 | 13 | 558 | 14 | 557 | 15 | 556 | 16 | 555 | 17 | 554 | 18 | 553 | 19 | 552 | 20 | 551 |
| 40-59 | 21 | 550 | 22 | 549 | 23 | 548 | 24 | 547 | 25 | 546 | 26 | 545 | 27 | 544 | 28 | 543 | 29 | 542 | 30 | 541 |
| 60-79 | 31 | 540 | 32 | 539 | 33 | 538 | 34 | 537 | 35 | 536 | 36 | 535 | 37 | 534 | 38 | 533 | 39 | 532 | 40 | 531 |
| 80-99 | 41 | 530 | 42 | 529 | 43 | 528 | 44 | 527 | 45 | 526 | 46 | 525 | 47 | 524 | 48 | 523 | 49 | 522 | 50 | 521 |
| 100-119 | 51 | 520 | 52 | 519 | 53 | 518 | 54 | 517 | 55 | 516 | 56 | 515 | 57 | 514 | 58 | 513 | 59 | 512 | 60 | 511 |
| 120-139 | 61 | 510 | 62 | 509 | 63 | 508 | 64 | 507 | 65 | 506 | 66 | 505 | 67 | 504 | 68 | 503 | 69 | 502 | 70 | 501 |
| 140-159 | 71 | 500 | 72 | 499 | 73 | 498 | 74 | 497 | 75 | 496 | 76 | 495 | 77 | 494 | 78 | 493 | 79 | 492 | 80 | 491 |
| 160-179 | 81 | 490 | 82 | 489 | 83 | 488 | 84 | 487 | 85 | 486 | 86 | 485 | 87 | 484 | 88 | 483 | 89 | 482 | 90 | 481 |
| 180-199 | 91 | 480 | 92 | 479 | 93 | 478 | 94 | 477 | 95 | 476 | 96 | 475 | 97 | 474 | 98 | 473 | 99 | 472 | 100 | 471 |
| 200-219 | 101 | 470 | 102 | 469 | 103 | 468 | 104 | 467 | 105 | 466 | 106 | 465 | 107 | 464 | 108 | 463 | 109 | 462 | 110 | 461 |
| 220-239 | 111 | 460 | 112 | 459 | 113 | 458 | 114 | 457 | 115 | 456 | 116 | 455 | 117 | 454 | 118 | 453 | 119 | 452 | 120 | 451 |
| 240-259 | 121 | 450 | 122 | 449 | 123 | 448 | 124 | 447 | 125 | 446 | 126 | 445 | 127 | 444 | 128 | 443 | 129 | 442 | 130 | 441 |
| 260-279 | 131 | 440 | 132 | 439 | 133 | 438 | 134 | 437 | 135 | 436 | 136 | 435 | 137 | 434 | 138 | 433 | 139 | 432 | 140 | 431 |
| 280-299 | 141 | 430 | 142 | 429 | 143 | 428 | 144 | 427 | 145 | 426 | 146 | 425 | 147 | 424 | 148 | 423 | 149 | 422 | 150 | 421 |
| 300-319 | 151 | 420 | 152 | 419 | 153 | 418 | 154 | 417 | 155 | 416 | 156 | 415 | 157 | 414 | 158 | 413 | 159 | 412 | 160 | 411 |
| 320-339 | 161 | 410 | 162 | 409 | 163 | 408 | 164 | 407 | 165 | 406 | 166 | 405 | 167 | 404 | 168 | 403 | 169 | 402 | 170 | 401 |
| 340-359 | 171 | 400 | 172 | 399 | 173 | 398 | 174 | 397 | 175 | 396 | 176 | 395 | 177 | 394 | 178 | 393 | 179 | 392 | 180 | 391 |
| 360-379 | 181 | 390 | 182 | 389 | 183 | 388 | 184 | 387 | 185 | 386 | 186 | 385 | 187 | 384 | 188 | 383 | 189 | 382 | 190 | 381 |
| 380-399 | 191 | 380 | 192 | 379 | 193 | 378 | 194 | 377 | 195 | 376 | 196 | 375 | 197 | 374 | 198 | 373 | 199 | 372 | 200 | 371 |
| 400-419 | 201 | 370 | 202 | 369 | 203 | 368 | 204 | 367 | 205 | 366 | 206 | 365 | 207 | 364 | 208 | 363 | 209 | 362 | 210 | 361 |
| 420-439 | 211 | 360 | 212 | 359 | 213 | 358 | 214 | 357 | 215 | 356 | 216 | 355 | 217 | 354 | 218 | 353 | 219 | 352 | 220 | 351 |
| 440-459 | 221 | 350 | 222 | 349 | 223 | 348 | 224 | 347 | 225 | 346 | 226 | 345 | 227 | 344 | 228 | 343 | 229 | 342 | 230 | 341 |
| 460-479 | 231 | 340 | 232 | 339 | 233 | 338 | 234 | 337 | 235 | 336 | 236 | 335 | 237 | 334 | 238 | 333 | 239 | 332 | 240 | 331 |
| 480-499 | 241 | 330 | 242 | 329 | 243 | 328 | 244 | 327 | 245 | 326 | 246 | 325 | 247 | 324 | 248 | 323 | 249 | 322 | 250 | 321 |
| 500-519 | 251 | 320 | 252 | 319 | 253 | 318 | 254 | 317 | 255 | 316 | 256 | 315 | 257 | 314 | 258 | 313 | 259 | 312 | 260 | 311 |
| 520-539 | 261 | 310 | 262 | 309 | 263 | 308 | 264 | 307 | 265 | 306 | 266 | 305 | 267 | 304 | 268 | 303 | 269 | 302 | 270 | 301 |
| 540-559 | 271 | 300 | 272 | 299 | 273 | 298 | 274 | 297 | 275 | 296 | 276 | 295 | 277 | 294 | 278 | 293 | 279 | 292 | 280 | 291 |
| 560-569 | 281 | 290 | 282 | 289 | 283 | 288 | 284 | 287 | 285 | 286 | - | - | - | - | - | - | - | - | - | - |

Table 6.3.3.1-5:  for preamble formats with kHz.

|  |  |  |  |
| --- | --- | --- | --- |
| *zeroCorrelationZoneConfig*, *msgA-ZeroCorrelationZoneConfig* | value | | |
| Unrestricted set | Restricted set type A | Restricted set type B |
| 0 | 0 | 15 | 15 |
| 1 | 13 | 18 | 18 |
| 2 | 15 | 22 | 22 |
| 3 | 18 | 26 | 26 |
| 4 | 22 | 32 | 32 |
| 5 | 26 | 38 | 38 |
| 6 | 32 | 46 | 46 |
| 7 | 38 | 55 | 55 |
| 8 | 46 | 68 | 68 |
| 9 | 59 | 82 | 82 |
| 10 | 76 | 100 | 100 |
| 11 | 93 | 128 | 118 |
| 12 | 119 | 158 | 137 |
| 13 | 167 | 202 | - |
| 14 | 279 | 237 | - |
| 15 | 419 | - | - |

Table 6.3.3.1-6:  for preamble formats with kHz.

|  |  |  |  |
| --- | --- | --- | --- |
| *zeroCorrelationZoneConfig*, *msgA-ZeroCorrelationZoneConfig* | value | | |
| Unrestricted set | Restricted set type A | Restricted set type B |
| 0 | 0 | 36 | 36 |
| 1 | 13 | 57 | 57 |
| 2 | 26 | 72 | 60 |
| 3 | 33 | 81 | 63 |
| 4 | 38 | 89 | 65 |
| 5 | 41 | 94 | 68 |
| 6 | 49 | 103 | 71 |
| 7 | 55 | 112 | 77 |
| 8 | 64 | 121 | 81 |
| 9 | 76 | 132 | 85 |
| 10 | 93 | 137 | 97 |
| 11 | 119 | 152 | 109 |
| 12 | 139 | 173 | 122 |
| 13 | 209 | 195 | 137 |
| 14 | 279 | 216 | - |
| 15 | 419 | 237 | - |

Table 6.3.3.1-7:  for preamble formats with .

|  |  |  |  |
| --- | --- | --- | --- |
| *zeroCorrelationZoneConfig*, *msgA-ZeroCorrelationZoneConfig* | value | | |
|  |  |  |  |
| 0 | 0 | 0 | 0 |
| 1 | 2 | 8 | 17 |
| 2 | 4 | 10 | 21 |
| 3 | 6 | 12 | 25 |
| 4 | 8 | 15 | 30 |
| 5 | 10 | 17 | 35 |
| 6 | 12 | 21 | 44 |
| 7 | 13 | 25 | 52 |
| 8 | 15 | 31 | 63 |
| 9 | 17 | 40 | 82 |
| 10 | 19 | 51 | 104 |
| 11 | 23 | 63 | 127 |
| 12 | 27 | 81 | 164 |
| 13 | 34 | 114 | 230 |
| 14 | 46 | 190 | 383 |
| 15 | 69 | 285 | 575 |

##### 6.4.1.4.1 SRS resource

An SRS resource is configured by the *SRS-Resource* IE or the *SRS-PosResource* IE and consists of

- antenna ports , where the number of antenna ports is given by the higher layer parameter *nrofSRS-Ports* or *nrofSRS-Ports-n8* if configured, otherwise , and when the SRS resource is in a SRS resource set with higher-layer parameter *usage* in *SRS-ResourceSet* not set to 'nonCodebook', or determined according to [6, TS 38.214] when the SRS resource is in a SRS resource set with higher-layer parameter *usage* in *SRS-ResourceSet* set to 'nonCodebook'.

- , the number of hops for SRS Tx hopping for an SRS resource configured by *SRS-PosResource* and given by the higher layer parameter *numberOfHops* if configured, otherwise .

- consecutive OFDM symbols given by the field *nrofSymbols* contained in the higher layer parameter *resourceMapping*. If ,is the number of consecutive OFDM symbol per hop.

- , the starting position in the time domain given by  where the offset counts symbols backwards from the end of the slot and is given by the field *startPosition* contained in the higher layer parameter *resourceMapping* and . If is the starting position of each hop in the time domain, determined by the field *startPosition* for each SRS transmission hop.

- , the frequency-domain starting position of the sounding reference signal.

##### 6.4.1.4.3 Mapping to physical resources

Throughout this clause, when the higher layer parameter *numberOfHops* is provided for *SRS-PosResource*, the sounding reference signal sequence definitions applies to a given hop.

When SRS is transmitted on a given SRS resource, the sequence for each OFDM symbol and for each of the antenna ports of the SRS resource shall be multiplied with the amplitude scaling factor  in order to conform to the transmit power specified in [5, 38.213] and mapped in sequence starting with  to resource elements  in a slot for each of the antenna ports  according to

The length of the sounding reference signal sequence is given by

where is given by a selected row of Table 6.4.1.4.3-1 with  where  is given by the field *b-SRS* contained in the higher-layer parameter *freqHopping* if configured, otherwise . The row of the table is selected according to the index  given by the field *c-SRS* contained in the higher-layer parameter *freqHopping*. The quantity is given by the higher-layer parameter *FreqScalingFactor* if configured, otherwise . When *FreqScalingFactor* is configured, the UE expects the length of the SRS sequence to be a multiple of 6.

The frequency-domain starting position is defined by

where

and

and

- is given by the higher-layer parameter *StartRBIndex* if configured, otherwise ;

- is given by Table 6.4.1.4.3-3 with

if the higher-layer parameter *EnableStartRBHopping* is configured, otherwise .

- is given by the higher-layer parameter *overlapValue* in *TxHoppingConfig*.

- is the hop transmission counter in the time domain, where corresponds to the order of the higher-layer parameter *SlotOffsetForRemainingHops* in *slotOffsetForRemainingHopsList*.

- is the initial hop index.

The quantity is given by

- if the higher-layer parameter *combOffsetHopping* is not configured:

- if the higher-layer parameter *combOffsetHopping* is configured:

where and is the th entry and the cardinality of the set

respectively, where is given by the higher-layer parameter *hoppingSubset* inthe *combOffsetHopping* IE if configured, otherwise . The higher-layer parameter *hoppingSubset* inthe *combOffsetHopping* IE includes a bitmap of bits with non-zero bits, where if the th non-zero bit is the :th bit in the bitmap, then .

The pseudo-random sequence is defined by clause 5.2.1 and shall be initialized with at the beginning of each radio frame for which , where the comb offset hopping identity  is contained in the higher-layer parameter *combOffsetHopping*.

If the higher-layer parameter *hoppingWithRepetition* is set to *repetition*, , otherwise .

If *numberOfHops* is configured:

- The reference point for is the lowest subcarrier of the configured bandwidth for SRS with Tx hopping configured by the parameter *bwp* in *SRS-PosTx-Hopping*.

otherwise:

- If  the reference point for is subcarrier 0 in common resource block 0, otherwise the reference point is the lowest subcarrier of the BWP.

If the SRS is configured by the IE *SRS-PosResource*, the quantity is given by Table 6.4.1.4.3-2, otherwise .

The frequency domain shift value adjusts the SRS allocation with respect to the reference point grid and is contained in the higher-layer parameter *freqDomainShift* in the *SRS-Resource* IE or the *SRS-PosResource* IE. The transmission comb offset is contained in the higher-layer parameter *transmissionComb* in the *SRS-Resource* IE or the *SRS-PosResource* IE and is a frequency position index.

Frequency hopping of the sounding reference signal is configured by the parameter , given by the field *b-hop* contained in the higher-layer parameter *freqHopping* if configured, otherwise .

If , frequency hopping is disabled and the frequency position index remains constant (unless re-configured) and is defined by



for all OFDM symbols of the SRS resource. The quantity  is given by the higher-layer parameter *freqDomainPosition* if configured, otherwise , and the values of and for are given by the selected row of Table 6.4.1.4.3-1 corresponding to the configured value of .

If , frequency hopping is enabled and the frequency position indices are defined by

where is given by Table 6.4.1.4.3-1,



and where regardless of the value of . The quantity counts the number of SRS transmissions. For the case of an SRS resource configured as aperiodic by the higher-layer parameter *resourceType*, it is given by within the slot in which the symbol SRS resource is transmitted. The quantity is given by if the higher-layer parameter *nrofSRS-Ports-n8* equals ‘ports8tdm’, otherwise . The quantity is the repetition factor given by the field *repetitionFactor* if configured, otherwise .

For the case of an SRS resource configured as periodic or semi-persistent by the higher-layer parameter *resourceType*, the SRS counter is given by

for slots that satisfy . The periodicity  in slots and slot offset  are given in clause 6.4.1.4.4.

Table 6.4.1.4.3-1: SRS bandwidth configuration.

|  |  | |  | |  | |  | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
| 0 | 4 | 1 | 4 | 1 | 4 | 1 | 4 | 1 |
| 1 | 8 | 1 | 4 | 2 | 4 | 1 | 4 | 1 |
| 2 | 12 | 1 | 4 | 3 | 4 | 1 | 4 | 1 |
| 3 | 16 | 1 | 4 | 4 | 4 | 1 | 4 | 1 |
| 4 | 16 | 1 | 8 | 2 | 4 | 2 | 4 | 1 |
| 5 | 20 | 1 | 4 | 5 | 4 | 1 | 4 | 1 |
| 6 | 24 | 1 | 4 | 6 | 4 | 1 | 4 | 1 |
| 7 | 24 | 1 | 12 | 2 | 4 | 3 | 4 | 1 |
| 8 | 28 | 1 | 4 | 7 | 4 | 1 | 4 | 1 |
| 9 | 32 | 1 | 16 | 2 | 8 | 2 | 4 | 2 |
| 10 | 36 | 1 | 12 | 3 | 4 | 3 | 4 | 1 |
| 11 | 40 | 1 | 20 | 2 | 4 | 5 | 4 | 1 |
| 12 | 48 | 1 | 16 | 3 | 8 | 2 | 4 | 2 |
| 13 | 48 | 1 | 24 | 2 | 12 | 2 | 4 | 3 |
| 14 | 52 | 1 | 4 | 13 | 4 | 1 | 4 | 1 |
| 15 | 56 | 1 | 28 | 2 | 4 | 7 | 4 | 1 |
| 16 | 60 | 1 | 20 | 3 | 4 | 5 | 4 | 1 |
| 17 | 64 | 1 | 32 | 2 | 16 | 2 | 4 | 4 |
| 18 | 72 | 1 | 24 | 3 | 12 | 2 | 4 | 3 |
| 19 | 72 | 1 | 36 | 2 | 12 | 3 | 4 | 3 |
| 20 | 76 | 1 | 4 | 19 | 4 | 1 | 4 | 1 |
| 21 | 80 | 1 | 40 | 2 | 20 | 2 | 4 | 5 |
| 22 | 88 | 1 | 44 | 2 | 4 | 11 | 4 | 1 |
| 23 | 96 | 1 | 32 | 3 | 16 | 2 | 4 | 4 |
| 24 | 96 | 1 | 48 | 2 | 24 | 2 | 4 | 6 |
| 25 | 104 | 1 | 52 | 2 | 4 | 13 | 4 | 1 |
| 26 | 112 | 1 | 56 | 2 | 28 | 2 | 4 | 7 |
| 27 | 120 | 1 | 60 | 2 | 20 | 3 | 4 | 5 |
| 28 | 120 | 1 | 40 | 3 | 8 | 5 | 4 | 2 |
| 29 | 120 | 1 | 24 | 5 | 12 | 2 | 4 | 3 |
| 30 | 128 | 1 | 64 | 2 | 32 | 2 | 4 | 8 |
| 31 | 128 | 1 | 64 | 2 | 16 | 4 | 4 | 4 |
| 32 | 128 | 1 | 16 | 8 | 8 | 2 | 4 | 2 |
| 33 | 132 | 1 | 44 | 3 | 4 | 11 | 4 | 1 |
| 34 | 136 | 1 | 68 | 2 | 4 | 17 | 4 | 1 |
| 35 | 144 | 1 | 72 | 2 | 36 | 2 | 4 | 9 |
| 36 | 144 | 1 | 48 | 3 | 24 | 2 | 12 | 2 |
| 37 | 144 | 1 | 48 | 3 | 16 | 3 | 4 | 4 |
| 38 | 144 | 1 | 16 | 9 | 8 | 2 | 4 | 2 |
| 39 | 152 | 1 | 76 | 2 | 4 | 19 | 4 | 1 |
| 40 | 160 | 1 | 80 | 2 | 40 | 2 | 4 | 10 |
| 41 | 160 | 1 | 80 | 2 | 20 | 4 | 4 | 5 |
| 42 | 160 | 1 | 32 | 5 | 16 | 2 | 4 | 4 |
| 43 | 168 | 1 | 84 | 2 | 28 | 3 | 4 | 7 |
| 44 | 176 | 1 | 88 | 2 | 44 | 2 | 4 | 11 |
| 45 | 184 | 1 | 92 | 2 | 4 | 23 | 4 | 1 |
| 46 | 192 | 1 | 96 | 2 | 48 | 2 | 4 | 12 |
| 47 | 192 | 1 | 96 | 2 | 24 | 4 | 4 | 6 |
| 48 | 192 | 1 | 64 | 3 | 16 | 4 | 4 | 4 |
| 49 | 192 | 1 | 24 | 8 | 8 | 3 | 4 | 2 |
| 50 | 208 | 1 | 104 | 2 | 52 | 2 | 4 | 13 |
| 51 | 216 | 1 | 108 | 2 | 36 | 3 | 4 | 9 |
| 52 | 224 | 1 | 112 | 2 | 56 | 2 | 4 | 14 |
| 53 | 240 | 1 | 120 | 2 | 60 | 2 | 4 | 15 |
| 54 | 240 | 1 | 80 | 3 | 20 | 4 | 4 | 5 |
| 55 | 240 | 1 | 48 | 5 | 16 | 3 | 8 | 2 |
| 56 | 240 | 1 | 24 | 10 | 12 | 2 | 4 | 3 |
| 57 | 256 | 1 | 128 | 2 | 64 | 2 | 4 | 16 |
| 58 | 256 | 1 | 128 | 2 | 32 | 4 | 4 | 8 |
| 59 | 256 | 1 | 16 | 16 | 8 | 2 | 4 | 2 |
| 60 | 264 | 1 | 132 | 2 | 44 | 3 | 4 | 11 |
| 61 | 272 | 1 | 136 | 2 | 68 | 2 | 4 | 17 |
| 62 | 272 | 1 | 68 | 4 | 4 | 17 | 4 | 1 |
| 63 | 272 | 1 | 16 | 17 | 8 | 2 | 4 | 2 |

Table 6.4.1.4.3-2: The offset for SRS as a function of and .

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | | | | |
|  |  |  |  |  |
| 2 | 0 | 0,1 | 0,1,0,1 | - | - |
| 4 | - | 0, 2 | 0, 2, 1, 3 | 0, 2, 1, 3, 0, 2, 1, 3 | 0, 2, 1, 3, 0, 2, 1, 3, 0, 2, 1, 3 |
| 8 | - | - | 0, 4, 2, 6 | 0, 4, 2, 6, 1, 5, 3, 7 | 0, 4, 2, 6, 1, 5, 3, 7, 0, 4, 2, 6 |

Table 6.4.1.4.3-3: The quantity as a function of .

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | | |
|  |  |  |  |
| 0 | 0 | 0 | 0 |
| 1 | - | 1 | 2 |
| 2 | - | - | 1 |
| 3 | - | - | 3 |

##### 6.4.1.4.4 Sounding reference signal slot configuration

Throughout this clause, when the higher layer parameter *numberOfHops* is provided for *SRS-PosResource*, the sounding reference signal slot configuration applies to a given hop.

For an SRS resource configured as periodic or semi-persistent by the higher-layer parameter *resourceType*, a periodicity  (in slots) and slot offset  are configured according to the higher-layer parameter *periodicityAndOffset-p* or *periodicityAndOffset-sp* in the *SRS-Resource* IE, or *periodicityAndOffset-p* or *periodicityAndOffset-sp* in the *SRS-PosResource* IE. Candidate slots in which the configured SRS resource may be used for SRS transmission are the slots satisfying

and, if the higher-layer parameter *srs-PosPeriodicConfigHyperSFN-Index* is configured for a periodicity larger than or equal to slots, also

where is given by the higher-layer parameter *srs-PosPeriodicConfigHyperSFN-Index* and is the hyper-frame number.

SRS is transmitted as described in clause 6.2.1 of [6, TS 38.214].

#### 7.3.1.1 Scrambling

Up to two codewords  can be transmitted. In case of single-codeword transmission, .

For each codeword , the UE shall assume the block of bits , where is the number of bits in codeword  transmitted on the physical channel, are scrambled prior to modulation, resulting in a block of scrambled bits according to

where the scrambling sequence is given by clause 5.2.1. The scrambling sequence generator shall be initialized with

where

-  equals the higher-layer parameter *dataScramblingIdentityPDSCH* if configured and the RNTI equals the C-RNTI, MCS-C-RNTI, or CS-RNTI, and the transmission is not scheduled using DCI format 1\_0 in a common search space;

- equals the higher-layer parameter *dataScramblingIdentityPDSCH* if configured in a common MBS frequency resource and the RNTI equals the G-RNTI, G-CS-RNTI, MCCH-RNTI, or Multicast-MCCH-RNTI, and the transmission is scheduled using DCI in a common search space configured in the common MBS frequency resource;

- equals

- the higher-layer parameter *dataScramblingIdentityPDSCH* if the codeword is scheduled using a CORESET with *CORESETPoolIndex* equal to 0;

- the higher-layer parameter *dataScramblingIdentityPDSCH2* if the codeword is scheduled using a CORESET with *CORESETPoolIndex* equal to 1;

if the higher-layer parameters *dataScramblingIdentityPDSCH* and *dataScramblingIdentityPDSCH2* are configured together with the higher-layer parameter *CORESETPoolIndex* containing two different values, and the RNTI equals the C-RNTI, MCS-C-RNTI, or CS-RNTI, and the transmission is not scheduled using DCI format 1\_0 in a common search space;

- otherwise

and where  corresponds to the RNTI associated with the PDSCH transmission as described in clause 5.1 of [6, TS 38.214].

#### 7.3.1.5 Mapping to virtual resource blocks

The UE shall, for each of the antenna ports used for transmission of the physical channel, assume the block of complex-valued symbols conform to the downlink power allocation specified in [6, TS 38.214] and are mapped in sequence starting with to resource elements in the virtual resource blocks assigned for transmission which meet all of the following criteria:

- they are in the virtual resource blocks assigned for transmission;

- the corresponding physical resource blocks are declared as available for PDSCH according to clause 5.1.4 of [6, TS 38.214];

- the corresponding resource elements in the corresponding physical resource blocks are

- not used for transmission of the associated DM-RS or DM-RS intended for other co-scheduled UEs as described in clause 7.4.1.1.2;

- not used for non-zero-power CSI-RS, which is according to clause 7.4.1.5 and not configured by the *TRS-ResourceSet* IE, if the corresponding physical resource blocks are for a PDSCH scheduled by a PDCCH with the CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI for multicast, G-CS-RNTI, or a PDSCH with SPS, except if the non-zero-power CSI-RS is a CSI-RS configured by the higher-layer parameter *CSI-RS-Resource-Mobility* in the *MeasObjectNR* IE or except if the non-zero-power CSI-RS is an aperiodic non-zero-power CSI-RS resource;

- not used for PT-RS according to clause 7.4.1.2;

- not declared as 'not available for PDSCH according to clause 5.1.4 of [6, TS 38.214].

The mapping to resource elements allocated for PDSCH according to [6, TS 38.214] and not reserved for other purposes shall be in increasing order of first the index over the assigned virtual resource blocks, where is the first subcarrier in the lowest-numbered virtual resource block assigned for transmission, and then the index .

#### 7.3.1.6 Mapping from virtual to physical resource blocks

The UE shall assume the virtual resource blocks are mapped to physical resource blocks according to the indicated mapping scheme, non-interleaved or interleaved mapping. If no mapping scheme is indicated, the UE shall assume non-interleaved mapping.

For non-interleaved VRB-to-PRB mapping, virtual resource block is mapped to physical resource block , except for PDSCH transmissions scheduled with DCI format 1\_0 in a common search space in which case virtual resource block is mapped to physical resource block where is the lowest-numbered physical resource block in the control resource set where the corresponding DCI was received. When two PDCCH candidates from two linked common search space sets as indicated by the higher-layer parameter *searchSpaceLinking* are detected, and the two linked common search space sets are associated with different control resource sets, the control resource set with the lowest number among the two linked control resource sets is used to determine .

For interleaved VRB-to-PRB mapping, the mapping process is defined by:

- Resource block bundles are defined as

- for PDSCH transmissions scheduled with DCI format 1\_0 with the CRC scrambled by SI-RNTI in Type0-PDCCH common search space in CORESET 0, the set of resource blocks in CORESET 0 are divided into resource-block bundles in increasing order of the resource-block number and bundle number where is the bundle size and is the size of CORESET 0.

- resource block bundle consists of resource blocks if and resource blocks otherwise,

- all other resource block bundles consists of resource blocks.

- for PDSCH transmissions scheduled with DCI format 1\_0 in any common search space in bandwidth part with starting position , other than Type0-PDCCH common search space in CORESET 0, the set of virtual resource blocks , where is the size of CORESET 0 if CORESET 0 is configured for the cell and the size of initial downlink bandwidth part if CORESET 0 is not configured for the cell, are divided into virtual resource-block bundles in increasing order of the virtual resource-block number and virtual bundle number and the set of physical resource blocks are divided into physical resource-block bundles in increasing order of the physical resource-block number and physical bundle number, where , is the bundle size, and is the lowest-numbered physical resource block in the control resource set where the corresponding DCI was received. When two PDCCH candidates from two linked search space sets as indicated by the higher-layer parameter *searchSpaceLinking* are detected, and the two linked search space sets are associated with different control resource sets, the control resource set with the lowest number among the two linked control resource sets is used to determine .

- resource block bundle 0 consists of resource blocks,

- resource block bundle consists of resource blocks if and resource blocks otherwise,

- all other resource block bundles consists of resource blocks.

- for all other PDSCH transmissions, the set of resource blocks in bandwidth part  with starting position are divided into resource-block bundles in increasing order of the resource-block number and bundle number where  is the bundle size for bandwidth part  provided by the higher-layer parameter *vrb-ToPRB-Interleaver* for DCI formats 1\_0, 1\_1, and 1\_3 in a UE-specific search space, or *vrb-ToPRB-InterleaverDCI-1-2* for DCI format 1\_2, and

- resource block bundle 0 consists of  resource blocks,

- resource block bundle  consists of  resource blocks if  and  resource blocks otherwise,

- all other resource block bundles consists of  resource blocks.

- Virtual resource blocks in the interval  are mapped to physical resource blocks according to

- virtual resource block bundle  is mapped to physical resource block bundle 

- virtual resource block bundle  is mapped to physical resource block bundle  where



- The UE is not expected to be configured with simultaneously with a PRG size of 4 as defined in [6, TS 38.214]

The UE may assume that the same precoding in the frequency domain is used within a PRB bundle and the bundle size is determined by clause 5.1.2.3 in [6, TS 38.214]. The UE shall not make any assumption that the same precoding is used for different bundles of common resource blocks.

For PDSCH transmissions scheduled by DCI format 4\_1 or 4\_2, and using G-RNTI or G-CS-RNTI, the quantities and in this clause are replaced by and , respectively, and is the bundle size for the common MBS frequency resource provided by the higher-layer parameter vrb-ToPRB-Interleaver in pdsch-ConfigMulticast.

For PDSCH transmissions scheduled by DCI format 4\_0, and using G-RNTI for broadcast, MCCH-RNTI, or Multicast-MCCH-RNTI, the quantities and in this clause are replaced by and , respectively, and *.*

#### 7.3.2.2 Control-resource set (CORESET)

A control-resource set consists of resource blocks in the frequency domain and symbols in the time domain.

A control-channel element consists of 6 resource-element groups (REGs) where a resource-element group equals one resource block during one OFDM symbol. Resource-element groups within a control-resource set are numbered in increasing order in a time-first manner, starting with 0 for the first OFDM symbol and the lowest-numbered resource block in the control resource set.

A UE can be configured with multiple control-resource sets. Each control-resource set is associated with one CCE-to-REG mapping only.

The CCE-to-REG mapping for a control-resource set can be interleaved or non-interleaved and is described by REG bundles:

- REG bundle  is defined as REGs where  is the REG bundle size, , and is the number of REGs in the CORESET

- CCE  consists of REG bundles where is an interleaver

For non-interleaved CCE-to-REG mapping, and .

For interleaved CCE-to-REG mapping, for and for . The interleaver is defined by

where .

The UE is not expected to handle configurations resulting in the quantity not being an integer.

For a CORESET configured by the *ControlResourceSet* IE:

- is given by the higher-layer parameter *frequencyDomainResources*;

- is given by the higher-layer parameter *duration*, where is supported only if the higher-layer parameter *dmrs-TypeA-Position* equals 3;

- interleaved or non-interleaved mapping is given by the higher-layer parameter *cce-REG-MappingType*;

- equals 6 for non-interleaved mapping and is given by the higher-layer parameter *reg-BundleSize* for interleaved mapping;

- is given by the higher-layer parameter *interleaverSize*;

- is given by the higher-layer parameter *shiftIndex* if provided, otherwise ;

- for both interleaved and non-interleaved mapping:

- if the higher-layer parameter *precoderGranularity* equals *sameAsREG-bundle* the UE may assume the same precoding being used within a REG bundle

- if the higher-layer parameter *precoderGranularity* equals *allContiguousRBs*,

- the UE may assume the same precoding being used across the all resource-element groups within the set of contiguous resource blocks in the CORESET;

- the UE may assume that no resource elements in the CORESET overlap with an SSB;

- if the UE is not provided with the higher-layer parameter *pdcch-CandidateReceptionWith-CRS-Overlap*, the UE may assume that no resource elements in the CORESET overlap with LTE cell-specific reference signals as indicated by the higher-layer parameter *lte-CRS-ToMatchAround*, *lte-CRS-PatternList1*, *lte-CRS-PatternList2*, *lte-CRS-PatternList3*, or *lte-CRS-PatternList4*.

For CORESET 0 configured by the *ControlResourceSetZero* IE:

- and are defined by clause 13 of [5, TS 38.213];

- the UE may assume interleaved mapping;

- ;

- ;

- ;

- the UE may assume normal cyclic prefix when CORESET 0 is configured by MIB or SIB1;

- the UE may assume the same precoding being used within a REG bundle.

For CORESET 0 on a carrier where the SS/PBCH block is detected at sync raster points defined in Tables 5.4.3.1-2 or 5.4.3.1-3 of [14, TS 38.101-1] and configured by the *ControlResourceSetZero* IE:

- and are defined by Table 13-0 in clause 13 of [5, TS 38.213];

- if on a carrier with a channel bandwidth of 3 MHz, the CORESET is obtained by applying the description above assuming interleaved mapping with ;

- if on a carrier with a channel bandwidth of 3 MHz, the CORESET is obtained by applying the description above assuming interleaved mapping with or non-interleaved mapping as defined by clause 13 of [5, TS 38.213], followed by puncturing the 9 highest-numbered resource blocks to obtain the 15 resource blocks forming CORESET 0;

- if on a carrier with a channel bandwidth of 5 MHz, the CORESET is obtained by applying the description above assuming interleaved mapping with , followed by puncturing the 4 highest-numbered resource blocks to obtain the 20 resource blocks forming CORESET 0;

- ;

- ;

- the UE may assume normal cyclic prefix when CORESET 0 is configured by MIB or SIB1;

- the UE may assume the same precoding being used within a REG bundle.

#### 7.3.2.3 Scrambling

The UE shall assume the block of bits , where is the number of bits transmitted on the physical channel, is scrambled prior to modulation, resulting in a block of scrambled bits according to

where the scrambling sequence  is given by clause 5.2.1. The scrambling sequence generator shall be initialized with



where

- for a UE-specific search space as defined in clause 10 of [5, TS 38.213],  equals the higher-layer parameter *pdcch-DMRS-ScramblingID* if configured;

- for a PDCCH with the CRC scrambled by G-RNTI, G-CS-RNTI, MCCH-RNTI, or Multicast-MCCH-RNTI in a common search space as defined in clause 10 of [5, TS 38.213], equals the higher-layer parameter *pdcch-DMRS-ScramblingID* if configured in a common MBS frequency resource;

- otherwise

and where

-  is given by the C-RNTI for a PDCCH in a UE-specific search space if the higher-layer parameter *pdcch-DMRS-ScramblingID* is configured, and

-  otherwise.

##### 7.4.1.1.1 Sequence generation

The UE shall assume the sequence is defined by

.

where the pseudo-random sequence is defined in clause 5.2.1. The pseudo-random sequence generator shall be initialized with

where is the OFDM symbol number within the slot, is the slot number within a frame, and

- are given by the higher-layer parameters *scramblingID0* and *scramblingID1*, respectively, in the *DMRS-DownlinkConfig* IE if provided and the PDSCH is scheduled by PDCCH using DCI format 1\_1, 1\_2, or 1\_3 with the CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI;

- is given by the higher-layer parameter *scramblingID0* in the *DMRS-DownlinkConfig* IE if provided and the PDSCH is scheduled by PDCCH using DCI format 1\_0 with the CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI;

- are given by the higher-layer parameters *scramblingID0* and *scramblingID1*, respectively, in the *DMRS-DownlinkConfig* IE if provided in a common MBS frequency resource for multicast and the PDSCH is scheduled by PDCCH using DCI format 4\_2 with the CRC scrambled by G-RNTI or G-CS-RNTI;

- is given by the higher-layer parameter *scramblingID0* in the *DMRS-DownlinkConfig* IE if provided in a common MBS frequency resource and the PDSCH is scheduled by PDCCH with the CRC scrambled by G-RNTI, G-CS-RNTI, MCCH-RNTI, or Multicast-MCCH-RNTI;

- otherwise;

- given by

- if the higher-layer parameter *dmrs-Downlink* in the *DMRS-DownlinkConfig* IE is provided

where λ is the CDM group defined in clause 7.4.1.1.2.

- otherwise by

The quantity is given by the DM-RS sequence initialization field, if present, in the DCI associated with the PDSCH transmission if DCI format 1\_1, 1\_2, 1\_3, or 4\_2 in [4, TS 38.212] is used, otherwise .

##### 7.4.1.1.2 Mapping to physical resources

The UE shall assume the PDSCH DM-RS being mapped to physical resources according to configuration type 1 or configuration type 2 as given by the higher-layer parameter *dmrs-Type*.

The UE shall assume the sequence  is scaled by a factor to conform with the transmission power specified in [6, TS 38.214] and mapped to resource elements according to

- if the higher-layer parameter *dmrs-TypeEnh* is configured

- otherwise

where , , and are given by Tables 7.4.1.1.2-1 and 7.4.1.1.2-2 and the following conditions are fulfilled:

- the resource elements are within the common resource blocks allocated for PDSCH transmission

The reference point for is

- subcarrier 0 of the lowest-numbered resource block in CORESET 0 if the corresponding PDCCH is associated with CORESET 0 and Type0-PDCCH common search space and is addressed to SI-RNTI;

- otherwise, subcarrier 0 in common resource block 0

The reference point for  and the position  of the first DM-RS symbol depends on the mapping type:

- for PDSCH mapping type A:

-  is defined relative to the start of the slot

- if the higher-layer parameter *dmrs-TypeA-Position* is equal to 'pos3' and  otherwise

- for PDSCH mapping type B:

-  is defined relative to the start of the scheduled PDSCH resources

- 

The position(s) of the DM-RS symbols is given by  and duration where

- for PDSCH mapping type A, is the duration between the first OFDM symbol of the slot and the last OFDM symbol of the scheduled PDSCH resources in the slot

- for PDSCH mapping type B, is the duration of the scheduled PDSCH resources

and according to Tables 7.4.1.1.2-3 and 7.4.1.1.2-4.

For PDSCH mapping type A

- the case *dmrs-AdditionalPosition* equals to 'pos3' is only supported when *dmrs-TypeA-Position* is equal to 'pos2';

- and symbols in Tables 7.4.1.1.2-3 and 7.4.1.1.2-4 respectively is only applicable when *dmrs-TypeA-Position* is equal to 'pos2';

- single-symbol DM-RS, except if all of the following conditions are fulfilled in which case :

- the higher-layer parameter *lte-CRS-ToMatchAround*, *lte-CRS-PatternList1*, *lte-CRS-PatternList2*, *lte-CRS-PatternList3*, or *lte-CRS-PatternList4* is configured; and

*-* the higher-layer parameter *dmrs-AdditionalPosition* is equal to 'pos1' and ; and

*-* the UE has indicated it is capable of *additionalDMRS-DL-Alt*

For PDSCH mapping type B

- if the PDSCH duration  OFDM symbols for normal cyclic prefix or OFDM symbols for extended cyclic prefix, and the front-loaded DM-RS of the PDSCH allocation collides with resources reserved for a search space set associated with a CORESET,  shall be incremented such that the first DM-RS symbol occurs immediately after the CORESET and until no collision with any CORESET occurs, and

- if the PDSCH duration is 2 symbols, the UE is not expected to receive a DM-RS symbol beyond the second symbol;

- if the PDSCH duration is 5 symbols and if one additional single-symbol DMRS is configured, the UE only expects the additional DM-RS to be transmitted on the 5th symbol when the front-loaded DM-RS symbol is in the 1st symbol of the PDSCH duration, otherwise the UE should expect that the additional DM-RS is not transmitted;

- if the PDSCH duration is 7 symbols for normal cyclic prefix or 6 symbols for extended cyclic prefix:

- if one additional single-symbol DM-RS is configured, the UE only expects the additional DM-RS to be transmitted on the 5th or 6th symbol when the front-loaded DM-RS symbol is in the 1st or 2nd symbol, respectively, of the PDSCH duration, otherwise the UE should expect that the additional DM-RS is not transmitted;

- if the PDSCH duration OFDM symbols, the UE is not expected to receive the front-loaded DM-RS beyond the 4th symbol;

- if the PDSCH duration is 12 or 13 symbols, the UE is not expected to receive DM-RS mapped to symbol 12 or later in the slot;

- for all values of the PDSCH duration other than 2, 5, and 7 symbols, the UE is not expected to receive DM-RS beyond the :th symbol;

- if the PDSCH duration is less than or equal to 4 OFDM symbols, only single-symbol DM-RS is supported.

- if the higher-layer parameter *lte-CRS-ToMatchAround*, *lte-CRS-PatternList1*, *lte-CRS-PatternList2*, *lte-CRS-PatternList3*, or *lte-CRS-PatternList4* is configured, the PDSCH duration symbols for normal cyclic prefix, the subcarrier spacing configuration , single-symbol DM-RS is configured, and at least one PDSCH DM-RS symbol in the PDSCH allocation collides with a symbol containing resource elements as indicated by the higher-layer parameter *lte-CRS-ToMatchAround*, *lte-CRS-PatternList1*, *lte-CRS-PatternList2*, *lte-CRS-PatternList3*, or *lte-CRS-PatternList4*, then shall be incremented by one in all slots.

The time-domain index and the supported antenna ports are given by Table 7.4.1.1.2-5 where

- single-symbol DM-RS is used if the higher-layer parameter *maxLength* in the *DMRS-DownlinkConfig* IE is not configured;

- single-symbol or double-symbol DM-RS is determined by the associated DCI if the higher-layer parameter *maxLength* in the *DMRS-DownlinkConfig* IE is equal to 'len2';

- basic or enhanced DM-RS multiplexing is controlled by the higher-layer parameter *dmrs-TypeEnh.*

In absence of CSI-RS configuration, and unless otherwise configured, the UE may assume PDSCH DM-RS and SS/PBCH block to be quasi co-located with respect to Doppler shift, Doppler spread, average delay, delay spread, and, when applicable, spatial Rx parameters. Unless specified otherwise, the UE may assume that the PDSCH DM-RS within the same CDM group are quasi co-located with respect to Doppler shift, Doppler spread, average delay, delay spread, and spatial Rx (when applicable). The UE may assume that DMRS ports associated with a TCI state as described in clause 5.1.6.2 of [6, TS 38.214] of a PDSCH are QCL with QCL Type A, Type D (when applicable) and average gain.

The UE may assume that no DM-RS collides with the SS/PBCH block.

Table 7.4.1.1.2-1: Parameters for PDSCH DM-RS configuration type 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **CDM group** |  |  |  |
| 1000 | 0 | 0 |  |  |
| 1001 | 0 | 0 |  |  |
| 1002 | 1 | 1 |  |  |
| 1003 | 1 | 1 |  |  |
| 1004 | 0 | 0 |  |  |
| 1005 | 0 | 0 |  |  |
| 1006 | 1 | 1 |  |  |
| 1007 | 1 | 1 |  |  |
| 1008 | 0 | 0 |  |  |
| 1009 | 0 | 0 |  |  |
| 1010 | 1 | 1 |  |  |
| 1011 | 1 | 1 |  |  |
| 1012 | 0 | 0 |  |  |
| 1013 | 0 | 0 |  |  |
| 1014 | 1 | 1 |  |  |
| 1015 | 1 | 1 |  |  |

Table 7.4.1.1.2-2: Parameters for PDSCH DM-RS configuration type 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **CDM group** |  |  |  |
| 1000 | 0 | 0 |  |  |
| 1001 | 0 | 0 |  |  |
| 1002 | 1 | 2 |  |  |
| 1003 | 1 | 2 |  |  |
| 1004 | 2 | 4 |  |  |
| 1005 | 2 | 4 |  |  |
| 1006 | 0 | 0 |  |  |
| 1007 | 0 | 0 |  |  |
| 1008 | 1 | 2 |  |  |
| 1009 | 1 | 2 |  |  |
| 1010 | 2 | 4 |  |  |
| 1011 | 2 | 4 |  |  |
| 1012 | 0 | 0 |  |  |
| 1013 | 0 | 0 |  |  |
| 1014 | 1 | 2 |  |  |
| 1015 | 1 | 2 |  |  |
| 1016 | 2 | 4 |  |  |
| 1017 | 2 | 4 |  |  |
| 1018 | 0 | 0 |  |  |
| 1019 | 0 | 0 |  |  |
| 1020 | 1 | 2 |  |  |
| 1021 | 1 | 2 |  |  |
| 1022 | 2 | 4 |  |  |
| 1023 | 2 | 4 |  |  |

Table 7.4.1.1.2-3: PDSCH DM-RS positions  for single-symbol DM-RS.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **in symbols** | **DM-RS positions** | | | | | | | |
| **PDSCH mapping type A** | | | | **PDSCH mapping type B** | | | |
| ***dmrs-AdditionalPosition*** | | | | ***dmrs-AdditionalPosition*** | | | |
| ***pos0*** | ***pos1*** | ***pos2*** | ***pos3*** | ***pos0*** | ***pos1*** | ***pos2*** | ***pos3*** |
| 2 | - | - | - | - |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  | , 7 | , 7 | , 7 |  |  |  |  |
| 9 |  | , 7 | , 7 | , 7 |  |  |  |  |
| 10 |  | , 9 | , 6, 9 | , 6, 9 |  |  |  |  |
| 11 |  | , 9 | , 6, 9 | , 6, 9 |  |  |  |  |
| 12 |  | , 9 | , 6, 9 | , 5, 8, 11 |  |  |  |  |
| 13 |  | , | , 7, 11 | , 5, 8, 11 |  |  |  |  |
| 14 |  | , | , 7, 11 | , 5, 8, 11 | - | - | - | - |

Table 7.4.1.1.2-4: PDSCH DM-RS positions  for double-symbol DM-RS.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **in symbols** | **DM-RS positions** | | | | | |
| **PDSCH mapping type A** | | | **PDSCH mapping type B** | | |
| ***dmrs-AdditionalPosition*** | | | ***dmrs-AdditionalPosition*** | | |
| ***pos0*** | ***pos1*** | ***pos2*** | ***pos0*** | ***pos1*** | ***pos2*** |
| <4 |  |  |  | - | - |  |
| 4 |  |  |  | - | - |  |
| 5 |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |
| 10 |  | , 8 |  |  |  |  |
| 11 |  | , 8 |  |  |  |  |
| 12 |  | , 8 |  |  |  |  |
| 13 |  | , 10 |  |  |  |  |
| 14 |  | , 10 |  | - | - |  |

Table 7.4.1.1.2-5: PDSCH DM-RS time index and antenna ports .

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DM-RS multiplexing** | **DM-RS duration** |  | **Supported antenna ports** | |
| **Configuration type 1** | **Configuration type 2** |
| Basic | single-symbol DM-RS | 0 | 1000 – 1003 | 1000 – 1005 |
| double-symbol DM-RS | 0, 1 | 1000 – 1007 | 1000 – 1011 |
| Enhanced | single-symbol DM-RS | 0 | 1000 – 1003, 1008 – 1011 | 1000 – 1005, 1012 – 1017 |
| double-symbol DM-RS | 0, 1 | 1000 – 1015 | 1000 – 1023 |

##### 7.4.1.5.1 General

Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined

- for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE or by the *CSI-RS-Resource-Mobility* field in the *CSI-RS-ResourceConfigMobility* IE or by the *TRS-ResourceSet* IE, the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3

- for a zero-power CSI-RS configured by the *ZP-CSI-RS-Resource* IE, the UE shall assume that the resource elements defined in clause 7.4.1.5.3 are not used for PDSCH transmission subject to clause 5.1.4.2 of [6, TS 38.214]. The UE performs the same measurement/reception on channels/signals except PDSCH regardless of whether they collide with ZP CSI-RS or not.

##### 7.4.1.5.3 Mapping to physical resources

For each CSI-RS configured, the UE shall assume the sequence  being mapped to resources elements according to



when the following conditions are fulfilled:

- the resource element is within the resource blocks occupied by the CSI-RS resource for which the UE is configured

The reference point for is subcarrier 0 in common resource block 0.

The value of is given by the higher-layer parameter *density* in the *CSI-RS-ResourceMapping* IE or the *CSI-RS-CellMobility* IE and the number of ports is given by the higher-layer parameter *nrofPorts*. For NZP CSI-RS configured by the *TRS-ResourceSet* IE, the density and number of ports .

The UE is not expected to receive CSI-RS and DM-RS on the same resource elements.

The UE shall assume  for a non-zero-power CSI-RS where  is selected such that the power offset specified by the higher-layer parameter *powerControlOffsetSS* in the *NZP-CSI-RS-Resource* IE or in the *TRS-ResourceSet* IE, if provided, is fulfilled.

The quantities , , , and  are given by Tables 7.4.1.5.3-1 to 7.4.1.5.3-5 where each in a given row of Table 7.4.1.5.3-1 corresponds to a CDM group of size 1 (no CDM) or size 2, 4, or 8. The CDM type is provided by the higher layer parameter *cdm-Type* in the *CSI-RS-ResourceMapping* IE. For NZP CSI-RS configured by the *TRS-ResourceSet* IE, the CDM type is 'noCDM'. The indices and index resource elements within a CDM group.

The time-domain locations and are provided by the higher-layer parameters *firstOFDMSymbolInTimeDomain* and *firstOFDMSymbolInTimeDomain2*, respectively, in the *CSI-RS-ResourceMapping* IE or the *CSI-RS-ResourceConfigMobility* IE and defined relative to the start of a slot. For NZP CSI-RS configured by *TRS-ResourceSet* IE, the time-domain location is provided by the higher-layer parameter *firstOFDMSymbolInTimeDomain* or *firstOFDMSymbolInTimeDomain*+4.

The frequency-domain location is given by a bitmap provided by the higher-layer parameter *frequencyDomainAllocation* in the *CSI-RS-ResourceMapping* IE, the *CSI-RS-ResourceConfigMobility* IE, or the *TRS-ResourceSet* IE, with the bitmap and value of in Table 7.4.1.5.3-1 given by

- , for row 1 of Table 7.4.1.5.3-1

- , for row 2 of Table 7.4.1.5.3-1

- , for row 4 of Table 7.4.1.5.3-1

- , for all other cases

where  is the bit number of the  bit in the bitmap set to one, repeated across every of the resource blocks configured for CSI-RS reception by the UE. The starting position and number of the resource blocks in which the UE shall assume that CSI-RS is transmitted are given by the higher-layer parameters *freqBand* and *density* in the *CSI-RS-ResourceMapping* IE for the bandwidth part given by the higher-layer parameter *BWP-Id* in the *CSI-ResourceConfig* IE or given by the higher-layer parameters *nrofPRBs* in the *CSI-RS-CellMobility* IE where the the *startPRB* given by *csi-rs-MeasurementBW* is relative to common resource block 0*.* For NZP CSI-RS configured by *TRS-ResourceSet* IE, the starting position and number of the resource blocks in which the CSI-RS can be transmitted are given by the higher-layer parameters *nrofRBs*, and *startingRB* in the *TRS-ResourceSet* IE, where *startingRB* is relative to common resource block 0 and the density .

The UE shall assume that a CSI-RS is transmitted using antenna ports  numbered according to



where  is the sequence index provided by Tables 7.4.1.5.3-2 to 7.4.1.5.3-5,  is the CDM group size, and  is the number of CSI-RS ports. The CDM group index  given in Table 7.4.1.5.3-1 corresponds to the time/frequency locations  for a given row of the table. The CDM groups are numbered in order of increasing frequency domain allocation first and then increasing time domain allocation.

For a CSI-RS resource configured as periodic or semi-persistent by the higher-layer parameter *resourceType*, configured by the higher-layer parameter *CSI-RS-CellMobility*,or configured by the higher-layer parameter *TRS-ResourceSet*, the UE shall assume that the CSI-RS is transmitted in slots satisfying



where the periodicity  (in slots) and slot offset  are obtained from the higher-layer parameter *CSI-ResourcePeriodicityAndOffset*, *slotConfig*, *periodicityAndOffset*. The UE shall assume that CSI-RS is transmitted in a candidate slot as described in clause 11.1 of [5, TS 38.213], clause 10.4B of [5, TS 38.213].

The UE may assume that antenna ports within a CSI-RS resource are quasi co-located with QCL Type A, Type D (when applicable), and average gain.

Table 7.4.1.5.3-1: CSI-RS locations within a slot.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Row** | **Ports** | **Density** | ***cdm-Type*** |  | **CDM group index** |  |  |
| 1 | 1 | 3 | noCDM | , , | 0,0,0 | 0 | 0 |
| 2 | 1 | 1, 0.5 | noCDM | , | 0 | 0 | 0 |
| 3 | 2 | 1, 0.5 | fd-CDM2 | , | 0 | 0, 1 | 0 |
| 4 | 4 | 1 | fd-CDM2 | , | 0,1 | 0, 1 | 0 |
| 5 | 4 | 1 | fd-CDM2 | , | 0,1 | 0, 1 | 0 |
| 6 | 8 | 1 | fd-CDM2 | , , , | 0,1,2,3 | 0, 1 | 0 |
| 7 | 8 | 1 | fd-CDM2 | , ,, | 0,1,2,3 | 0, 1 | 0 |
| 8 | 8 | 1 | cdm4-FD2-TD2 | , | 0,1 | 0, 1 | 0, 1 |
| 9 | 12 | 1 | fd-CDM2 | , , , ,, | 0,1,2,3,4,5 | 0, 1 | 0 |
| 10 | 12 | 1 | cdm4-FD2-TD2 | , , | 0,1,2 | 0, 1 | 0, 1 |
| 11 | 16 | 1, 0.5 | fd-CDM2 | , , , ,, , , | 0,1,2,3,  4,5,6,7 | 0, 1 | 0 |
| 12 | 16 | 1, 0.5 | cdm4-FD2-TD2 | , , , | 0,1,2,3 | 0, 1 | 0, 1 |
| 13 | 24 | 1, 0.5 | fd-CDM2 | , , , , , ,, , , , , | 0,1,2,3,4,5,  6,7,8,9,10,11 | 0, 1 | 0 |
| 14 | 24 | 1, 0.5 | cdm4-FD2-TD2 | , , , , , | 0,1,2,3,4,5 | 0, 1 | 0, 1 |
| 15 | 24 | 1, 0.5 | cdm8-FD2-TD4 | , , | 0,1,2 | 0, 1 | 0, 1, 2, 3 |
| 16 | 32 | 1, 0.5 | fd-CDM2 | , , , ,, , , , , , , , , , , | 0,1,2,3,  4,5,6,7,  8,9,10,11,  12,13,14,15 | 0, 1 | 0 |
| 17 | 32 | 1, 0.5 | cdm4-FD2-TD2 | , , , , , , , | 0,1,2,3,4,5,6,7 | 0, 1 | 0, 1 |
| 18 | 32 | 1, 0.5 | cdm8-FD2-TD4 | , , , | 0,1,2,3 | 0,1 | 0,1, 2, 3 |

Table 7.4.1.5.3-2: The sequences  and  for *cdm-Type* equal to 'noCDM'.

|  |  |  |
| --- | --- | --- |
| Index |  |  |
| 0 | 1 | 1 |

Table 7.4.1.5.3-3: The sequences  and  for *cdm-Type* equal to 'fd-CDM2'.

|  |  |  |
| --- | --- | --- |
| Index |  |  |
| 0 |  | 1 |
| 1 |  | 1 |

Table 7.4.1.5.3-4: The sequences  and  for *cdm-Type* equal to 'cdm4-FD2-TD2'.

|  |  |  |
| --- | --- | --- |
| Index |  |  |
| 0 |  |  |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |

Table 7.4.1.5.3-5: The sequences  and  for *cdm-Type* equal to 'cdm8-FD2-TD4'.

|  |  |  |
| --- | --- | --- |
| Index |  |  |
| 0 |  |  |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
| 6 |  |  |
| 7 |  |  |