**3GPP TSG RAN meeting #91e RP-21xxxx**

**Electronic Meeting, March 16-26, 2021**

## Status Report to TSG

**Agenda item:** 9.7.26

|  |  |
| --- | --- |
| **WI / SI Name** | **NR coverage enhancements** |
| included in this status report | Study Item: No | Core part: Yes | Performance part:Yes | Testing part:No |
| **Acronym** | NR\_cov\_enh |
| **Unique ID** | 900061 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-202928 |
| **Target Completion Date****(indicate if changed)** | Study Item: NA | Core part: 03/2022 | Performance part: 09/2022 | Testing part: NA |
| **Overall Completion level** | Study Item: NA | Core part: 15% | Performance Part: 0% | Testing part: NA |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |
| --- | --- |
| **Leading WG** | RAN WG1 |
| **Rapporteur** | **Name** | Jianchi Zhu |
| **Company** | China Telecom |
| **Email** | zhujc@chinatelecom.cn |

## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | Yes |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.
 One time unit (TU) corresponds to ~ 2 hours in the meeting.
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.
 Note: If no Excel table is attached, then this means no time budget change.*

**Additional explanations/motivations for the time budget changes in the attached Excel table:**

0.25 TU is added for RAN4 #98e-bis, i.e., RAN4 TU to this WI is started from RAN4 #98e-bis.

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

 NOTE: Agreements and Open issues impacted cross-TSG aspects shall be explicitly highlighted

## 2.1 RAN1

#### 2.1.1 Agreements

RAN1 #104-e

**PUSCH enhancements:**

Agreements:

Select one of the following alternatives, considering the aspect whether or not the determination of all the available slots should be done prior to the first actual transmission of the repetitions (other alternatives are not precluded)

-        Alt1: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and does not depend on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC).

-        Alt2: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and also depends on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC).

Agreements:

The maximum number of repetitions for DG-PUSCH is also applicable to CG-PUSCH.

Agreements:

For defining available slots: a slot is determined as unavailable if at least one of the symbols indicated by TDRA for a PUSCH in the slot overlaps with the symbol not intended for UL transmissions

* FFS details

Agreements:

Rel-17 PUSCH repetition Type A supports the increase of maximum number of repetitions with repetition factors configured in a TDRA list with a row index indicated either by the configured grant configuration or by TDRA field in a DCI.

* FFS: increasing the maximum number of repetitions with repetition factor configured in *PUSCH-Config* and/or *ConfiguredGrantConfig*.

**Conclusion:**

Discuss further to select one of the following alternatives:

* Alt-a: The determination of all the available slots has to be done prior to the first actual transmission of the repetitions.
* Alt-b: The determination of all the available slots does not have to be done prior to the first actual transmission of the repetitions. The timeline requirement is per repetition basis.

Agreement:

* Consider one or two of the following options as starting points to design time domain resource determination of TBoMS
	+ PUSCH repetition type A like TDRA, i.e., the number of allocated symbols is the same in each slot.
	+ PUSCH repetition type B like TDRA, i.e., the number of allocated symbols in each slot can be different

Agreement:

* The same number of PRBs per symbol is allocated across slots for TBoMS transmission.

Agreements:

* Consecutive physical slots for UL transmission can be used for TBoMS for unpaired spectrum
	+ To resolve in RAN1#104b-e whether to support non-consecutive physical slots for UL transmission for TBoMS for unpaired spectrum
* Consecutive physical slots for UL transmission can be used for TBoMS for paired spectrum and the SUL band
	+ FFS if non-consecutive physical slots for UL transmission are also supported for paired spectrum and the SUL band

Agreements**:**

For TBoMS, the maximum supported TBS should not exceed legacy maximum supported TBS in Rel-15/16, for the same number of layers.

* FFS: Details and further constraints on the applicability of TBoMS.

Agreements:

One or two of the following approaches will be considered as a starting point to decide how$N\_{info}$ *N*Info for TBoMS is calculated (aiming for down selection in RAN1 #104-bis-e):

* **Approach 1**: Based on all REs determined across the symbols or slots (FFS whether symbols or slots are used) over which the TBoMS transmission is allocated
* **Approach 2**: Based on the number of REs determined in the first L symbols over which the TBoMS transmission is allocated, scaled by K≥1.
	+ FFS: the definition of K

Note: L is the number of symbols determined using the SLIV of PUSCH indicated via TDRA

FFS: impacts and further details if repetitions of TBoMS is supported.

FFS: whether the symbols over which the TBoMS transmission is allocated are the same or can be different from the symbols over which the TBoMS transmission is performed, and details on how to handle such scenarios.

Agreements:

One or two of the following options will be considered (aiming for down-selection in RAN1#104b-e) to calculate *NohPRB* for TBoMS:

* **Option 1**: *NohPRB* is assumed to be the same for all the slots over which the TBoMS transmission is allocated and can be configured by xOverhead as in Rel-15/16.
* **Option 2**: *NohPRB* is calculated depending on both xOverhead and the number of symbols or slots (FFS whether symbol or slot are used) over which the TBoMS transmission is allocated.
	+ FFS: if either the number of symbols or the number of slots is used.
	+ FFS: if xOverhead is separately configured from the one in Rel-15/16.

FFS: impacts and further details if repetitions of TBoMS is supported.

FFS: whether the symbols allocated over which the TBoMS transmission is allocated are the same or can be different from the symbols over which the TBoMS transmission is performed.

Agreements:

* Following potential use cases are considered for joint channel estimation for PUSCH:
	+ Use case 1: back-to-back PUSCH transmissions within one slot.
	+ Use case 2: non-back-to-back PUSCH transmissions within one slot.
	+ Use case 3: back-to-back PUSCH transmissions across consecutive slots.
	+ Use case 4: non-back-to-back PUSCH transmissions across consecutive slots.
	+ Use case 5: PUSCH transmissions across non-consecutive slots.

Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions.

Agreements:

* For back-to-back PUSCH transmissions across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation at least for the following case:
	+ Over back-to-back PUSCH transmissions (of the same TB) for repetition type A scheduled by dynamic grant or configured grant
	+ FFS details (including possible other cases)

Agreements:

* For joint channel estimation, a time domain window is introduced to facilitate further discussion, during which UE is expected to maintain power consistency and phase continuity among PUSCH transmissions subject to power consistency and phase continuity requirements.
	+ FFS: whether the window should be specified
	+ FFS: the length of the time domain window is defined by a set of repetitions/slots/symbols
	+ FFS: single or multiple time domain windows
* FFS: relation with UE capability
* FFS: the time domain window may or may not be configured.
* FFS: whether the term "time domain window" is used in the specification or replaced by other technical terms
* FFS: Whether the window is determined by the power consistency and phase continuity requirements and/or by other factors is to be decided.

Agreements:

* Companies are encouraged to study optimization of DMRS granularity in time domain with joint channel estimation, including:
	+ Use cases
	+ Simulations results
	+ Enhanced schemes, e.g.,
		- Different DMRS density for different PUSCH transmissions
		- No DMRS for some PUSCH transmissions
	+ If applicable, impact of dynamic changes, e.g., cancellation of a repetition and companies report the evaluation method.
* Companies are encouraged to study optimization of DMRS location in time domain with joint channel estimation, including:
	+ Use cases
	+ Simulations results
	+ Enhanced schemes, e.g.,
		- DMRS equally spaced among PUSCH transmissions
		- DMRS located in special slots
		- Orphan symbol used for DMRS
	+ If applicable, impact of dynamic changes, e.g., cancellation of a repetition and companies report the evaluation method.
* Note: the simulation assumptions for DM-RS in TR 38.830 are used as baseline for performance evaluation on optimization of DMRS location/granularity in time domain.
	+ Take into account impairments such as frequency offset, and report corresponding parametrization together with the results. Further discuss impairment details.

**Working assumption:**

* For back-to-back PUSCH transmissions across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following case:
	+ Over back-to-back PUSCH transmissions for one TB processed over multiple slots
		- It’s subject to UE capability

Agreements:

* For joint channel estimation.
	+ Take into account the residual frequency error, e.g., +/- 0.1 ppm as upper bound.
	+ Companies can report other values and frequency error model.

**PUCCH enhancements:**

Agreements: Down select from the following two options to support dynamic PUCCH repetition factor indication.

* Option 1 (without DCI enhancement): Enhance RRC signaling to allow configuration of PUCCH repetition factor per PUCCH resource. PUCCH repetition factor is implicitly indicated by DCI.
	+ FFS details, e.g., via reusing the “PUCCH resource indicator” field (without increase # bits of it), starting CCE index (when applicable) of DCI, by PDCCH aggregation level, etc.
	+ FFS: RRC signaling enhancement details
* Option 2 (with DCI enhancement): PUCCH repetition factor is explicitly indicated by DCI
	+ e.g., introduce a new field or increase the number of bits of an existing field (e.g., PRI) in DCI for PUCCH repetition factor indication
	+ FFS whether there is a need for RRC update

Agreements: Subject to the prerequisite of DMRS bundling for PUCCH repetitions, enhance inter-slot frequency hopping pattern for PUCCH repetitions with DMRS bundling.

* FFS: details in inter-slot frequency hopping pattern enhancement, e.g., additional frequency hopping patterns than Rel-16.
* Strive for common design for PUSCH/PUCCH with DMRS bundling as much as possible

Agreements:

Subject to the prerequisites of DMRS bundling for PUCCH repetitions, support enabling PUCCH repetitions with DMRS bundling via RRC configuration.

* FFS: the configuration is per UE or per PUCCH resource.
* FFS: whether additional dynamic signaling is needed to enable/disable PUCCH repetitions with DMRS bundling
* FFS: necessity of additional signaling/configuration of DMRS bundling duration/window and associated size

**Conclusion**: In Rel-17, deprioritize the study of DMRS pattern/location/granularity optimization for PUCCH coverage enhancement in AI 8.8.2. This conclusion could be revisited after the progress on the study of  DMRS pattern/location/granularity optimization for PUSCH coverage enhancement in AI 8.8.1.3.

**Conclusion**: For the study of enhancing inter-slot frequency hopping pattern for PUCCH repetitions with DMRS bundling, at least the following aspects can be considered:

* Performance tradeoff between maximizing # consecutive UL slots in one frequency hop (to achieve more DMRS bundling gain) and maximizing # hops (to achieve more diversity gain)
	+ Note: the maximum # frequency hopping positions is still 2 as in Rel-15/16.
* Interaction between hopping boundary determination and TDD configuration

**Conclusion**: For the simulations to study the enhancement of inter-slot frequency hopping pattern for PUCCH repetitions with DMRS bundling, simulation assumptions in 38.830 are reused as a starting point.

Note: Additional simulation scenarios/assumptions are not precluded.

**Type A PUSCH repetitions for Msg3:**

**Agreements:**

* For indication of the number of repetitions for Msg3 initial transmission, down-select one option from the options below.
	+ Option1: UL grant scheduling Msg3.
		- FFS details.
		- FFS fallbackRAR UL grant.
		- Note: Optimization specific for fallbackRAR UL grant in 2-step RACH is not considered in Rel-17 CovEnh WI, if supported.
	+ Option2: DCI format 1\_0 with CRC scrambled by RA-RNTI
		- FFS details.
	+ Option3: SIB1 only
* Any modifications of RAR UL grant or DCI format 1\_0 with CRC scrambled by RA-RNTI for indicating Msg3 repetitions shall not impact the legacy UE interpretation of the RAR or DCI format 1\_0 with CRC scrambled by RA-RNTI respectively

**Agreements:**

* For indication of the number of repetitions for Msg3 re-transmission, down-select one option from the options below.

Option1: DCI format 0\_0 with CRC scrambled by TC-RNTI.

FFS details.

Any modifications of DCI format 0\_0 with CRC scrambled by TC-RNTI for indicating Msg3 repetitions shall not impact the legacy UE interpretation of the DCI format 0\_0 with CRC scrambled by TC-RNTI.

Option2: Can be determined based on the repetition number  for  Msg3 initial transmission

**Agreements:**

Support inter-slot frequency hopping for repetition of Msg3 initial and re-transmission.

FFS details, e.g., signaling etc.

**Agreements:**

For Msg3 PUSCH repetition, the following options are considered, aiming for down-selection in RAN1#104b-e:

* Option 1-1: For gNB scheduled Msg3 PUSCH repetition without UE request,
* A UE indicates to support of Msg3 PUSCH repetition via separate PRACH occasion or separate PRACH preamble in case of shared PRACH occasions.
* For a UE supporting Msg3 PUSCH repetition, gNB decides whether to schedule Msg3 PUSCH repetition or not. If scheduled, gNB decides the number of repetitions.
* FFS details if any.
* Option 1-2: For gNB scheduled Msg3 PUSCH repetition without UE request,
* gNB decides whether to schedule Msg3 PUSCH repetition or not. If scheduled, gNB decides the number of repetitions.
* For UE does not support Msg3 PUSCH repetition, UE transmits Msg3 PUSCH without repetition
* For UE does support Msg3 PUSCH repetition, UE transmits Msg3 PUSCH with repetition as indicated by gNB and UE uses, e.g., separate DMRS configuration or UCI multiplexing with Msg3 PUSCH (or other ways)
* Note: e.g., this can be for differentiation between UEs not supporting Msg3 PUSCH repetition and Rel-17 CE UEs supporting Msg3 PUSCH repetition or between RACH procedure with Msg3 PUSCH repetition and Msg3 PUSCH without repetition, etc.
* gNB blindly decodes Msg3 PUSCH with two different assumptions, w/ and w/o repetition.
* FFS details if any.
* Option 2-1: For UE triggered Msg3 PUSCH repetition with gNB indicating the number of repetitions,
* A UE can trigger RACH procedure with Msg3 PUSCH repetition via separate PRACH occasion or separate PRACH preamble in case of shared PRACH occasions.
* Whether a UE would trigger is based on some conditions, e.g., measured SS-RSRP threshold, which may or may not have spec impact.
* If Msg3 PUSCH repetition is triggered by UE, gNB decides the number of repetitions for Msg3 PUSCH 3 (re)-transmission.
* FFS details if any.
* Option 2-2: For UE triggered Msg3 PUSCH repetition with gNB indicating the number of repetitions,
	+ gNB decides whether to schedule Msg3 PUSCH repetition or not. If scheduled, gNB decides the number of repetitions.
	+ If Msg3 PUSCH repetition is scheduled, UE transmits Msg3 PUSCH with or without repetition. If UE transmits Msg3 PUSCH repetition, the number of repetition follows the indication of gNB and UE uses e.g., separate DMRS configuration or UCI multiplexing with Msg3 PUSCH (or other ways)
* Whether a UE would trigger is based on some conditions, e.g., measured SS-RSRP threshold, which may or may not have spec impact.
	+ FFS details if any.
* Other options are not precluded.

#### 2.1.2 Remaining Open issues

* PUSCH enhancements
	+ Detailed mechanisms for enhancements on PUSCH repetition type A
		- Increasing the maximum number of repetitions.
		- The number of repetitions counted on the basis of available UL slots.
	+ Detailed mechanism(s) to support TB processing over multi-slot PUSCH
		- TBS determined based on multiple slots and transmitted over multiple slots.
	+ Detailed mechanism(s) to support joint channel estimation
		- Mechanism(s) to enable joint channel estimation over multiple PUSCH transmissions
			* Potential optimization of DMRS location/granularity in time domain is not precluded
		- Inter-slot frequency hopping with inter-slot bundling to enable joint channel estimation
* PUCCH enhancements
	+ Detailed signaling mechanism to support dynamic PUCCH repetition factor indication
	+ Detailed mechanism to support DMRS bundling across PUCCH repetitions
* Detailed mechanism(s) to support Type A PUSCH repetitions for Msg3

## 2.2 RAN2

#### 2.2.1 Agreements

#### 2.2.2 Remaining Open issues

## 2.3 RAN3

#### 2.3.1 Agreements

#### 2.3.2 Remaining Open issues

## 2.4 RAN4

#### 2.4.1 Agreements

The progress in RAN4 #98e meeting is summarized below:

* The Email discussion summary for [98e][155] NR\_reply\_LS\_Part\_2 was provided in R4-2103341.
* The Reply LS on PUCCH and PUSCH repetition was approved in R4-2103393.
* The Way forward on phase continuity and power consistency for PUCCH and PUSCH repetition was approved in R4-2103363.

#### 2.4.2 Remaining Open issues

* Conditions for joint channel estimation to keep power consistency and phase continuity to be investigated and specified if necessary by RAN4.

## 2.5 RAN5

#### 2.5.1 Agreements

#### 2.5.2 Remaining Open issues

#### 2.5.3 Remaining Open issues with cross-WG dependencies

## 2.6 RAN6

#### 2.6.1 Agreements

#### 2.6.2 Remaining Open issues

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

NOTE: This section only needs to be filled in for WI/SIs where there is a corresponding relevant WI/SI in SA/CT.

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

NOTE: This section should also flag any critical dependencies that need TSG attention.

## 4. References

NOTE: This can be e.g. a list of all related Tdocs in the affected WGs since last TSG, references to LSs, produced TRs/TSs, the work/study item description or status reports of previous TSGs.

RAN1 #104e:

1. R1-2100914, Work plan for Rel-17 WI on NR coverage enhancements, China Telecom
2. R1-2102113, FL Summary on Enhancements on PUSCH repetition type A, Moderator (Sharp)
3. R1-2102241, FL summary of TB processing over multi-slot PUSCH, Moderator (Nokia, Nokia Shanghai Bell)
4. R1-2102161, [104-e-NR-CovEnh-03] Summary of email discussion on joint channel estimation for PUSCH, Moderator (China Telecom)
5. R1-2102226, Feature lead summary on support of Type A PUSCH repetitions for Msg3, Moderator (ZTE Corporation)
6. R1-2100095, Discussion on enhanced PUSCH repetition type A, ZTE
7. R1-2100172, Enhancements on PUSCH repetition type A, OPPO
8. R1-2100196, Coverage enhancements for PUSCH repetition typeA Huawei, HiSilicon
9. R1-2100397, Discussion on enhancements on PUSCH repetition type A CATT
10. R1-2100457, Discussion on enhancement for PUSCH repetition type A vivo
11. R1-2100665, Enhancements on PUSCH repetition type A Intel Corporation
12. R1-2100712, Discussions on PUSCH repetition type A enhancements LG Electronics
13. R1-2100731, PUSCH repetition for coverage enhancements InterDigital, Inc.
14. R1-2100915, Enhancements on PUSCH repetition type A China Telecom
15. R1-2100942, Discussion on  enhancements on PUSCH repetition type A NEC
16. R1-2101001, Enhancements on PUSCH repetition type A Lenovo, Motorola Mobility
17. R1-2101017, Discussion on enhancements on PUSCH repetition Type A Panasonic Corporation
18. R1-2101055, Discussion on enhancements on PUSCH repetition type A CMCC
19. R1-2101127, Enhancements on PUSCH repetiton type A Xiaomi
20. R1-2101221, Enhancements on PUSCH repetition type A Samsung
21. R1-2101327, Design Considerations for Enhancements on PUSCH repetition Sierra Wireless, S.A.
22. R1-2101395, Discussion on PUSCH repetition type A enhancement Apple
23. R1-2101407, PUSCH Repetitions for Coverage Enhancement Indian Institute of Tech (H)
24. R1-2101477, Enhancements on PUSCH repetition type A Qualcomm Incorporated
25. R1-2101520, PUSCH Repetition Type A Enhancement Ericsson
26. R1-2101545, Enhancements on PUSCH repetition type A Sharp
27. R1-2101641, Enhancements on PUSCH repetition type A NTT DOCOMO, INC.
28. R1-2101656, Enhancements on PUSCH repetiton type A Xiaomi
29. R1-2101679, Discussion on enhancements on PUSCH repetition type A WILUS Inc.
30. R1-2101710, Enhancements on PUSCH repetition type A Nokia, Nokia Shanghai Bell
31. R1-2100096, Discussion on TB processing over multi-slot PUSCH ZTE
32. R1-2100173, Supporting TB over multi-slot PUSCH OPPO
33. R1-2100232, Discussion on TB processing over multi-slot PUSCH Huawei, HiSilicon
34. R1-2100398, Discussion on TB processing over multi-slot PUSCH CATT
35. R1-2100458, Discussion on PUSCH TB processing over multiple slots vivo
36. R1-2100666, Discussion on TB processing over multi-slot PUSCH Intel Corporation
37. R1-2100713, Discussions on TB processing over multi-slot PUSCH LG Electronics
38. R1-2100732, TB processing over multi-slot PUSCH InterDigital, Inc.
39. R1-2100743, Views on TB processing over multi-slot PUSCH Fujitsu
40. R1-2100916, Discussion on TB processing over multi-slot PUSCH China Telecom
41. R1-2100943, Discussion on TB processing over multi-slot PUSCH NEC
42. R1-2101002, Enhancements for TB processing over multi-slot PUSCH Lenovo, Motorola Mobility
43. R1-2101018, Discussion on TB processing over multi-slot PUSCH Panasonic Corporation
44. R1-2101056, Discussion on TB processing over multi-slot PUSCH CMCC
45. R1-2101128, Joint channel estimation for PUSCH Xiaomi
46. R1-2101222, TB processing over multi-slot PUSCH Samsung
47. R1-2101328, Design Considerations for TB processing over multi-slot PUSCH Sierra Wireless, S.A.
48. R1-2101396, Discussion on TB processing over multi-slot PUSCH Apple
49. R1-2101406, On TB processing over multiple slots for PUSCH Indian Institute of Tech (H)
50. R1-2101478, TB processing over multi-slot PUSCH Qualcomm Incorporated
51. R1-2101521, TB Processing over Multi-Slot PUSCH Ericsson
52. R1-2101546, TB processing over multi-slot PUSCH Sharp
53. R1-2101642, TB processing over multi-slot PUSCH NTT DOCOMO, INC.
54. R1-2101646, Discussion on TB processing over multi-slot PUSCH MediaTek Inc.
55. R1-2101680, Discussion on TB processing over multi-slot PUSCH WILUS Inc.
56. R1-2101711, Transport block processing for PUSCH coverage enhancements Nokia, Nokia Shanghai Bell
57. R1-2100097, Discussion on joint channel estimation for PUSCH ZTE
58. R1-2100174, Joint channel estimation for PUSCH OPPO
59. R1-2100233, Discussion on Joint channel estimation for PUSCH Huawei, HiSilicon
60. R1-2100399, Discussion on joint channel estimation for PUSCH CATT
61. R1-2100459, Discussion on Joint channel estimation for PUSCH vivo
62. R1-2100558, Potential techniques for PUSCH coverage enhancement Potevio Company Limited
63. R1-2100667, Discussion on joint channel estimation for PUSCH Intel Corporation
64. R1-2100714, Discussions on joint channel estimation for PUSCH LG Electronics
65. R1-2100733, Discussions on joint channel estimation for PUSCH InterDigital, Inc.
66. R1-2100797, Considerations on joint channel estimation over multi-PUSCH Spreadtrum Communications
67. R1-2100917, Discussion on joint channel estimation for PUSCH China Telecom
68. R1-2101003, Enhancements for DM-RS bundling for multiple PUSCH Lenovo, Motorola Mobility
69. R1-2101020, Discussion on joint channel estimation for PUSCH Panasonic Corporation
70. R1-2101057, Discussion on joint channel estimation for PUSCH CMCC
71. R1-2101223, Joint channel estimation for PUSCH Samsung
72. R1-2101329, Design Considerations for Joint channel estimation for PUSCH Sierra Wireless, S.A.
73. R1-2101397, Discussion on joint channel estimation for PUSCH Apple
74. R1-2101479, Joint channel estimation for PUSCH Qualcomm Incorporated
75. R1-2101522, Joint Channel Estimation for PUSCH Ericsson
76. R1-2101547, Joint channel estimation for PUSCH Sharp
77. R1-2101643, Joint channel estimation for PUSCH NTT DOCOMO, INC.
78. R1-2101681, Discussion on joint channel estimation for PUSCH WILUS Inc.
79. R1-2101712, Joint channel estimation for PUSCH coverage enhancements Nokia, Nokia Shanghai Bell
80. R1-2100098, Discussion on coverage enhancements for PUCCH ZTE
81. R1-2100175, PUCCH enhancements for coverage OPPO
82. R1-2100198, PUCCH coverage enhancement Huawei, HiSilicon
83. R1-2100400, Discussion on PUCCH enhancements CATT
84. R1-2100460, Discussion on PUCCH enhancements vivo
85. R1-2100668, Discussion on PUCCH enhancements Intel Corporation
86. R1-2100715, Discussions on coverage enhancement for PUCCH LG Electronics
87. R1-2100747, Discussions on PUCCH enhancements InterDigital, Inc.
88. R1-2100798, Considerations on PUCCH coverage enhancement Spreadtrum Communications
89. R1-2100918, Discussion on PUCCH enhancements China Telecom
90. R1-2101021, Discussion on PUCCH enhancement for NR coverage enhancement Panasonic Corporation
91. R1-2101058, Discussion on PUCCH enhancements CMCC
92. R1-2101081, PUCCH enhancements ETRI
93. R1-2101129, PUCCH enhancement Xiaomi
94. R1-2101224, PUCCH enhancements Samsung
95. R1-2101398, PUCCH coverage enhancement Apple
96. R1-2101480, PUCCH coverage enhancements Qualcomm Incorporated
97. R1-2101523, PUCCH Dynamic Repetition and DMRS Bundling Ericsson
98. R1-2101548, Dynamic PUCCH repetition factor indication Sharp
99. R1-2101576, Enhancements for PUCCH repetition Lenovo, Motorola Mobility
100. R1-2101626, PUCCH enhancements for coverage enhancements NTT DOCOMO, INC.
101. R1-2101682, Discussion on PUCCH enhancements for coverage enhancement WILUS Inc.
102. R1-2101713, PUCCH coverage enhancements Nokia, Nokia Shanghai Bell
103. R1-2100099, Discussion on support of Type A PUSCH repetitions for Msg3 ZTE
104. R1-2100176, Type A PUSCH repetitions for Msg3 coverage OPPO
105. R1-2100197, Msg3 repetition for coverage enhancement Huawei, HiSilicon
106. R1-2100401, Discussion on Type A PUSCH repetitions for Msg3 CATT
107. R1-2100461, Discussion on Type A PUSCH repetitions for Msg3 vivo
108. R1-2100490, Target of PUSCH Msg.3 coverage enhancements SoftBank Corp.
109. R1-2100669, On Msg3 PUSCH repetition Intel Corporation
110. R1-2100716, Discussion on coverage enhancement for Msg3 PUSCH LG Electronics
111. R1-2100748, Type A PUSCH repetitions for Msg3 InterDigital, Inc.
112. R1-2100919, Discussion on type A PUSCH repetitions for Msg3 China Telecom
113. R1-2100944, Discussion on PUSCH repetitions for Msg3 NEC
114. R1-2101022, Discussion on Type A PUSCH repetitions for Msg.3 Panasonic Corporation
115. R1-2101059, Discussion on type A PUSCH repetitions for Msg3 CMCC
116. R1-2101082, PUSCH coverage enhancement ETRI
117. R1-2101130, Type A PUSCH repetitions for Msg3 Xiaomi
118. R1-2101225, Type A PUSCH repetitions for Msg3 Samsung
119. R1-2101399, Discussion on msg3 PUSCH repetition Apple
120. R1-2101481, Type A PUSCH repetition for Msg3 Qualcomm Incorporated
121. R1-2101524, Type A PUSCH Repetition for Msg3 Ericsson
122. R1-2101549, Type A PUSCH repetitions for Msg3 Sharp
123. R1-2101627, Type A PUSCH repetitions for Msg3 for coverage enhancements NTT DOCOMO, INC.
124. R1-2101683, Discussion on Type A PUSCH repetitions for Msg3 WILUS Inc.
125. R1-2101714, Approaches and solutions for Type A PUSCH repetitions for Msg3 Nokia, Nokia Shanghai Bell
126. R1-2100100, Discussion on PUSCH and Msg3 enhancements for Redcap UEs ZTE
127. R1-2100177, Other considerations for coverage enhancement OPPO
128. R1-2100402, Views on reusing PUSCH enhancements for Msg3 CATT
129. R1-2100462, Enhanced Contention resolution mechanism for CBRA procedure with MSG3 PUSCH repetition vivo
130. R1-2100749, Discussion on the number of HARQ processes for VoIP InterDigital, Inc.
131. R1-2100868, Association of dual polarized SSBs Sony
132. R1-2101226, Discussion on PRACH enhancements for msg3 improvement Samsung
133. R1-2101253, Views on handling potential overlaps with other WIs Huawei, HiSilicon
134. R1-2101525, Other Coverage Enhancements for PUSCH Ericsson
135. R1-2101715, On the scope of RAN1 LS on phase and power requirements for joint channel estimation/DM-RS bundling of PUSCH and PUCCH Nokia, Nokia Shanghai Bell

RAN4 #98e:

1. R4-2103003 Email discussion summary for [98e][155] NR\_reply\_LS\_Part\_2 Moderator (China Telecom)
2. R4-2103341 Email discussion summary for [98e][155] NR\_reply\_LS\_Part\_2 Moderator (China Telecom)
3. R4-2103288 Reply LS on PUCCH and PUSCH repetition Qualcomm
4. R4-2103393 Reply LS on PUCCH and PUSCH repetition Qualcomm
5. R4-2103289 Way forward on phase continuity and power consistency for PUCCH and PUSCH repetition Huawei, HiSilicon
6. R4-2103363 Way forward on phase continuity and power consistency for PUCCH and PUSCH repetition Huawei, HiSilicon
7. R4-2100159 Discussion on phase continuity for PUSCH and PUCCH repetitions for LS reply InterDigital Communications
8. R4-2100889 Discussion on LS on PUCCH and PUSCH repetition Qualcomm Incorporated
9. R4-2102347 Reply LS on PUCCH and PUSCH repetition Ericsson
10. R4-2102630 on phase continuity for PUCCH and PUSCH repetition and reply LS Huawei, HiSilicon

 28.01.2021 minor adaptations for RAN #91e

 09.11.2020 minor adaptations for RAN #90e

 31.08.2020 minor adaptations for RAN #89e

 20.04.2020 minor adaptations for RAN #88e

 18.02.2020 minor adaptations for RAN #87e

 14.11.2019 minor adaptations for RAN #86

 18.08.2019 minor adaptations for RAN #85

 12.05.2019 minor adaptations for RAN #84

 27.02.2019 minor adaptations for RAN #83

 21.11.2018 completion levels with colours added (for RAN #82)

v04.81 31.07.2018 simplification of template and addition of cross-TSG aspects (for RAN #81)

v04.80 21.05.2018 minor adaptations for RAN #80

v04.79 26.02.2018 minor adaptations for RAN #79

v04.78 18.11.2017 minor adaptations for RAN #78

v04.77 06.08.2017 minor adaptations for RAN #77

v04.76 15.05.2017 minor adaptations for RAN #76

v04.75 31.01.2017 minor adaptations for RAN #75

v04.74 28.10.2016 minor adaptations for RAN #74

v04.73 01.09.2016 adaptations for RAN #73 (time units in extra Excel table, RAN6 reporting included)

v04.72 26.05.2016 adaptations for RAN #72 (introduction of NR & GERAN TUs)

v04.71 10.02.2016 minor adaptations for RAN #71

v04.70 30.10.2015 minor adaptations for RAN #70

v04.69 12.08.2015 minor adaptations for RAN #69

v04.68 21.05.2015 minor adaptations for RAN #68

v04.67 01.02.2015 minor adaptations for RAN #67

v04.66 16.11.2014 minor adaptations for RAN #66

v04.65 16.08.2014 minor adaptations for RAN #65

v04.64 22.05.2014 minor adaptations for RAN #64

v04.63 24.01.2014 restructuring for RAN #63 to cover Core & Perf. in one doc file

v03.62 11.11.2013 section 1.2.3 adapted for RAN #62

v03 11.08.2013 section 1.2.3 added on time budget

v02 07.05.2010 history added, some spelling corrections

v01 13.11.2009 First version of the template