**3GPP TSG RAN meeting #97-e RP-22xxxx**

**e-meeting, September 12-16, 2022**

## Status Report to TSG

**Agenda item:** 9.3.1.2

|  |  |
| --- | --- |
| **WI / SI Name** | Multi-carrier enhancements for NR |
| included in this status report | Study Item: No | Core part: Yes | Performance part:Yes | Testing part:No |
| **Acronym** | NR\_MC\_enh |
| **Unique ID** | 940094 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-221435 |
| **Target Completion Date****(indicate if changed)** | Study Item: N/A | Core part: 12/2023 | Performance part: 06/2024 | Testing part: N/A |
| **Overall Completion level** | Study Item: N/A | Core part: 30% | Performance Part: 0% | Testing part: N/A |

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** | RAN1 |
| **Rapporteur** | **Name** | Hiroki Harada |
| **Company** | NTT DOCOMO, INC. |
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## 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?** | No |

*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:**

## 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

9.10.1 Multi-cell PUSCH/PDSCH scheduling with a single DCI

**RAN1#110**

**Agreement**

All the co-scheduled cells by a DCI format 0\_X and the scheduling cell are included in the same PUCCH group.

**Agreement**

Confirm below working assumption reached in RAN1#109e meeting.

* **(Working assumption)** DCI format 0\_X/1\_X is a new DCI format for multi-cell scheduling

**Working Assumption**

For a cell within a set of cells which can be co-scheduled by a DCI format 0\_X/1\_X, support monitoring the DCI format 0\_X/1\_X and legacy single cell scheduling DCI format(s) from a same scheduling cell.

* The DCI format 0\_X/1\_X and the legacy DCI format(s) can be monitored simultaneously.
	+ FFS: whether monitoring of the DCI format 0\_X/1\_X and the legacy DCI format(s) is supported for one, a subset, or all cells within the set of cells.
* FFS: number of different DCI sizes for 0\_X/1\_X and for legacy DCI formats
* FFS: whether to support a subset or all legacy DCI format(s) to be monitored with DCI 0\_X/1\_X

**Working Assumption**

* The maximum number of co-scheduled cells by a DCI format 1\_X in Rel-18 is 4.
* The maximum number of co-scheduled cells by a DCI format 0\_X in Rel-18 is 4.

FFS: The maximum number of configurable cells for co-scheduling

**Agreement**

For discussing field design of DCI format 0\_X/1\_X which schedules more than one cell, reformulate the types of DCI fields as below:

* Type-1 field:
	+ Type-1A field: A single field indicating common information to all the co-scheduled cells
	+ Type-1B field: A single field indicating separate information to each of co-scheduled cells via joint indication
	+ Type-1C field: A single field indicating an information to only one of co-scheduled cells
* Type-2 field: Separate field for each of the co-scheduled cells
* Type-3 field: Common or separate to each of the co-scheduled cells, or separate to each sub-group, dependent on explicit configuration.
	+ Note: One sub-group comprises a subset of co-scheduled cells where a single field is commonly applied to the co-scheduled cell(s) belonging to a same sub-group.
* Note: Handling of any parameters applicable to multi-cell scheduling where corresponding fields are not included in DCI format 0\_X/1\_X (if any) will be separately discussed.

**Agreement**

* For DCI format 1\_X/0\_X which can schedule more than one cell,
* Type-1 fields at least include below:
	+ Type-1A:
		- Identifier for DCI formats
		- Downlink assignment index
		- TPC for scheduled PUCCH
		- PUCCH resource indicator
		- PDSCH-to-HARQ timing indicator
		- One-shot HARQ-ACK request
* Type-2 fields at least include below:
	+ New data indicator per TB
	+ Redundancy version per TB
* FFS: Other fields to be included in DCI format 1\_X/0\_X and which type of the fields belongs to.
* FFS: size for each field

**Agreement**

* When UE detects a DCI format 1\_X scheduling a set of PDSCHs, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot , where is a number of slots and is indicated by the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format and is the last UL slot overlapping with the DL slot for the reference PDSCH reception for slot-based PUCCH or an UL slot overlapping with the end of the reference PDSCH reception in DL slot for sub-slot based PUCCH.

* FFS details of reference PDSCH

**Agreement**

* For Type-2 HARQ-ACK codebook, two sub-codebooks are generated with a first sub-codebook comprising HARQ-ACK information bits for PDSCH(s) scheduled by DCI(s) with each scheduling a single cell and a second sub-codebook comprising HARQ-ACK information bits for PDSCH(s) scheduled by DCI(s) with each scheduling more than one cell.
* Separate DAI counting for DCI(s) with each scheduling a single cell and DCI(s) with each scheduling more than one cell.
* FFS whether a DCI scheduling more than one cell is associated with the first sub-codebook or the second sub-codebook when the number of cells with actual PDSCH reception due to collision with semi-static TDD DL/UL configuration is one.
* Type-2 HARQ-ACK codebook is generated by concatenating the first sub-codebook and the second sub-codebook.
* If at least one cell of the set of cells which can be co-scheduled by a DCI format 1\_X is configured with maximum 2 codewords per PDSCH without spatial bundling,
	+ FFS: the number of HARQ-ACK information bits for each DCI format 1\_X that schedules more than one cell;
* Otherwise, the number of HARQ-ACK information bits for each DCI format 1\_X that schedules more than one cell is equal to N, where N is the maximum number of cells which can be co-scheduled by a DCI format 1\_X in the PUCCH group for the UE.
* HARQ-ACK information bits for co-scheduled PDSCHs by a DCI format 1\_X is ordered based on serving cell indices associated with co-scheduled PDSCHs.
* HARQ-ACK bundling across co-scheduled cells is not supported for multi-cell scheduling.

**Agreement**

UE does not expect to be configured both CBG-based PDSCH/PUSCH transmission and the multi-cell PDSCH/PUSCH scheduling on the same or different cells within a same PUCCH group.

**Agreement**

* At least cases 1-1 and 1-2 on SCS are supported:
* Case 1-1: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells including the scheduling cell and same SCS is used among all the co-scheduled cells including the scheduling cell.
* Case 1-2: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells not including the scheduling cell and same SCS is used among all the co-scheduled cells which may be same or different to the SCS of the scheduling cell.
* Case 1-3: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells including the scheduling cell and different SCS is used among the co-scheduled cells including the scheduling cell.
* Case 1-4: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells not including the scheduling cell and different SCS is used among the co-scheduled cells.
* FFS: Whether Case 1-3 or 1-4 is additionally supported.

9.10.2 Multi-carrier UL Tx switching scheme

**RAN1#110**

**Working Assumption**

* If Rel-18 UL Tx switching is supported, following switching mechanism is considered as baseline for the Rel-18 UL Tx switching across 3 or 4 bands
	+ Alt.1: Dynamic Tx carrier switching can be across all the supported switching cases by the UE and based on the UL scheduling, i.e., via dynamic grant and/or RRC configuration for UL transmission
* RAN1 will support one or more of following complexity reduction options, considering at least the potential additional preparation time, additional interruption time, and RF complexity for certain switching cases/patterns, if Rel-18 UL Tx switching is supported based on Alt.1, and companies are encouraged to investigate options with striving for down-selection at RAN1#110bis-e.
	+ Option 1: UE is allowed to support only some of concurrent UL cases (band pairs)
		- FFS: at least one band pair should be supported as in Rel-17
		- FFS: for both 3 and 4 bands cases or only for 4 bands case
		- FFS: potential capability/RRC signaling
	+ Option 2: UE is allowed to support 2 ports transmission only on some of bands out of configured bands for UL Tx switching
		- FFS: at least two bands should support up to 2 Tx as in Rel-17
		- FFS: for both 3 and 4 bands cases or only for 4 bands case
		- FFS: for both switched UL and dual UL cases or only for dual UL case
		- FFS: whether/how to reuse or extend existing capability/RRC signaling
	+ Option 3: UE is allowed with more preparation procedure time (or interruption time) only for some specific switching cases/patterns
		- FFS: specific switching cases/patterns where more preparation procedure time (or interruption time) is necessary, e.g., switching patterns not existed in Rel-17
		- FFS: how long preparation procedure time and/or interruption time is necessary, and whether RAN4 involvement is necessary
		- FFS: whether/how to report/indicate the specific switching cases/patterns and/or value(s) of preparation procedure time (or interruption time)
		- FFS: what is the definition of preparation procedure time or interruption time, including whether interruption happens during the preparation procedure time and whether it includes switching period
		- FFS: whether/how long minimum interval between two succeeding UL Tx switching is necessary
	+ Option 4: UE is allowed to support only some of band pairs for tx switching
		- FFS: at least one band pair should be supported as in Rel-17
		- FFS: for both 3 and 4 bands cases or only for 4 bands case
		- FFS: for switched UL and/or dual UL
		- FFS: potential capability/RRC signaling
	+ Other options are not precluded

## 2.2 RAN2

#### 2.2.1 Agreements

**RAN2#119-e**

* As a baseline, RAN2 reuse Rel-16/17 UL Tx switching band combination list (i.e. *BandCombinationList-UplinkTxSwitch-r16*) for Rel-18 UL Tx switching capability reporting.
* As a baseline, uplink bands for Rel-18 UL Tx switching are configured as in legacy way, i.e. by *UplinkConfig*.
* RAN2 waits for RAN1/4 input and then addresses the potential issues according to RAN1/4 indication, e.g.:

– whether the switching period is configured per band pair or per band combination on UE capability reporting.

– whether the switching option (i.e. switchedUL or dualUL) is configured per band pair or per band combination on UE capability reporting.

– how RRC configures a period location for each band pair within three or four bands on RRC configuration.

– how to configure a state of Tx chains after the UL Tx switching is not unique in Rel-18 framework on RRC configuration.

#### 2.2.2 Remaining Open issues

All objectives related to RAN2 from WID on Multi-carrier enhancements for NR as below

- Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN2, RAN4]

* UL Tx switching schemes across up to 3 or 4 bands with restriction of up to 2 Tx simultaneous transmission for FR1 UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands for both single TAG and multiple TAGs configurations (RAN1, RAN4)
	+ UE capability and RRC configuration related signalling (RAN2)

## 2.3 RAN3

#### 2.3.1 Agreements

#### 2.3.2 Remaining Open issues

## 2.4 RAN4

#### 2.4.1 Agreements

**RAN4#104-e**

Agreement from R4-2214463

Issue 2-1-1: Set of values for Tx switching period

RAN4 agreements have been captured in the reply LS to RAN1.

Issue 2-1-2: Granularity of Tx switching period

RAN4 agreements have been captured in the reply LS to RAN1.

Issue 2-1-3: Exact value of Tx switching period

Further discuss the two options in the next meeting:

Option 1: Reuse the ***same*** switching period for each band pair as UE reported in Rel-16/17, i.e., UE does not need to report new or larger switching period per band pair for Rel-18 Tx switching.

Option 2: Although the set of switching periods is the same as in Rel-16/17, a ***different*** value can be reported for each band pair in Rel-18 Tx switching with 3/4 bands configured.

Sub-topic 2-2: Impact from switching of one Tx chain on the other Tx chain

Issue 2-2-1: Impact on the band with the number of Tx chain ***changed*** due to switching

RAN4 agreements have been captured in the reply LS to RAN1.

Issue 2-2-2: Impact on the band with the number of Tx chain ***unchanged*** due to switching

GTW Agreement:

As baseline UE assumption, neither of Tx chains is expected to be used for transmission on band C during the switching period.

RAN4 will further discuss optional advanced features to allow the other Tx chain can be expected to be used for transmission on band C during the switching period as advanced/optional UE assumption.

Sub-topic 2-3: Possible mechanisms for dynamic Tx carrier switching across the configured bands

Issue 2-3-2: Switching cases for CA option 2

This issue is covered in the switching mechanism discussion in RAN1.

Sub-topic 2-4: PUSCH preparation time

Issue 2-4-1: PUSCH preparation procedure time / scheduling delay

To be discussed in RAN1.

Sub-topic 2-5: Other issues

Issue 2-5-1: Concurrent UL transmission on 2 bands

RAN4 agreements have been captured in the reply LS to RAN1.

Issue 2-5-2: Number of bands supporting 2Tx / UL-MIMO

Issue 2-5-2A: On 2Tx

Covered in RAN1 discussion

Issue 2-5-2B: On UL-MIMO

Covered in RAN1 discussion

Issue 2-5-3: Support of intra-band UL CA

The following observation is aligned with the current WI scope approved in RAN plenary. Further update on the WI scope is not precluded and is up to RAN plenary decision.

Observation: Scope of the WI is limited such way that only one band among 3 or 4 bands that are part of the configured TX switching scheme can have intra-band UL CA configured.

Issue 2-5-4: RF requirements

No need to define RF requirements for UL CA with UL simultaneous transmission on 3 and 4 bands in the WI.

For the next meeting, encourage analysis/identification of the RAN4 RF requirements needed for this WI.

Issue 2-5-5: UE complexity aspect

GTW Agreement:

The complexity related aspects would be discussed in RAN4 in future meetings.

Agreement from R4-2214464

On the length of switching period:

* For UL switching period with Tx switching across 3 or 4 bands, RAN4 agreed to reuse the same set of values as in Rel-16/17, i.e., {35 us, 140 us, 210 us} for UL CA and SUL.
* The length of switching period is applied per band pair for each band combination.
* For each band pair, the switching period can be the same or different for 1Tx-2Tx switching and 2Tx-2Tx switching based on UE reporting, which is similar as in Rel-17.
	+ Note: For UE reporting different periods for 1Tx-2Tx switching and 2Tx-2Tx switching for a band pair, similar to Rel-17, it is RAN4 understanding that the 2Tx-2Tx switching period is applied when 2Tx-2Tx switching mode is configured.
* For the same band pair, RAN4 has not concluded on whether the same or a different value can be reported for the specific band pair supporting Tx switching across 3 or 4 bands in Rel-18 compared to Tx switching across 2 bands specified in Rel-16/17.

On the UE complexity:

RAN4 has not identified any technical difficulty for UE to prevent realizing Tx switching across 3 or 4 bands.

RAN4 would like to recommend the UE memory sharing issue to be further discussed in RAN1 if necessary.

RAN4 has discussed the UE assumption/behavior considering two cases:

* Case 1: One of the two Tx chains is triggered to switch from one band (named “band A”) to another band (name “band B”), and the other Tx chain is maintained on either band A or band B.

For Case 1, RAN4 agreed that neither of Tx chains is expected to be used for transmission during the switching period.

* Case 2: One of the two Tx chains is triggered to switch from one band (named “band A”) to another band (name “band B”), and the other Tx chain is maintained on a different band (named “band C”).

For Case 2, RAN4 agreed that, as baseline UE assumption, neither of Tx chains is expected to be used for transmission on band C during the switching period.

RAN4 also discussed other related issues for UL Tx switching across 3 or 4 bands in single TAG scenario, and reached the following agreements:

**For concurrent UL transmission on 2 bands:**

For UL Tx switching across 3 and 4 bands, the support of concurrent UL transmission on 2 (out of 3 or 4) bands at least requires UL CA support on the corresponding band pair(s) by the UE.

Agreement from R4-2214465

Sub-topic 3.1 Tx switching with multiple TAGs

Issue 3-1-1 UL switching time

**WF (as per agreement at the Aug 22 GTW)**

**Agreement:**

RAN4 further discuss if the UL switching time is the same for single TAG and 2 TAGs

UL switching time should not include timing difference up to MTTD between two TAGs.

**FFS:**

UE may omit the uplink transmissions corresponding to any TAG during the UE switching time.

Issue 3-1-2: UL outage time

**WF**

**Factors for UL outage time discussed in RF session, to be further checked in RRM session**

**UL switching time (UE capability)**

**The difference between the TA on the two TAGs, up to MTTD**

**Timing and measurement error**

Issue 3-1-3: Sub-topic PUSCH preparation time

**WF**

**The PUSCH preparation time includes the effect of TA and difference between multiple active component carriers in addition to the switching period (Rel-16)**

**RAN1 to confirm in case further clarification is needed**

Issue 3-1-4: DL interruption time for Tx switching with multiple TAGs

**WF**

**to be discussed in the RRM session**

Issue 3-1-5 UE capability and release independence

**WF**

**To be discussed after we know requirements and spec impact**

Sub-topic 3-1-6 RAN4 CR text

**WF**

**Further discuss at the next meeting**

Issue 3-1-7 Need of RAN1 spec impact

**WF**

**Inform RAN1 that the target scenario considered by RAN4 for the Rel-18 specification is multiple-TAG (dual-TAG) for switching between 2 bands..**

Sub-topic 3-2 Additional issue for Tx switching accorss 3/4 bands with multiple TAGs

Issue 3-2-1 Target scenarios

Option 1: Limit number of TAGs to up to 2 for all the cases in the Rel-18 WI (QC, DCM, CTC, Samsung, OPPO, Xiaomi, Sony, OPPO, E///, Nokia)

Option 2: Limit number of TAGs for 3 and 4 band cases to 1 (QC, Nokia)

Option 3: In the scenario of multi-TAG, the switching time masks do not include timing advance difference but the timing advance difference should be considered with the switching time. (HW)

Option 4: focus on 2-TAG case at first, and then extend to the same number of bands if time allowed. (ZTE)

**WF (as per agreement at the Aug 22 GTW)**

Agreement:

Agree option 1.

#### 2.4.2 Remaining Open issues

All objectives related to RAN4 from WID on Multi-carrier enhancements for NR as below

-Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN2, RAN4]

* UL Tx switching schemes across up to 3 or 4 bands with restriction of up to 2 Tx simultaneous transmission for FR1 UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands for both single TAG and multiple TAGs configurations (RAN1, RAN4)
* Switching time and other RF aspects, and RRM requirements for above UL Tx switching schemes across up to 3 or 4 bands (RAN4)

-Specify RRM test cases related to core requirements on UL Tx switching schemes across up to 3 or 4 bands

[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#110**

|  |  |  |
| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [**R1-2205862**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205862.zip) | Discussion on multi-cell scheduling with a single DCI | Huawei, HiSilicon |
| [**R1-2205962**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205962.zip) | Discussion on Multi-cell PUSCH/PDSCH scheduling with a single DCI | ZTE |
| [**R1-2206005**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206005.zip) | Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI | Spreadtrum Communications |
| [**R1-2206059**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206059.zip) | Discussion on multi-cell scheduling | vivo |
| [**R1-2206103**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206103.zip) | Discussions on multi-cell PUSCH/PDSCH scheduling with a single DCI | Langbo |
| [**R1-2206155**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206155.zip) | On multi-cell PUSCH/PDSCH scheduling with a single DCI | Nokia, Nokia Shanghai Bell |
| [**R1-2206176**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206176.zip) | Consideration on multi-cell PUSCH/PDSCH scheduling with a single DCI | Fujitsu |
| [**R1-2206326**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206326.zip) | Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI | OPPO |
| [**R1-2206382**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206382.zip) | Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI | CATT |
| [**R1-2206451**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206451.zip) | Discussion on multi-cell scheduling via a single DCI | Lenovo |
| [**R1-2206467**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206467.zip) | Discussion on Multi-cell PXSCH scheduling with a single DCI | NEC |
| [**R1-2206599**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206599.zip) | Discussions on multi-cell scheduling with a single DCI | Intel Corporation |
| [**R1-2206627**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206627.zip) | Discussion on the design of multi-cell scheduling with a single DCI | Xiaomi |
| [**R1-2206663**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206663.zip) | Multi-cell scheduling with a single DCI | InterDigital, Inc. |
| [**R1-2206682**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206682.zip) | Discussions on multi-cell PUSCH/PDSCH scheduling with a single DCI | CAICT |
| [**R1-2206700**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206700.ZIP) | Discussion on multi-cell scheduling with a single DCI | China Telecom |
| [**R1-2206844**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206844.zip) | Multi-cell PUSCH/PDSCH scheduling with a single DCI | Samsung |
| [**R1-2206929**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206929.zip) | Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI | CMCC |
| [**R1-2207007**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207007.zip) | On multi-cell PUSCH/PDSCH scheduling with a single DCI | MediaTek Inc. |
| [**R1-2207040**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207040.zip) | Discussion on Multi-cell PUSCH/PDSCH scheduling with a single DCI | LG Electronics |
| [**R1-2207097**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207097.zip) | Discussion on Multicarrier scheduling with a single DCI | FGI |
| [**R1-2207143**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207143.zip) | Discussions on multi-cell scheduling with a single DCI | Sharp |
| [**R1-2207251**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207251.zip) | Multi-cell PUSCH/PDSCH scheduling with a single DCI | Qualcomm Incorporated |
| [**R1-2207349**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207349.zip) | On multi-cell PUSCH/PDSCH scheduling with a single DCI | Apple |
| [**R1-2207424**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207424.zip) | Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI | NTT DOCOMO, INC. |
| [**R1-2207441**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207441.zip) | Multi-cell PUSCH/PDSCH scheduling with a single DCI | Ericsson |
| [**R1-2207447**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207447.zip) | Discussion on multi-cell scheduling with a single DCI | ITRI |
| [**R1-2207553**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207553.zip) | Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI | Google Inc. |
| [**R1-2207695**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207695.zip) | Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI | Spreadtrum Communications |
| [**R1-2207769**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207769.zip) | Feature lead summary#1 on multi-cell PUSCH/PDSCH scheduling with a single DCI | Moderator (Lenovo) |
| [**R1-2207770**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207770.zip) | Feature lead summary#2 on multi-cell PUSCH/PDSCH scheduling with a single DCI | Moderator (Lenovo) |
| [**R1-2207771**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207771.zip) | Feature lead summary#3 on multi-cell PUSCH/PDSCH scheduling with a single DCI | Moderator (Lenovo) |
| [**R1-2208046**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2208046.zip) | Feature lead summary#4 on multi-cell PUSCH/PDSCH scheduling with a single DCI | Moderator (Lenovo) |
| [**R1-2208047**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2208047.zip) | Feature lead summary#5 on multi-cell PUSCH/PDSCH scheduling with a single DCI | Moderator (Lenovo) |
| R1-2208048 | Feature lead summary#6 on multi-cell PUSCH/PDSCH scheduling with a single DCI | Moderator (Lenovo) |
| [**R1-2205863**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205863.zip) | Discussion on multi-carrier UL Tx switching | Huawei, HiSilicon |
| [**R1-2205963**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205963.zip) | Discussion on Multi-carrier UL Tx switching scheme | ZTE |
| [**R1-2206006**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206006.zip) | Discussion on multi-carrier UL Tx switching scheme | Spreadtrum Communications |
| [**R1-2206060**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206060.zip) | Discussion on UL TX switching | vivo |
| [**R1-2206130**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206130.zip) | Considerations on Multi-carrier UL Tx switching scheme | Sony |
| [**R1-2206177**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206177.zip) | Views on multi-carrier UL Tx switching scheme | Fujitsu |
| [**R1-2206327**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206327.zip) | Discussion on multi-carrier UL Tx switching scheme | OPPO |
| [**R1-2206383**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206383.zip) | Discussion on multi-carrier UL Tx switching scheme | CATT |
| [**R1-2206434**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206434.zip) | On Multi-Carrier UL Tx Switching | Nokia, Nokia Shanghai Bell |
| [**R1-2206600**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206600.zip) | Discussions on multi-carrier UL Tx switching scheme | Intel Corporation |
| [**R1-2206628**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206628.zip) | Discussion on multi-carrier UL Tx switching scheme | Xiaomi |
| [**R1-2206664**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206664.zip) | Multi-carrier UL Tx switching scheme | InterDigital, Inc. |
| [**R1-2206701**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206701.zip) | Discussion on UL Tx switching across up to 3 or 4 bands | China Telecom |
| [**R1-2206845**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206845.zip) | On multi-carrier UL Tx switching | Samsung |
| [**R1-2206930**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206930.zip) | Discussion on multi-carrier UL Tx switching scheme | CMCC |
| [**R1-2206986**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206986.zip) | On multi-carrier UL Tx switching scheme | MediaTek Inc. |
| [**R1-2207041**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207041.zip) | Discussion on Multi-carrier UL Tx switching scheme | LG Electronics |
| [**R1-2207252**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207252.zip) | Discussion on Rel-18 UL Tx switching | Qualcomm Incorporated |
| [**R1-2207350**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207350.zip) | On multi-carrier UL Tx switching | Apple |
| [**R1-2207425**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207425.zip) | Discussion on multi-carrier UL Tx switching scheme | NTT DOCOMO, INC. |
| [**R1-2207442**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207442.zip) | Multi-carrier UL Tx switching | Ericsson |
| [**R1-2207555**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207555.zip) | Discussion on multi-carrier UL Tx switching scheme | Google Inc. |
| [**R1-2207752**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207752.zip) | Summary on discussion on multi-carrier UL Tx switching scheme | Moderator (NTT DOCOMO, INC.) |
| [**R1-2207870**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207870.zip) | Summary#2 on discussion on multi-carrier UL Tx switching scheme | Moderator (NTT DOCOMO, INC.) |
| [**R1-2207942**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207942.zip) | Summary#3 on discussion on multi-carrier UL Tx switching scheme | Moderator (NTT DOCOMO, INC.) |

**RAN2#119-e**

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| **TDoc** | **Title** | **Source** |
| [**R2-2208107**](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119-e/Docs/R2-2208107.zip) | Consideration on Rel-18 UL Tx switching capability | ZTE Corporation, Sanechips |
| [**R2-2208324**](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119-e/Docs/R2-2208324.zip) | Potential issues on UL Tx switching schemes across up to 3 or 4 bands | NTT DOCOMO INC. |
| [**R2-2208327**](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119-e/Docs/R2-2208327.zip) | Work plan for Multi-carrier enhancements | NTT DOCOMO INC. |
| [**R2-2208481**](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119-e/Docs/R2-2208481.zip) | RAN2 impact to support Rel-18 UL Tx switching enhancements | Huawei, HiSilicon |
| [**R2-2208936**](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119-e/Inbox/R2-2208936.zip) | Summary of [AT119-e][026][NR18] UL Tx Switching (NTT Docomo) | NTT DOCOMO Inc. |

**RAN4#104-e**

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| **TDoc** | **Title** | **Source** |
| [**R4-2211556**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211556.zip) | Switching period on UL Tx switching across 3 or 4 bands in Rel-18 | Nokia, Nokia Shanghai Bell |
| [**R4-2211607**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211607.zip) | Work plan for REl-18 Multi-carrier enhancements for NR | NTT DOCOMO INC. |
| [**R4-2211625**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211625.zip) | UL Tx switching across 3/4 bands and Tx switching between 2 bands with 2 TAGs | China Telecom |
| [**R4-2211909**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211909.zip) | On UL Tx switching across 3 or 4 bands | Apple |
| [**R4-2212218**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212218.zip) | Discussion and draft Reply LS on UL Tx switching across 3 or 4 bands in Rel-18 | MediaTek Inc. |
| [**R4-2212284**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212284.zip) | Scenarios and switching period for UL Tx switching across 3 or 4 bands | CMCC |
| [**R4-2212385**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212385.zip) | Initial views and draft LS on Rel-18 Multi-carrier enhancements | NTT DOCOMO INC. |
| [**R4-2212467**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212467.zip) | Discussion on UL Tx Switching Across 3 or 4 Bands and Reply LS | Samsung |
| [**R4-2212613**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212613.zip) | Discussion on switching time for multi-carrier enhancement | Xiaomi |
| [**R4-2212789**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212789.zip) | On uplink TX switching across two or more bands | Ericsson |
| [**R4-2212807**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212807.zip) | Discussion and Reply LS on UL Tx switching across 3 or 4 bands in Rel-18 | vivo |
| [**R4-2213308**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213308.zip) | R18 Discussion on Tx switching for 3 or 4 bands | OPPO |
| [**R4-2213381**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213381.zip) | Draft reply LS on UL Tx switching across 3 or 4 bands in Rel-18 | ZTE Wistron Telecom AB |
| [**R4-2213569**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213569.zip) | Views on switching time UL Tx switching across 3 or 4 bands in Rel-18 | Sony |
| [**R4-2213628**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213628.zip) | Discussion on Multi-carrier enhancements | Huawei, HiSilicon |
| [**R4-2213632**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213632.zip) | draft reply LS on UL Tx switching across 3 or 4 bands in Rel-18 | Huawei, HiSilicon |
| [**R4-2214043**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214043.zip) | UL TX switching schemes for multiple TAGs | Qualcomm Incorporated |
| [**R4-2214044**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214044.zip) | UL TX switching requirements for two TAGs | Qualcomm Incorporated |
| [**R4-2214116**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214116.zip) | Email Discussion Summary for [104-e][138] NR\_MC\_enh | Moderator (China Telecom) |
| [**R4-2214249**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214249.zip) | Email Discussion Summary for [104-e][138] NR\_MC\_enh | Moderator (China Telecom) |
| [**R4-2214463**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214463.zip) | WF on UL Tx switching across 3/4 bands with single TAG | China Telecom |
| [**R4-2214464**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214464.zip) | Reply LS on UL Tx switching across 3 or 4 bands | China Telecom |
| [**R4-2214465**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214465.zip) | WF on UL Tx switching with multiple TAGs | Ericsson |
| [**R4-2214466**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2214466.zip) | LS on UL Tx switching with multiple TAGs | Ericsson |
| [**R4-2215163**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2215163.zip) | WF on UL Tx switching with multiple TAGs | Ericsson |

 10.01.2022 minor adaptations for RAN #95e

 04.10.2021 minor adaptations for RAN #94e

 08.08.2021 minor adaptations for RAN #93e

 17.05.2021 minor adaptations for RAN #92e

 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

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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