**3GPP TSG-RAN WG2 Meeting #123 R2-2309317**

**Toulouse 21th -25th Aug, 2023**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **37.340** | **CR** |  | **rev** | **-** | **Current version:** | **17.5.0** |  |
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| *For* ***[HELP](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)*** *on using this form: comprehensive instructions can be found at <http://www.3gpp.org/Change-Requests>.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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|  |
| ***Title:***  | 37.340 running CR for introduction of DualTxRx\_MUSIM |
|  |  |
| ***Source to WG:*** | ZTE Corporation, Sanechips |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_DualTxRx\_MUSIM-Core |  | ***Date:*** | 2023-8-30 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***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 canbe 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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | This CR is for the support of Rel-18 DualTxRx\_MUSIM solutions. |
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| ***Summary of change:*** | Introduction of Rel-18 DualTxRx\_MUSIM solutions.  |
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| ***Consequences if not approved:*** | Rel-18 DualTxRx\_MUSIM solutions are not supported in NR |
|  |  |
| ***Clauses affected:*** | 7.2, 7.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.300 CR TS 38.331 CR TS 38.306 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:*** | R2-2307538 |

START OF CHANGE

7.2 Measurements

If the measurement is configured to the UE in preparation for the Secondary Node Addition procedure described in clause 10.2, the Master node should configure the measurement to the UE.

In case of the intra-secondary node mobility described in clause 10.3, the SN should configure the measurement to the UE in coordination with the MN, if required.

The Secondary Node Change procedure described in clause 10.5 can be triggered by both the MN (only for inter-frequency secondary node change) and the SN. For secondary node changes triggered by the SN, the RRM measurement configuration is maintained by the SN which also processes the measurement reporting, without providing the measurement results to the MN.

Measurements can be configured independently by the MN and by the SN (intra-RAT measurements on serving and non-serving frequencies). The MN indicates the maximum number of frequency layers and measurement identities of intra-frequency and inter-frequency measurement that can be used in the SN to ensure that UE capabilities are not exceeded. In MR-DC, to assist MN to identify the measurement type, the SN indicates to the MN the list of SCG serving frequencies. In NR-DC, to assist SN to identify the measurement type, the MN indicates also to SN the list of MCG serving frequencies. The SN can also request the MN for new maximum values of the number of measurement identities that it can configure, and it is up to the MN whether to accommodate the SN request, based on the capability coordination principles as described in 7.3. If the SN receives from the MN a new value for the maximum number of measurement identities, is SN responsibility to ensure that its configured measurement identities to comply with the new limit.

If MN and SN both configure measurements on the same carrier frequency then the configurations need to be consistent (if the network wants to ensure these are considered as a single measurement layer). Each node (MN and SN) can configure independently a threshold for the SpCell quality. In (NG)EN-DC scenario, when the PCell quality is above the threshold configured by the MN, the UE is still required to perform inter-RAT measurements configured by the MN on the SN RAT (while it's not required to perform intra-RAT measurements); when the PSCell quality is above the threshold configured by the SN, the UE is not required to perform measurements configured by the SN. In NR-DC or NE-DC scenario, when the PCell quality is above the threshold configured by the MN, the UE is not required to perform measurements configured by the MN; when the PSCell quality is above the threshold configured by the SN, the UE is not required to perform measurements configured by the SN.

NOTE: The SN cannot renegotiate the number of frequency layers allocated by the MN in this version of the protocol.

In MR-DC, both the MN and the SN can configure CGI reporting. The MN can configure CGI reporting for intra-RAT and inter-RAT cells but the SN can only configure CGI reporting of intra-RAT cells. At any point in time, the UE can be configured with at most one CGI reporting configuration. For CGI reporting coordination, the SN sends the CGI measurement request and the embedded CGI reporting configuration to the MN. Optionally, the SN sends the unknown cell information to the MN. If there is no ongoing CGI reporting measurement on UE side, the MN forwards the SN CGI measurement configuration to UE. Otherwise the MN rejects the request by sending X2/Xn reject message. In case the SN indicates the unknown cell information, and the CGI information of the requested cell is already available in the MN, the MN can also reject the request, and sends the CGI information of the requested cell to the SN. The SN cannot configure the CGI measurement using the SRB3.

Both MN-configured and SN-configured RRM measurements are supported while the SCG is deactivated. The PSCell measurement cycle when in deactivated SCG state is configured by RRC.

When SRB3 is not configured or the SCG is deactivated, reports for measurements configured by the SN are sent on SRB1. When SRB3 is configured and SCG transmission of radio bearers is not suspended and the SCG is not deactivated, reports for measurements configured by the SN are sent on SRB3.

Measurement results related to the target SN can be provided by MN to target SN at MN initiated SN change procedure. Measurement results of target SN can be forwarded from source SN to target SN via MN at SN initiated SN change procedure. Measurement results related to the target SN can be provided by source MN to target MN at Inter-MN handover with/without SN change procedure.

Measurement results according to measurement configuration from the MN are encoded according to SN RRC when they are provided by MN to SN in *SgNB Addition Request* message / *SN Addition Request* message. During SN initiated SN change procedure, measurement results according to measurement configuration from SN are encoded according to SN RRC when they are provided by MN to SN in *SgNB Addition Request* message / *SN Addition Request* message.

Per-UE or per-FR measurement gaps can be configured, depending on UE capability to support independent FR measurement and network preference. Per-UE gap applies to both FR1 (E-UTRA, UTRA-FDD and NR) and FR2 (NR) frequencies. For per-FR gap, two independent gap patterns (i.e. FR1 gap and FR2 gap) are configured for FR1 and FR2 respectively. The UE may also be configured with a per-UE gap sharing configuration (applying to per-UE gap) or with two separate gap sharing configurations (applying to FR1 and FR2 measurement gaps respectively) [8].

A measurement gap configuration is always provided:

- In EN-DC, NGEN-DC and NE-DC, for UEs configured with E-UTRA inter-frequency measurements as described in table 9.1.2-2 in TS 38.133 [8];

- In EN-DC and NGEN-DC, for UEs configured with UTRAN and GERAN measurements as described in table 9.1.2-2 in TS 38.133 [8];

- In NR-DC, for UEs configured with E-UTRAN measurements as described in table 9.1.2-3 in TS 38.133 [8];

- In NR-DC, NE-DC, for UEs configured with UTRAN measurements as described in table 9.4.6.3-1 and 9.4.6.3-2 in TS 38.133 [8];

- In MR-DC, for UEs that support either per-UE or per-FR gaps, when the conditions to measure SSB based inter-frequency measurement or SSB based intra-frequency measurement as described in clause 9.2.4 in TS 38.300 [3] are met;

If per-UE gap is used, the MN decides the gap pattern and the related gap sharing configuration. If per-FR gap is used, in EN-DC and NGEN-DC, the MN decides the FR1 gap pattern and the related gap sharing configuration for FR1, while the SN decides the FR2 gap pattern and the related gap sharing configuration for FR2; in NE-DC and NR-DC, the MN decides both the FR1 and FR2 gap patterns and the related gap sharing configurations.

In EN-DC and NGEN-DC, the measurement gap configuration from the MN to the UE indicates if the configuration from the MN is a per-UE gap or an FR1 gap configuration. The MN also indicates the configured per-UE or FR1 measurement gap pattern and the gap purpose (per-UE or per-FR1) to the SN. Measurement gap configuration assistance information can be exchanged between the MN and the SN. For the case of per-UE gap, the SN indicates to the MN the list of SN configured frequencies in FR1 and FR2 measured by the UE. For the per-FR gap case, the SN indicates to the MN the list of SN configured frequencies in FR1 measured by the UE and the MN indicates to the SN the list of MN configured frequencies in FR2 measured by the UE.

In NE-DC, the MN indicates the configured per-UE or FR1 measurement gap pattern to the SN. The SN can provide a gap request to the MN, without indicating any list of frequencies.

In NR-DC, the MN indicates the configured per-UE, FR1 or FR2 measurement gap pattern and the gap purpose to the SN. The SN can indicate to the MN the list of SN configured frequencies in FR1 and FR2 measured by the UE.

In (NG)EN-DC and NR-DC, SMTC can be used for PSCell addition/PSCell change to assist the UE in finding the SSB in the target PSCell. In case the SMTC of the target PSCell is provided by both MN and SN it is up to UE implementation which one to use.

CLI measurements can be configured for NR cells in all MR-DC options. In EN-DC and NGEN-DC, only the SN can configure CLI measurements. In NE-DC, only the MN can configure CLI measurements. In NR-DC, both the MN and the SN can configure CLI measurements, and the MN informs the SN about the maximum number of CLI measurement resources that can be configured by the SN to ensure that the total number of CLI measurement resources does not exceed the UE capabilities.

For MUSIM operation, when the UE is configured to operate in NR-DC in Network A, the MN may indicate the configured per-UE MUSIM gap pattern(s) to the SN.

SECOND CHANGE

7.3 UE capability coordination

In (NG)EN-DC and NE-DC, the capabilities of a UE supporting MR-DC are carried by different capability containers. Some MR-DC related capabilities are in the MR-DC container e.g. MR-DC band combinations, while other MR-DC related capabilities are contained in the E-UTRA and NR capability containers e.g. feature sets as described in TS 38.300 [3]. The MR-DC capabilities in the MR-DC container need to be visible to both MN and SN, while the capabilities in the E-UTRA and NR containers only need to be visible to the node of the concerned RAT.

In NR-DC, all NR-DC related capabilities are in the NR capability container and are visible to both MN and SN.

When retrieving MR-DC related capabilities, the MN shall provide an MR-DC filter that affects the MR-DC related capabilities in MR-DC, E-UTRA and NR capability containers. When using different *UE capability enquiry* messages to retrieve the different containers, the MN shall employ the same MR-DC filter in all enquiry messages. In the E-UTRA RRC UE capability enquiry, the MR-DC filter is also used for retrieval of NR capabilities i.e. there is in fact one MR-DC/NR filter (while there is a separate filter for E-UTRA capabilities). Furthermore, the MN stores the retrieved capabilities and the corresponding filter, used to retrieve those capabilities, in the core network for later use.

For the UE capabilities requiring coordination between E-UTRA and NR (i.e. band combinations, feature sets and the maximum power for FR1 the UE can use in SCG) or between NR MN and NR SN (i.e. band combinations, feature sets and the maximum power for FR1 and FR2), it is up to the MN to decide on how to resolve the dependency between MN and SN configurations. The MN then provides the resulting UE capabilities usable for SCG configuration to the SN, including the list of allowed MR-DC band combinations and feature sets, and the SN indicates the selected band combination and feature set to the MN. When subsequently reconfiguring the SCG, the SN should inform the MN whenever the band combination and/or feature set it selected for the SCG changes (i.e. even if the selection concerns a band combination and feature set that is allowed). As part of an SN initiated SN modification, the SN may also indicate the desired UE capabilities usable for SCG configuration (e.g. a band combination and a feature set) outside those allowed by the MN (i.e. it may re-negotiate the UE capabilities for SCG configuration), and it is up to the MN to make the final decision whether to accept or reject the request. If the MN accepts the request, the MN may provide the resulting UE capabilities e.g. by indicating the allowed band combinations and feature sets. If MN accepts but does not provide resulting UE capabilities, SN assumes the UE capabilities usable for SCG configuration are updated in accordance with the modification it requested. Otherwise, the MN rejects the request by sending X2/Xn refuse message.

In EN-DC and MR-DC with 5GC, the MN may provide the UE radio capability ID to the SN. For EN-DC, the SN may retrieve the UE Radio Capability information associated to a UE radio capability ID from the MN. For MR-DC with 5GC, the SN may retrieve the UE radio capability information associated to a UE radio capability ID from the 5GC.

For MUSIM operation, when the UE is configured to operate in NR-DC in Network A, the MN may trigger capability coordination towards the SN based on the temporary capability restrictions indicated by the UE.

Editor’s note: FFS on details of MN-SN coordination of MUSIM temporary capability restrictions.

Editor’s note: FFS whether UE can indicate temporary capability restrictions by explicitly indicating a SCG/SCell release via SRB3 for MUSIM purpose.

END OF CHANGE

# Annex - RAN2 agreements

Green highlight – agreement captured in the specification

Blue highlight – agreement captured as editor’s notes

No highlight – agreement with no direct impact on specifications

RAN2#119bis Agreements

* The R18 MUSIM solution should work in DC/CA and RAN sharing scenarios (but need not be optimized for RAN sharing).
* RAN2 aims to address at least the Scenario 1: the UE in network A in RRC\_CONNECTED indicates (i.e. adds/removes) its preference on temporary UE capability due start/stop connection in NW B. This can be e.g. CA/DC capability restriction.
* 2 The following is assumed when defining the solution:
* The two networks are independent (i.e. no inter-network communication);
* The Core Network is not aware of the temporary restrictions of the UE capability;
* 1: RAN2 can discuss NW A MN-SN coordination of Rel-18 MUSIM temporary capability restrictions due to UE being configured with NR-DC in NW A.
* RAN2 thinks MN-SN coordination for Rel-17 MUSIM gaps requires WI clarification in RAN
* RAN2 needs to discuss which UE capabilities can be impacted by sharing of resources between the MUSIM links.
* RAN2 aims to prioritize only few solutions and avoid multiple solutions for the same problem (FFS pending on solution details).

* A7: The UE can initiate signaling for UE capability restrictions on NW A if NW A allows it. The specification will not capture NW B events which can cause such need.
* A4: RAN2 to discuss whether the following UE capabilities (not a complete list) are impacted for dual-active MUSIM: MIMO layers, BC capabilities, Measurement capabilities, Bandwidth, srs-TxSwitch, UL tx power, Power Class.

* For proposals A1-A2, the solution details need more discussion. Other solutions are not precluded (requires company input with details). Will discuss further over email on the solutions (after this meeting) and which capabilities can be affected.
* For B1-B3, B5, the solution details need more discussion. May prioritize B1, B2 and B5. FFS on signalling details. Other solutions are not precluded (requires company input with details) and none of B1-B5 are agreed as solutions for this WI.
* Do not consider solution B4 in Rel-18 (since it may have CN impacts which are precluded in this WI)
* CX: RAN2 to continue evaluation of any Xn-AP, F1-AP or RAN4 impact due to dual-active MUSIM operation.
* 1: RAN2 can consider such Band conflict scenarios for MUSIM in CONNECTED to arrive at a graceful specification-based solution intended to mitigate such conflicts.
* Wait for RAN4 feedback on MUSIM gap priority.

RAN2#121 Agreements

* A2a: When the UE is in Connected mode in two NR networks, it is up to the UE implementation to select which NW to perform signaling for temporary UE capability restrictions.
* A2b: When the UE is in Connected mode in NR NW A and moving from Idle/Inactive to connected mode in NR NW B, the signaling for temporary UE capability restrictions can happen on NW A. FFS how to handle if UE is moving from IDLE/INACTIVE in NW A and is in CONNECTED with NW B.
* A2c: When the UE is in Connected mode in both networks and one is E-UTRAN, the signaling for temporary UE capability restrictions happens on the NR network.
* A3: The UE will request a temporary capability restrictions (e.g. via UAI) only after the NW signals via RRC that this is allowed. FFS whether the UE can indicate if it is already connecting with reduced capabilities during connection set-up/resume.
* A4: RAN2 to discuss whether prohibit timer is needed for the signaling of temporary UE capability restrictions This can wait until after progress is made on the signaling framework.
* A1: UAI can be used for the signaling of temporary UE capability changes for dual-active MUSIM. FFS if we have additional signalling (depends on e.g. SCell/SCG deactivation usability for MUSIM)
* A8: For dual-active MUSIM, at least the following type of UE capabilities can be expected to be impacted:
* • Transmission and reception capabilities (e.g. MIMO layers)
* • Measurement capabilities (e.g. gaps)
* • Supported bandwidth
* • Supported band-combinations (FFS whether this is CA or DC or both)
* FFS what is the granularity of reported temporary UE capability restrictions (also pending the band conflict discussion).
* FFS whether UE reports some or all of the above or whether we can do something simpler
* A6: For dual-active MUSIM, UE signaling will support the request for release (and reversal) of SCells and SCG. The signaling details (e.g. implicit or explicit request of each SCell or SCG) is FFS. FFS if we support deactivation (based on discussion in which case it can be used). It is up to network how to react to UE request.
* RAN2 does not intend to create new procedures for e.g. SCell/SCG deactivation for MUSIM purposes in Rel-18. Existing procedures can be used based on NW choice.

* B4: RAN2 considers the only RAN3 impact may be to support the UE request of SCG/SCell release via SRB3 (if supported) for MUSIM purpose (e.g. cause value). If this can be done via inter-node messages, RAN2 expects no RAN3 impacts.
* 1: The UE is only allowed to provide MUSIM assistance information for Rel-17 MUSIM gap preference to NR MN and NR MN configures the UE with Re-17 MUSIM gap(s). This requires no specification impacts.
* Use inter-node messages to convey Rel-17 MUSIM gap configuration from MN to SN in NW A when UE is in NR-DC.
* RAN2 confirms that the band conflict scenarios will be covered by the temporary UE capability restrictions. FFS on signalling details.

RAN2#121 bis Agreements

* Consider “proactive” approach (wherein the UE can request capability restrictions which can be independent of current RRC configuration if allowed by the NW) to MUSIM capability restrictions in addition to the reactive approach (which has been agreed previously). Such a mechanism shall still be under NW control, i.e. it is up to network whether to allow such signalling. FFS on the details – should aim for a common framework for the reactive and proactive approach. FFS on UE capabilities
* Support “early indication” from UE to network during RRC connection setup/resume procedure.
* FFS how to indicate this and in which message. The indication will tell network that UE capabilities are temporarily restricted.
* FFS on details (i.e. when UE can indicate this, what does it indicate, how does it relate to UAI, etc.)
* No consensus to support UE-initiated SCell deactivation for MUSIM in Rel-18.
* 1: For Rel-18 MUSIM dual active operation, the maximum MIMO layer may be changed and the change can be indicated to the NW. FFS if this is only for NW A or also NW B.
* 3: For Rel-18 MUSIM dual active operation, the measurement gap requirement may be changed and the change can be indicated to the NW. FFS if this is only for NW A or also NW B.
* 4: For Rel-18 MUSIM dual active operation, the measurement gap requirement change is reported for each serving cells, and for target bands or all supported NR bands depending on whether target bands are configured by the NW. FFS on whether the reporting can reuse the current needForGapInfoNR in RRC reconfiguration complete or extend the similar function in UAI. FFS if this is only for NW A or also NW B.
* 8: The maximum UL power may be changed due to Rel-18 MUSIM dual active operation, but there is no need to introduce any new UE behavior for reporting this change.
* 6: UE can explicitly request specific serving cells or serving cell group to be released for Rel-18 MUSIM purpose. FFS how/whether this works for the proactive case.
* 9: RAN2 should avoid duplicating all the capabilities that UE reports via the UECapabilityInformation in the UAI for R18 MUSIM purpose.
* RAN2 can discuss P2, P5 and P7 from R2-2304397 during RAN2#123.
* RAN2 will aim to address the RAN4 LS in Rel-18 signalling. Should discuss how to handle Rel-17 gaps without priority (e.g. lowest, highest, network-decided somehow, etc.). Handled in email [231]
* 1: Introduce 1 optional per-UE capability bit (with
* out xDD/FRx differentiation) to indicate MUSIM gap priority configuration and preference. A UE supporting this feature shall also support musim-GapPreference-r17.
* 2: Introduce a new indication in the OtherConfig to indicate whether UE is allowed to report MUSIM gap priority preference via UAI.
* 4: The existing IE GapPriority-r17 is re-used to configure the priority for periodic MUSIM gap.
* 9: RAN2 assumes no RAN4 impact is expected on maximum UL power change due to R18 MUSIM. Can re-discuss if critical issues are found in RAN2.

RAN2#123 Agreements

* Use Msg5 for early indication of MUSIM capability restriction for UEs in IDLE.
* Using LCIDs would avoid any problems for RRC resume procedure. However, there are not many LCIDs left for UL and some other Rel-18 WIs also intend to use them.
* FFS whether there is a need to use the LCIDs or whether we can reuse the legacy LCIDs.
* Whether we can use the LCIDs (given that multiple WIs may be trying to use them) will be discussed in the main session. How to proceed LCID usage for MUSIM can be discussed in the next meeting based on the main session decision.
* 3: UE sends early indication of MUSIM temporary capability restriction only if the network indicates that it is allowed in SIB1.
* No support to use RRCReconfigurationComplete for the early indication of MUSIM capability restriction. Can come back if sufficient support.
* Continue discussion in Thursday session with proactive approach on whether UE can indicating frequency that it would prefer to use.
* Discussion was not continued due to lack of time. Post-meeting email discussion (long, vivo) on this topic.
* If a timer is introduced, RAN2 needs to define UE behaviour when timer expires and network response is not received. RAN2 also needs to define what “network response” means, i.e. is it a RRCReconfiguration message or a particular field or something else?
* FFS whether a timer is needed (e.g. to avoid UE from doing something while the network response has not yet arrived)
* Companies should provide Stage-3 details for the next meeting on UE behaviour when network does or does not respond to the UE request to restrict the capabilities due to MUSIM.
* 1: The UE can indicate that some frequencies (e.g. frequency ranges, bands or BCs) are impacted by NW B so that they are:
* 1) forbidden because of collision
* 2) having restricted (lower) capabilities (e.g. with lower MIMO layer).
* 4: The restrictions can apply to CA, DC and/or single CC.
* 5: The UL/DL MIMO layer and/or the UL/DL supported bandwidth restriction (if supported) shall only work for the restricted frequencies for the proactive case.
* 1 For dual active MUSIM, the UE can indicate the temporary maximum MIMO layers for specific serving cells for both UL and DL.
* FFS whether there is a use case for the UE to indicate the temporary supported channel bandwidth for specific serving cells.
* 3 Maximum MIMO layers/bandwidth restriction is reported per CC ((FFS how we signal this).
* FFS whether we support indicating temporary capability restrictions on SRS Tx switching capability. FFS whether this could be already indicated by the MIMO layer restrictions.
* 1. When requesting periodic MUSIM gap(s), UE indicates priority values (using R17 IE definition) for all periodic MUSIM gaps.
* For the last sentence, use the wording “If network doesn’t configure the relative priorities among MUSIM gaps as indicated by the UE, UE behavior is not specified.”
* With the above changes, the LS is approved (unseen) in [R2-2309008](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2309008.zip)