**3GPP TSG-RAN WG2 Meeting #124 *R2-23xxxxx***

**Chicago, USA, Nov. 13th – 17th, 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.300** | **CR** | **0741** | **rev** | **1** | **Current version:** | **17.6.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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|  |
| ***Title:***  | Introduction of NR MUSIM enhancements in TS 38.300 |
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| ***Source to WG:*** | China Telecom |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_DualTxRx\_MUSIM-Core |  | ***Date:*** | 2023-11-20 |
|  |  |  |  |  |
| ***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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | Introduce the Dual Transmission/Reception (Tx/Rx) MUSIM for NR feature to the specification |
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| ***Summary of change:*** | * §20.1: modify the title of 20.X
* §20.3: update description of UE notification on Network Switching
* §20.X: modify the title of this clause, and add description for UE temporary capability restriction
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| ***Consequences if not approved:*** | No support for Dual Transmission/Reception (Tx/Rx) MUSIM for NR |
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| ***Clauses affected:*** | * §20.1: General
* §20.3: UE notification on Network Switching
* §20.X: Temporary UE capability restriction and removal of restriction
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|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<<<<Change start>>>>

# 20 Support for Multi-USIM devices

## 20.1 General

NG-RAN may support one or more of the following enhancements for MUSIM device operation:

- Paging Collision Avoidance, as described in clause 20.2;

- UE notification on Network Switching, as described in clause 20.3;

- Temporary UE capability restriction and removal of restriction, as described in clause 20.X;

## 20.2 Paging Collision Avoidance

The purpose of paging collision avoidance is to address the overlap of paging occasions on both USIMs when a MUSIM device (e.g. dual USIM device) is in RRC\_IDLE/RRC\_INACTIVE state in both the networks (e.g. Network A and Network B) associated with respective USIMs. Network A is NR and Network B is E-UTRA or NR.

A MUSIM device may determine potential paging collision on two networks and may trigger actions to prevent potential paging collision on NR network as specified in TS 23.501 [3].

NOTE: It is left to UE implementation as to how it selects one of the two RATs/networks for paging collision avoidance.

## 20.3 UE notification on Network Switching

For MUSIM operation, a MUSIM device in RRC\_CONNECTED state in Network A may have to switch from Network A to Network B. Network A is NR and Network B can either be E-UTRA or NR. Before switching from Network A, a MUSIM device should notify Network A to either leave RRC\_CONNECTED state, or be kept in RRC\_CONNECTED state in Network A while temporarily switching to Network B.

When configured to do so, a MUSIM device can signal to the Network A a preference to leave RRC\_CONNECTED state by using RRC (see TS 38.331 [12]) or NAS signalling (see TS 23.501 [3]). After sending a preference to leave RRC\_CONNECTED state by using RRC signalling, if the MUSIM device does not receive an *RRCRelease* message from the Network A within a certain time period (configured by the Network A, see TS 38.331 [12]), the MUSIM device can enter RRC\_IDLE state in Network A.

When configured to do so, a MUSIM device can signal to the Network A a preference to be temporarily switching to Network B while remaining in RRC\_CONNECTED state in Network. This is indicated by scheduling gaps preference.This preference can include information for setup or release of gap(s). The Network A can configure at most 4 gap patterns for MUSIM purpose: three periodic gaps and a single aperiodic gap. The Network A should always provide at least one of the requested gap pattern or no gaps. Network providing an alternative gap pattern instead of the one requested by the UE is not supported in this release.

When configured to do so, a MUSIM device can include priority of periodic gap(s) in addition to scheduling gaps preference, and the priority preference should be indicated for all periodic gap(s). If the Network does not configure the relative priorities among periodic MUSIM gaps as indicated by the UE, the UE behaviour is not specified.

## 20.X Temporary UE capability restriction and removal of restriction

For MUSIM operation, a MUSIM device in RRC\_CONNECTED state in Network A may indicate its preference on UE temporary capability restriction or removal of restriction with Network A when UE needs transmission or reception in Network B (e.g., including start/stop connection to Network B). Network A is NR and Network B can either be E-UTRA or NR. The UE may request a temporary capability restriction only after the Network signals via RRC that this is allowed.

When configured to do so, a MUSIM device can indicate the temporary maximum number of CCs per DL/UL to the Network A when UE needs transmission or reception in Network B.

When configured to do so, a MUSIM device can indicate the temporary maximum MIMO layers and the temporary supported channel bandwidth for specific serving cells for both UL/DL to Network A when UE needs transmission or reception in Network B, and the reporting granularity can be per CC.

When configured to do so, a MUSIM device can indicate its forbidden/affected band combinations or bands with temporary capability restriction (e.g. lower maximum MIMO layer and/or supported channel bandwith for both UL/DL) based on a band-filter list configured by network, and the reporting granularity can be per FSPC(per cc per BC).

When configured to do so, a MUSIM device can indicate the measurement gap requirement changes to Network A when UE needs transmission or reception in Network B. The requirement is reported for each serving cell, target band or all supported NR bands depending on whether target bands are configured by the Network.

When configured to do so, a MUSIM device can explicitly request specific serving cells or serving cell group to be released. After requesting a temporary restriction to Network A by using RRC signalling, if the MUSIM device does not receive a reconfiguration not exceeding its requested temporary capability restriction from Network A within a certain time period (configured by Network A, see TS38.331[12]), the MUSIM device can apply the requested temporary capability restriction in Network A.

When it is allowed by Network A in SIB1, the UE can indicate to the Network A using *RRCSetupComplete/RRCResumeComplete* message during RRC connection setup/resume procedure that its capabilities are temporarily restricted while UE is already in RRC\_CONNECTED state in Network B.

When the UE is in RRC\_CONNECTED state in both NR Network A and NR Network B, it is up to the UE implementation to select which network to request UE temporary capability restriction. When the UE is in RRC\_CONNECTED state in both NR Network A and E-UTRA Network B, the request for UE temporary capability restriction can only be performed on the NR network. When the UE is in RRC\_CONNECTED state in NR Network A and moving from RRC\_IDLE/INACTIVE state to RRC\_CONNECTED state in NR Network B, the request for UE temporary capability restriction can be performed on Network A.

<< End of changes >>

# Annex of meeting agreements

Highlighted below are the meeting agreements that have been considered for the CR.

**RAN2#124 Agreements**

* The MN can indicate the forbidden band entries (for the MUSIM purpose) info to the SN. Detailed signaling FFS.
* For the affected bands with restricted capabilities, the MN can also indicate the SN about the capability restriction info.
* To solve MUSIM band conflict issue, the UE can indicate the temporary supported channel bandwidth restriction.
* We use the ASN.1 coding in P4a in R2-2311845 as baseline for the temporary supported channel bandwidth restriction indication
* UE temporary capability restrictions indication via SRB3 for MUSIM purpose is not supported in this release.
* After UE indicates its preference for gap priority “keep” solution option, NW can configure UE to use “keep” solution option or not
* Early capability restriction indication is provided in Msg5.
* Add the following NOTE in clause of 5.3.13.11 of TS 38.331 (exact wording can be improved during the RRC CR review):

-NOTE: If configured by the NW to send early indication (i.e., via SIB1), and if the UE support MUSIM temporary capability restriction, the UE does not apply above failure handling in case it does not apply any part of the configuration for MUSIM purpose. It is up to UE implementation how to apply it. If UE does not go to IDLE in this case, UE still considers the received configuration as the current configuration as the baseline for delta configuration for future reconfigurations.

* The MN can indicate the proactive/reactive temporary capabilities restriction (e.g. musim-CapRestriction-r18) to the SN together with the musim-candidateBandList-r18 (only for the proactive case).
* The configuration of gap priority and the “Keep solution indication” can be transferred from the MN to the SN node in the CG-ConfigInfo inter-node message.
* MUSIM temporary capability restriction reporting on measurement gap requirement is not supported in NR-DC.
* For MUSIM capability restriction reporting, the UE can indicate the temporary maximum number of CCs per DL/UL to the network via UAI.
* Reuse the agreed Rel-18 UE capability bit for MUSIM gap priority configuration and preference to indicate whether the UE supports providing the UE preference of “keep solution” in MUSIM assistance information.
* Introduce 1 optional per-UE capability bit without xDD/FRx differentiation to indicate whether the UE supports providing MUSIM assistance information with temporary capability restriction and early indication in Msg5.

**RAN2#123bis Agreements**

* For proactive UE temporary capability reporting, UE reporting of the information regarding its impacted frequency is sufficient.
* UE can indicate impacted band(s)/frequencies in a BC for the proactive reporting, detailed signalling is FFS.
* UE is allowed to only report the impacted band(s)/frequencies based on a frequency/band filter list (e.g. frequencies/bands), if configured by the network.
* UAI based signalling is also used for proactive reporting of temporary UE capability restriction.
* One configuration is used to control all temporary capabilities update
* We will introduce ‘wait timer’ for the reactive approach
* The UE starts the timer when the UE requests a temporary restriction to the network if the timer is configured. We assume network configures the length for this timer.
* Stop: if UE receives reconfiguration that does not exceed the capabilities that UE suggested via capability restriction report
* Expiry: UE can apply the temporary UE capability restriction upon the timer expiry.
* We will introduce ‘prohibit timer’ for the proactive approach (Network can set zero value for this timer, details can be handled in spec drafting phase)
* The UE can remove the MUSIM capability restriction information by not including any fields in capability restriction report (details will be handled in the specification drafting).
* Working assumption: Early capability restriction indication is provided in Msg5. Detailed UE behaviour, if any, can be further discussed.
* The UE can indicate the temporary capability restriction of measurement gap for R18 MUSIM purpose in the UAI by using the existing NeedForGapInfoNR.
* It is confirmed that the previous agreement that Maximum MIMO layers restriction (and bandwidth restriction, if supported) is reported per CC at least applies for the reactive approach.
* Baseline for the proactive approach: Maximum MIMO layers restriction (and bandwidth restriction, if supported) is reported per FSPC (per cc per BC).
* For Rel-18 MUSIM dual active operation, UE is configured with the band-filter list by the NW A in the OtherConfig for forbidden/affected band signalling.
* For Rel-18 MUSIM dual active operation, UE indicates its forbidden/affected band combinations (or band(s)) based on the network configured band-filter list, in the UAI signalling to NW A.
* For Rel-18 MUSIM dual active operation, UE signals its temporary capabilities restrictions as forbidden band combinations with band indexed to the band-filter list and/or affected band combinations with band indexed to the band-filter list along with explicit fields for restricted (lower) capabilities e.g. maximum MIMO layers.
* RAN2 confirms that no need to request gap priority or configure gap priority for aperiodic gap. Below editor note from running CR could be removed.
* •Editor’s Note: FFS musim-GapPriorityToAddModList-r18 is for aperodic MUSIM gap.
* Introduce single bit indication in MUSIM assistance information to indicate the UE preference of “keep” option.
* Reuse existing control flag (i.e. musim-GapPriorityAssistanceConfig-r18 in running CR) to indicate whether the UE could include “keep” option for MUSIM gap.
* The prohibit timer configuration for R17 MUSIM gap preference (i.e. musim-GapProhibitTimer) is also apply to R18 MUSIM gap priority preference.
* FFS if any other configuration or related behaviour is needed.
* For the proactive approach, the MN can indicate the forbidden/affected band information (for the MUSIM purpose) to the SN. FFS for the reactive case.

**RAN2#123 Agreements**

* Temporary capability restriction
* 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.
* R17 MUSIM Gap coordination
* 1. When requesting periodic MUSIM gap(s), UE indicates priority values (using R17 IE definition) for all or a subset periodic MUSIM gaps.
* 2. When receiving priorities for periodic MUSIM gap(s), the UE may receive changed priority values. If network doesn’t retain the relative priorities among MUSIM gaps, UE behaviour is not specified.
* Send LS to RAN4 informing them of this agreement. Offline 203 (LGE).
* When a Rel-18 UE requests gap priorities for periodic MUSIM gaps, the UE shall always request priorities for all of its requested periodic MUSIM gaps. That means that UE requests the network of gap priority preferences for all of periodic MUSIM gaps using the existing R17 gap priority information (i.e. it cannot only include a subset). Include the agreement to the LS
* 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.

**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#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#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.