**3GPP TSG-RAN WG2 Meeting #116-e R2-21xxxx**

**Electronic Meeting, Nov 1st – 12th, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **36.304** | **CR** |  | **rev** |  | **Current version:** | **16.5.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | Running CR to 36.304 for Multi-USIM devices | | | | | | | | | |
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| ***Source to WG:*** | China Telecom | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | LTE\_NR\_MUSIM-Core | | | | |  | ***Date:*** | | | 2021-10-26 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | To capture the RAN2 agreements on LTE\_NR\_MUSIM-Core WI  **RAN2#113-bis-e has reached the following agreements**:   * For the EPS PO/PF calculation, include the UE\_offset to the UE\_ID calculation formula. * No additional modification for the EPS eDRX case.   SA2 has difined the alternative IMSI that is used for deriving the modified Paging Occasions in order to avoid paging collisions.  *The UE and MME use the Accepted IMSI Offset value to calculate the alternative IMSI value that is determined based on UE's IMSI as follows:*  *alternative IMSI value = [MCC] [MNC] [(MSIN value + Accepted IMSI Offset) mod (MSIN address space)]*  CT1 has defined the procedure to forward IMSI offset value to lower layers.  *If the ATTACH ACCEPT message contains Negotiated IMSI offset IE, the MUSIM capable UE shall forward the IMSI offset value to lower layers. If the ATTACH ACCEPT message does not contain Negotiated IMSI offset IE, the MUSIM capable UE shall indicate to lower layers to erase any IMSI offset value, if available.* | | | | | | | | |
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| ***Summary of change:*** | | 7.1 Specify how to derive the paging occasion when IMSI offset is configured | | | | | | | | |
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| ***Consequences if not approved:*** | | Multi -SIM operations are not supported | | | | | | | | |
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| ***Clauses affected:*** | | 7.1 Discontinuous Reception for paging | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  |  | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
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| ***Other comments:*** | | This Running CR is based on the version 16.5.0 of 36.304 | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | |

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START OF FIRST CHANGE

## 7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in idle mode in order to reduce power consumption. One Paging Occasion (PO) is a subframe where there may be P-RNTI transmitted on PDCCH or MPDCCH or, for NB-IoT on NPDCCH addressing the paging message. In P-RNTI transmitted on MPDCCH case, PO refers to the starting subframe of MPDCCH repetitions. In case of P-RNTI transmitted on NPDCCH, PO refers to the starting subframe of NPDCCH repetitions unless subframe determined by PO is not a valid NB-IoT downlink subframe then the first valid NB-IoT downlink subframe after PO is the starting subframe of the NPDCCH repetitions. The paging message is same for both RAN initiated paging and CN initiated paging.

The UE initiates RRC Connection Resume procedure upon receiving RAN paging. If the UE receives a CN initiated paging in RRC\_INACTIVE state, the UE moves to RRC\_IDLE and informs NAS.

One Paging Frame (PF) is one Radio Frame, which may contain one or multiple Paging Occasion(s). When DRX is used the UE needs only to monitor one PO per DRX cycle.

One Paging Narrowband (PNB) is one narrowband, on which the UE performs the paging message reception.

PF, PO, and PNB are determined by following formulae:

PF is given by following equation:

SFN mod T= (T div N)\*(UE\_ID mod N)

Index i\_s pointing to PO from subframe pattern defined in 7.2 will be derived from following calculation:

i\_s = floor(UE\_ID/N) mod Ns

If P-RNTI is monitored on MPDCCH, the PNB is determined by the following equation:

PNB = floor(UE\_ID/(N\*Ns)) mod Nn

If P-RNTI is monitored on NPDCCH and the UE supports paging on a non-anchor carrier, and if paging configuration for non-anchor carrier is provided in system information, then the paging carrier is determined by the paging carrier with smallest index n (0 ≤ n ≤ Nn-1) fulfilling the following equation:

floor(UE\_ID/(N\*Ns)) mod W < W(0) + W(1) + … + W(n)

System Information DRX parameters stored in the UE shall be updated locally in the UE whenever the DRX parameter values are changed in SI. If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use as default identity UE\_ID = 0 in the PF, i\_s, and PNB formulas above. If the UE has no 5G-S-TMSI, for instance when the UE has not yet registered onto the network, the UE shall use as default identity UE\_ID = 0 in the PF and i\_s formulas above.

The following Parameters are used for the calculation of the PF, i\_s, PNB, wg, and the NB-IoT paging carrier:

- T: DRX cycle of the UE.

In RRC\_IDLE state:

- Except for NB-IoT: If a UE specific extended DRX value of 512 radio frames is configured by upper layers according to 7.3, T =512. Otherwise, T is determined by the shortest of the UE specific DRX value, if allocated by upper layers, and a default DRX value broadcast in system information. If UE specific DRX is not configured by upper layers, the default value is applied.

In RRC\_INACTIVE state, if extended DRX is not configured by upper layers as defined in 7.3:

- T is determined by the shortest of the RAN paging cycle, if configured, the UE specific paging cycle, if allocated by upper layers, and the default paging cycle.

In RRC\_INACTIVE state if extended DRX is configured by upper layers according to 7.3:

- If a UE specific extended DRX value of 512 radio frames is configured, T is determined by the shortest of the RAN paging cycle, if configured, and 512 radio frames.

- If a UE specific extended DRX value other than 512 radio frames is configured:

- During the PTW, T is determined by the shortest of the RAN paging cycle, if configured, the UE specific paging cycle, if allocated by upper layers, and the default paging cycle. Outside the PTW, T is determined by the RAN paging cycle, if configured.

In RRC\_INACTIVE state, a BL UE or a UE in enhanced coverage uses the T value applicable for RRC\_IDLE state for the determination of PNB and i\_s.

For NB-IoT: If UE specific DRX value is allocated by upper layers and minimum UE specific DRX value is broadcast in system information, T = min (default DRX value, max (UE specific DRX value, minimum UE specific DRX value broadcast in system information)). If UE specific DRX is not configured by upper layers or if the minimum UE specific DRX value is not broadcast in system information, the default DRX value is applied.

- nB: 4T, 2T, T, T/2, T/4, T/8, T/16, T/32, T/64, T/128, and T/256, and for NB-IoT also T/512, and T/1024.

- N: min(T,nB)

- Ns: max(1,nB/T)

- Nn: number of paging narrowbands (for P-RNTI monitored on MPDCCH) or paging carriers (for P-RNTI monitored on NPDCCH) determined as follows:

If UE monitors GWUS according to clause 7.5.1:

this is the number of paging narrowbands (paging carriers) that are configured with GWUS.

else:

this is the number of paging narrowbands (paging carriers) provided in system information.

- UE\_ID:

If the UE supports E-UTRA connected to 5GC and NAS indicated to use 5GC for the selected cell:

5G-S-TMSI mod 1024, if P-RNTI is monitored on PDCCH.

5G-S-TMSI mod 16384, if P-RNTI is monitored on NPDCCH or MPDCCH.

else

IMSI mod 1024, if P-RNTI is monitored on PDCCH.

IMSI mod 4096, if P-RNTI is monitored on NPDCCH.

IMSI mod 16384, if P-RNTI is monitored on MPDCCH or if P-RNTI is monitored on NPDCCH and the UE supports paging on a non-anchor carrier, and if paging configuration for non-anchor carrier is provided in system information.

- W(i): Weight for NB-IoT paging carrier i.

- W: Total weight of all NB-IoT paging carriers, i.e. W = W(0) + W(1) + … + W(Nn-1). If UE monitors GWUS according to clause 7.5.1, Total weight of all NB-IoT paging carriers configured with GWUS.

IMSI is given as sequence of digits of type Integer (0..9), IMSI shall in the formulae above be interpreted as a decimal integer number, where the first digit given in the sequence represents the highest order digit.

For example:

IMSI = 12 (digit1=1, digit2=2)

In the calculations, this shall be interpreted as the decimal integer "12", not "1x16+2 = 18".

UE shall use the alternative IMSI value, if available, instead of the IMSI stored in the USIM to derive the UE\_ID. The alternative IMSI value is calculated based on the UE's IMSI and IMSI Offset value as defined in 23.401[23].

*Editor's note: FFS whether the alternative IMSI is calculated and indicated by upper layers.*

5G-S-TMSI is a 48 bit long bit string as defined in TS 23.501 [39]. 5G-S-TMSI shall in the PF and i\_s formulae above be interpreted as a binary number where the left most bit represents the most significant bit.

END OF FIRST CHANGE

Annex: RAN2 Agreements (LTE\_NR\_MUSIM-Core; leading WG: RAN2; REL-17; WID: RP-202895)

## RAN2#115-e

Agreement

1 RAN2 retains the agreement on NAS-based busy indication for RRC\_INACTIVE, and Reply SA2.

Agreements

Scenarios and supported gap types

1 RAN2 aims to support at least the below scenarios 1/2/3 in Rel-17 for cases when the UE is allowed to switch to network B without leaving connected state at network A.

- Scenarios 1: Periodic switching, including SSB detection/paging reception, serving cell measurement, neighboring cell measurement including intra-frequency,inter-frequency and inter-RAT measurement;

- Scenarios 2: SI receiving at network B;

- Scenarios 3: Aperiodic (one-shot) switching with both transmission and reception at network B but will not enter RRC-connected state in NW B (e.g. no RRC connection Resume/Setup) at network B, including On-demand SI request;

2 For switching without leaving connected state at network A, support gap types 2a (Normal periodic gap) and 2b (Normal aperiodic gap) in Rel-17.

3 Only per UE level scheduling gap is supported in Rel-17 for non-DC. FFS if we support MR-DC.

The scenarios will only be used for deriving RRC parameters. No need to capture them in e.g. Stage-2.

Agreements

Gap configuration and activation

5 The network is allowed to configure at most 3 gap patterns (for any MUSIM purpose).

6 Only a single aperiodic gap (for MUSIM) is supported in Rel-17. At most two periodic “gaps” (for MUSIM) and a single aperiodic gap (for MUSIM) is supported in Rel-17. FFS if signalling supports more.

7 The SFN and subframe of the PCell of the network A is used in the gap configuration to calculate the gap.

Agreements

Periodic/Aperiodic/autonomous Gap configuration and activation

8: The switching gap configuration will explicitly provide the gap starting position (e.g. offset value or start SFN and subframe explicitly), gap length and gap repetition period.

10: Switching Gaps (of any type) are configured or released by RRC signalling (e.g. RRCReconfiguration message) in Rel-17. FFS if gap can be released autonomously by UE after N repetitions.

Gap configuration assistance information

16 UE is allowed to include assistance information for setup or release of gaps for both 1) periodic gaps and 2) aperiodic gap in one UEAssistanceInformation Msg.

18 To report the assistance information, the UE maps the timing info of the Gap on the network B to the network A and reports the mapped timing info to the network A.

20 For the gap assistance information, the Gap start time, Duration of the gap and gap repetition period (for periodic) may be included. FFS is other information is included (e.g. gap purpose).

* Do not support autonomous gaps for MUSIM in Rel-17.
* 1 UE can indicate it wants to leave RRC\_CONNECTED in assistance information for MUSIM (FFS for signalling details, e.g. UAI).
* 3: UEAssistanceInformation message is extended for switching notification in both network switching procedures for leaving RRC\_CONNECTED state and without leaving RRC\_CONNECTED state.
* 6: UE is configured to provide assistance info for switching notification via otherConfig of RRCReconfiguration message
* 8: Introduce a new RRC timer for the “configured time”, used for the UE to leave RRC\_CONNECTED without a response.
* FFS if it's possible to configure UE to always wait for the network response (e.g. "infinite" waiting time)
* 7: UE is not allowed to enter RRC\_INACTIVE state if no NW response message is received within a certain configured time period after the network switching notification message is sent.
* 9: As baseline, how to handle the case, that UE performs switching without the response from network for a configured time during switching procedure without leaving RRC\_CONNECTED state, is not specified. Can re-discuss if there are serious issues found.

## RAN2#114-e

* 1: Send an LS to SA2 to inform that RAN2 majority would support, but there is no consensus to support NAS assistant information (similar to UE ID offset for LTE), so RAN2 thinks this issue should be discussed and decided by SA2.
* 2: RAN2 does not introduce RRC assistant information for paging collision issue for IDLE and INACTIVE. (Can revisit if serious problems are found.)
* 1: RRC signaling for network switching without leaving RRC\_Connected state should allow multiple configurations of periodic “gaps” with different parameters (e.g. periodicities and durations). FFS is multiple can be active at the same time. FFS if multiple aperiodic gaps are supported.
* 4: UE provides assistance information to the gNB of NW A in Connected state based on the configuration of USIM of NW B for the gNB to determine the necessary switching parameters. Up to network what is the action based on UE assistance information. FFS what assistance information is needed.
* 1: AS -based solution for network switching includes two steps: 1-) If configured, UE can send an RRC message to leave RRC\_CONNECTED for MUSIM purpose 2-) gNB may release the UE to Idle/Inactive.
* 2: Include the following RAN2#113bis-e agreement in the LS:

During switching procedure for leaving RRC\_CONNECTED state, UE is allowed to enter RRC\_IDLE state if it does not receive response message from network within a certain configured time period. FFS for RRC\_INACTIVE state

* 3: The “configured time” for AS-based solution for the UE to leave RRC\_CONNECTED without a response is configured by the gNB. Indicate RAN2 is still discussing this for AS-based solution in the LS.
* 4: Indicate that RAN2 has not discussed the interaction between AS-based solution and any SA2 agreement on NAS messages or NAS-based solution for network switching.

## RAN2#113-bis-e

Agreements

1: For the EPS PO/PF calculation, include the UE\_offset to the UE\_ID calculation formula.

2: No additional modification for the EPS eDRX case.

Agreements

1 Only support NAS-based busy indication (for IDLE and INACTIVE)

Agreements

1 RRC signalling is used for switching procedure without leaving RRC\_CONNECTED state in network A for UE temporarily switching to network B as a baseline. FFS on additional need of MAC signalling.

2 During switching procedure for leaving RRC\_CONNECTED state, UE is allowed to enter RRC\_IDLE state if it does not receive response message from network within a certain configured time period. FFS for RRC\_INACTIVE state.

* 1: RAN2 works to support the MUSIM paging cause feature that SA2 is working on and also addresses the paging cause issue raised by SA2 LS.
* 2: RAN2 attempts to reply LS to SA2 once we progress on solution and agree on CR(s) that support/address the above feature/issue.
* 5: If RAN2 agrees to add a paging cause value (or any other information that could lead to a specific paging cause) in Uu paging message, RAN2 specifies the relevant UE behavior (i.e. inform or passing to the upper layer) upon its reception in both LTE and NR specifications.
* RAN2 does not intend to introduce alternative paging IDs for MUSIM paging (unless requested by SA2).

## RAN2#113-e

* There is support for solution 1 (for 5GS) with something else, either solution 3 or 2b.

Agreement

1. Option 2b is the preferred solution to address paging collision for “LTE + LTE”.

Agreements

1 MUSIM UE determines potential paging collision on two networks and triggers actions on potential paging collision avoidance.

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

* FFS if we can make the UE behaviour predictable for paging collision avoidance

Agreements

1 Switching procedure can be used to notify network A that the UE has a preference to leave RRC\_CONNECTED state in network A.

2 The switching procedure can be used to notify network A that the UE has a preference to be kept in RRC\_CONNECTED state in network A while temporarily switching to network B.

Agreement

1 NAS signalling is baseline for UE reporting paging collision in 5GS side (to be confirmed by SA2).

2 It is FFS whether assistant information is needed for paging collision in 5GS side.

## RAN2#112-e

* Use: "Extending paging signalling is possible but RAN2 haven’t decided on overall feasibility of paging cause, including how it should be supported."
* With this change, the LS is approved in [R2-2011241](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_112-e\R2-2011241.zip) (unseen)
* From RAN2 point of view, Option 1 , 2a, 2b, and 3 are feasible to solve the paging collision issue in 5GS. Each have different effectiveness (as per analysis during the email discussion). When indicating reply to SA2, indicate both feasibility as well as effectiveness.
* Indicate to SA2 that RAN2 continues to further evaluate the pros and cons of options 1, 2a, 2b, 3.
* Option 4 is still allowed (but RAN2 will not specify UE implementation).
* Clarifying "No E-UTRA impact" can be done in RANP.
* Option 2c can be evaluated later as it doesn't work alone.
* Enhancement for 5GS should be prioritized since it can handle paging collision issue in both NR+NR and NR+LTE scenarios.
* Indicate to SA2 that the table 1 is a baseline on the discussion the expected time (in ms) required for UE to send a (NAS) busy indication to Network B.
* From RAN2 point of view, it is feasible that the busy indication is sent as an RRC message with security for RRC\_INACTIVE. FFS how this works.
* RAN2 will continue to discuss RRC-based switching/leaving and returning procedure in 5GS/NR when UE is in RRC\_CONNECTED. There may be different mechanisms (short/long, leaving/returning, etc.).
* Provide SA2 with information on paging cause costs based on the email discussion + contributions. Indicate that this may change if assumptions change.
* From RAN2 perspective, we haven't decided on paging cause feasibility yet.
* RAN2 will evaluate short/long time switching in this WI

**Agreements**

**1a: The sub-Case 3-1 is supported in WI, i.e., the switching/leaving and returning procedure in 5GS/NR when UE is in RRC\_CONNECTED includes the case where Dual-RX/Single-TX UE is in RRC\_CONNECTED state in NW A while performing only reception in NW B (i.e., in RRC\_idle State and RRC inactive state).**

**1b: For Sub-Case 3-1, whether the Rx capability coordination between UE and NW is needed can be decided after the RRC-based switching/leaving and returning procedure is defined.**

**2: The Sub-Case 3-2, i.e. Dual-RX/Single-TX UE stays in RRC\_CONNECTED mode in NW A while performing reception and transmission in NW B(in RRC\_ CONNECTED or during RRC setup/resume period ), is not considered in the WI from RAN2 viewpoint. Scheduling gap is not excluded.**

**4: FFS: The Sub-Case 4-1, i.e. Dual-RX/Dual-TX UE stays in RRC\_CONNECTED mode in NW A while performing both reception and transmission in NW B without changing into RRC\_CONNECTED state in NW B, is not considered in the WI from RAN2 viewpoint.**

**5: FFS: The Sub-Case 4-2, i.e. Dual-RX/Dual-TX UE stays in RRC\_CONNECTED state in NW A while performing both reception and transmission in RRC\_ CONNECTED in NW B, is not considered in the WI from RAN2 viewpoint.**

**=>** **FFS if/how to ensure UE doesn't disconnect from RRC\_CONNECTED during busy indication**

**=> Capability change is not precluded by proposals.**