3GPP TSG-RAN WG3 Meeting #115-e R3-222474

E-meeting, 21 Feb – 3 Mar 2022

Agenda Item: 22.2.4

Source: Huawei (moderator)

Title: Summary of discussion on MBS5\_MobilitySupport

Document for: Approval

# 1. Introduction

**CB: # MBS5\_MobilitySupport**

**- Final decision on data forwarding needed or not?**

**- Transmission status exchange between source and target nodes if data forwarding is supported?**

**- HO procedure and impacts to Xn/NG-C?**

**- Shared NG-U tunnel coordination for shared CU-UP?**

**- Common QoS to MRB mapping coordination for shared CU-UP?**

**- Capture agreements and provide TPs if agreeable**

(HW - moderator)

Summary of offline disc [R3-222474](file:///C:\Users\w00364378\AppData\Local\Temp\Rar$DIa5196.48317\Inbox\R3-222474.zip)

# 2. For the Chairman’s Notes

Agree CR R3-222082 by changing “Multicast Sequence Number Presence” to “MBS Sequence Number Presence” and removing “Encoding FFS”.

Provide the following MBS information from source gNB to target gNB：

* Mandatory sub IEs (MBS Session ID, MBS Session Status)
* Optional sub IEs (MBS Area Session ID, MBS Service Area Information, Associated QoS Flow Information List (MBS QFI, Associated Unicast QFI, QoS Flow Level QoS Parameters), Source MRB to QoS Flow Mapping List).

These MBS information are included in the XnAP: *PDU Session Resources To Be Setup List* IE, NGAP: *Source NG-RAN Node to Target NG-RAN Node Transparent Container* IE, and NGAP: *Path Switch Request Acknowledge Transfer* IE.

Introduce *MBS Support Indicator* IE in the XnAP: HANDOVER REQUEST ACKNOWLEDGE message.

Provide the MBS Progress (PDCP COUNT) from Source to Target, in Handover Preparation and Status Transfer. The MBS Progress also includes MBS QFI SN.

UE dedicated per MRB F1-U tunnel should be established at the target gNB, to transmit buffered/forwarded packets from target gNB-CU to target gNB-DU, to be transmitted to the UE via PTP leg.

Support MBS data forwarding from source gNB to target gNB.

In case data forwarding is supported, provide the MBS Progress (the information of the oldest packet available at the target NG-RAN node for the MRB) from Target to Source, in Handover Preparation.

On how to assign PDCP SN:

* If data loss is to be minimized for an MRB e.g. in order to meet the QoS requirement, the PDCP COUNT of the MRB should be synchronized by adding up every per-QoS-flow N3mb Sequence Number of each QoS flow which is mapped to this MRB, and thus no need to limit the QoS-flow-to-MRB mapping.
* The gNBs may use the GTP-U SNs to discover N3mb out-of-order delivery, and may perform N3mb packet reordering before assigning PDCP COUNTs, so that the PDCP COUNTs assigned by different gNBs for the same multicast packet can be guaranteed to be the same, as long as these gNBs use the same QoS-flow-to-MRB mapping rule.

The common UP is able to inform the CUCP about the MRB configuration in the MRB context setup response that is different from MRB configuration in the required MRB Setup request.

No need to exchange the Shared NG-U Termination Information over interfaces (NG, Xn, E1).

# 3. Discussion \_ First Round

* 1. MBS Context Exchanging during mobility

Previous RAN3 agreements:

**Xn Handover Request and NG Handover Request message contain MBS context information for the UE.**

**MBS context information within the UE context shall contain all MBS multicast session information the UE has joined.**

**After the HO Request and before HO Request Ack is issued, UP resources establishment can be triggered if the Multicast session resources are not yet established in the target node.**

**The deployment of alternatives 1 and 2 for PDCP SN sync is not mutually exclusive (no need for any specification text).**

**it is up to RAN implementation on whether the alternatives 1 and 2 for PDCP SN sync are applied to Broadcast session.**

**Indicate target RAN node about the activation/deactivation status of the Multicast session in the XnAP: HANDOVER REQUEST. LS SA2 about RAN3 understanding of the Xn impacts on Multicast status indication.**

**Introduce a new 32bits “MBS QFI SN” in 38.415.**

**CN shall include the MBS QFI SN for all the Qos flows for MBS services.**

**Sync in terms of QoS flow to MRB mapping among NG-RAN nodes is achieved by network implementation.**

In R3-222167/68 [7/8], it is proposed to introduce *MBS Session Information To Be Setup List* IE in the existing *PDU Session Resources To Be Setup List* IE within the XnAP: HANDOVER REQUEST. The information includes the MBS Session ID, Area Session ID, Session Status, Service Area Information, Associated QoS Flow information (MBS QFI, Associated Unicast QFI, MRBs to QoS Flows Mapping List).

In R3-222254 [9], similar proposal can be found as: The MBS session related information carried in *PDU Session Resources To Be Setup List* IE includes the MBS session ID, MBS QoS flow, associated unicast QoS flow and MBS service area.

And in [7], it clarifies that based on TS 34.247, RAN3 need to include “inactive” state in XnAP HO Request, and in SMF container in NGAP HO Request. Due to the *Associated QoS Flow Information To Be Setup List* IE is optional, it will be absent when all NG-RAN node support MBS, implicitly indicating “inactive” state by not including the *Associated QoS Flow Information To Be Setup List* IE is not feasible, and RAN should not remove QoS flows by its own. Thus, it is needed to introduce an *MBS Session Status* IE in the related messages.

In R3-222063 [4], the following is proposed: Provision of associated MBS Qos Flow information to the new/target gNB. For handover, provision of multicast MBS Session information to the target gNB. And in *PDU Session Resources To Be Setup List* IE, for each PDU session, the *MBS Session Associated Information* IE is included, which contains MBS Session ID and the mapping relationship between the MBS QFI and the associated unicast QFI.

And in this contribution [4], besides the information provided in the *PDU Session Resources To Be Setup List* IE, another two IEs are included as first level IEs within the HO Request message, one named as MBS Session Information (to include MBS Service Area and QoS Flow ID, QoS Flow level Parameters, MRB Mapping Information), and one named as MBS Session ID Indication (a list of MBS Session ID). It is noticed that the *MBS Support Indicator* IE is introduced in the XnAP: HANDOVER REQUEST ACKNOWLEDGE message in this paper as well.

From moderator point of view, we do not need to distribute MBS related information in three IEs in different places within the same message as proposed in [4], it is cleaner to include them once in the existing *PDU Session Resources To Be Setup List* IE, with mandatory sub IEs and optional sub IEs to include all other information proposed in all these papers.

**Proposal 1-1: Provide the MBS information from source gNB to target gNB, with mandatory sub IEs (MBS Session ID, MBS Session Status) and optional sub IEs (MBS Area Session ID, MBS Service Area Information, Associated QoS Flow Information List (MBS QFI, Associated Unicast QFI, QoS Flow Level QoS Parameters), Source MRB to QoS Flow Mapping List).**

**Proposal 1-2: These information are included in the XnAP: *PDU Session Resources To Be Setup List* IE, NGAP: *Source NG-RAN Node to Target NG-RAN Node Transparent Container* IE, and NGAP: *Path Switch Request Acknowledge Transfer* IE.**

**Proposal 1-3: Introduce *MBS Support Indicator* IE in the XnAP: HANDOVER REQUEST ACKNOWLEDGE message.**

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| Company | Answer | Comments |
| Huawei | Support all. |  |
| Nokia | Support All. |  |
| Ericsson |  | 1-1: Not entirely correct: Xn HO messages to include, in case of an ongoing active multicast session, outside PDU Session related IEs, MBS Session Context information, to allow establishment of MBS Session Resources - right away - in case the UE is the first UE to enter the gNB. The current content of PDU Session IEs can stay as it is.  1-2: not ok. common/shared information outside UE individual IEs, please.  1-3: well, fine. |
| CATT | Either [7/8] or [4] is ok for us. |  |
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* 1. Packet transmission from target gNB-CU to target gNB-DU after mobility

Regardless of whether data forwarding or buffer solution will be used in the discussion of section 3.5, at the target gNB side, as mentioned in R3-222167 [7], it is important to make sure the forwarded data or buffered data can be transmitted to the UE after handover via PTP leg. In this case, the switch decision between PTM and PTP cannot rely on DU as DU is not aware of the forwarded data or buffered data. Instead, in order to ensure PTP transmission is used for the forwarded data or buffered data, CU should make the decision and DU obeys.

There are two ways for CU to notify DU that these packets has to be transmitted via PTP, one is establishing a dedicated F1 tunnel for PTP transmission and the other is introducing UE specific indication for PTP transmission in the packets delivered through the shared F1-U tunnel. Considering the overhead and specs effort, the first option is preferred.

**Proposal 2: UE dedicated per MRB F1-U tunnel should be established at the target gNB, to transmit buffered/forwarded packets from target gNB-CU to target gNB-DU, to be transmitted to the UE via PTP leg.**

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| Company | Comments |
| Huawei | Support. |
| Nokia | Support. |
| Ericsson | that is quite a misconception on how things work: re-transmission is only supported in case RLC-AM is configured at the target side, a decision that makes the target DU. And, packets are only re-transmitted in case the UE requests them by means of PDCP SR, in which case, of course, the CU has to obey to retransmit, but would have the right to either retransmit it for the UE only or for all UEs. A CU could even implement a kind of “blind retransmission”, if it is made aware of UEs “moving in”, w/o supporting PDCP SR for MRBs.  please, bear also in mind, that according to principles of F1-U, there cannot be two F1-U tunnels for the same Radio Bearer instance, the “ptp” part of an MRB is not a “Private MRB” for that UE, but still the very same MRB.  furthermore, if it is only for re-transmitting PDCP packets requested by the UE, we think that establishing “private” F1-U tunnels is just an overkill as they would only be used for a short time. |
| CATT | We may say “if data forwarding is used, UE dedicated per-MRB F1-U tunnel(s) should be established”.  Of course if data forwarding is not used there is no need to establish that tunnel. |
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* 1. PDCP SYNC
     1. Introduction of MBS QFI SN

During the email discussion after RAN3#114bis-3 meeting, two agreements were achieved on the new MBS QFI SN:

Introduce a new 32bits “MBS QFI SN” in 38.415.

CN shall include the MBS QFI SN for all the Qos flows for MBS services.

In this meeting, a CR R3-222082 [5] to TS 38.415 is submitted, to introduce the new 32-bits MBS QFI SN, it is propose to update it based on companies comments and to be agreed at this meeting.

**Question: Any comments to the CR R3-222082 [5] to TS 38.415?**

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| Company | Comments |
| Huawei | 1. As it was agreed that it is up to RAN implementation on whether the alternatives 1 and 2 for PDCP SN sync are applied to Broadcast session. The new MBS QFI SN should not limited to multicast only, therefore, for the title of 5.5.3.x, should be updated as: MBS Sequence Number Presence (MSNP)  2. For the 5.5.3.y, the “Encoding FFS” should be removed. |
| Nokia | Agree with Huawei comments. |
| CATT | Agree with Huawei comments. |
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* + 1. Details on PDCP SN Assignment

In the email discussion after RAN3#114bis-e, an agreement was achieve about sync of QoS flow to MRB mapping among NG-RAN nodes:

Sync in terms of QoS flow to MRB mapping among NG-RAN nodes is achieved by network implementation.

In R3-222025 [1], the details on how to assign PDCP SN by the NG-RAN node based on the MBS QFI SN, from moderator point of view, these are good clarifications on how to assign PDCP SN by the NG-RAN nodes, comparing with left everything to implementation, it is preferred to capture them into specification.

**Proposal 3: on how to assign PDCP SN:**

* **If data loss is to be minimised for an MRB e.g. in order to meet the QoS requirement, the PDCP COUNT of the MRB should be synchronised by adding up every per-QoS-flow N3mb Sequence Number of each QoS flow which is mapped to this MRB, and thus no need to limit the QoS-flow-to-MRB mapping.**
* The gNBs may use the GTP-U SNs to discover N3mb out-of-order delivery, and may perform N3mb packet reordering before assigning PDCP COUNTs, so that the PDCP COUNTs assigned by different gNBs for the same multicast packet can be guaranteed to be the same, as long as these gNBs use the same QoS-flow-to-MRB mapping rule.

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| Company | Answer | Comments |
| Huawei | ok |  |
| Nokia | ok | But specified as one network deployment option. |
| Ericsson | no explicit specification work | we are fine to stay with this agreement and not add any further specification text apart from that agreement.  applying the CN SN approach for mappings different than 1:1 mapping between MBS QoS flow and MRB is, to our understanding, very unstable and error prone, we do not suggest to state a single word in specification text about it. |
| CATT | ok | Considering that we have agreed that the normal case is that neighbouring nodes uses the same flow-to-mapping rule, to synchronise the PDCP COUNT allocation is optimal for performance, i.e. PDCP COUNT is continuous for this case and thus no need to interrupt the Uu packet delivery in order to perform PDCP COUNT re-initialisation.  And technically, specifying is necessary to prevent interoperability problem:  If Node 1 allocates the PDCP COUNTs according to the MBS QFI SNs but is unaware that Node 2 does not behave so, handovers between the two nodes will likely cause huge gaps in PDCP COUNT and severe QoS degradation, e.g. a huge amount of data loss. Considering the magnitude of loss, we had better specify it rather than leaving it up to implementation.  Note: This sentence does not contradict the agreement we achieved before—we still think the mapping alignment can be configured the OAM, since even if the OAM mistakenly makes the mapping different, the only cost is that packet delivery is interrupted for the while in order to re-initialise the PDCP COUNT. Lossless delivery can still be guaranteed anyhow as shown in [1]. |
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* 1. MBS progress exchange
     1. MBS Progress from Source to Target

In R3-222063 [4], the following is proposed: Provision of associated MBS Qos Flow information to the new/target gNB. For handover, provision of multicast MBS Session information to the target gNB. The multicast MBS Session information contains MRBs HFNs. To be more precise, the current MRB Count is included in the XnAP: Handover Request message.

In R3-222084 [6], considering that achieving lossless w/o duplicates would require that source and target exchange the mapping between PDCP SN and CN SN so that the target gNB can avoid sending again a packet already delivered at source with a different PDCP SN. It is therefore proposed to exchange both PDCP SN and mapped CN SN during Handover Preparation and Status Transfer.

In R3-222168 [8], it is proposed to provide MBS Progress of the source gNB in the HO preparation and SN Status Transfer.

In R3-222292 [10], it is proposed that: The source gNB provides the current PDCP SN of each MRB in HO Request message. The target gNB decides if the data forwarding is needed or not, based on the SN status in the source gNB and target gNB.

**Proposal 4-1: Provide the MBS Progress (PDCP COUNT) from Source to Target, in Handover Preparation and Status Transfer.**

**Proposal 4-2: the MBS Progress also includes MBS QFI SN.**

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| Company | Answer | Comments |
| Huawei | Support all. |  |
| Nokia | Support all. |  |
| Ericsson |  | there is no Status Transfer procedure needed for MRBs  the provision of the “current” COUNT value was only proposed because some companies asked for it. we do not see an absolute need for it but we are not against it.  please bear in mind, that the decision to provide CN SNs on N3mb was made to achieve PDCP SN assignment alignment based on the CN SNs. In principle, we do not see the need for anything more, as long as the CN SNs have the same numbering space as COUNT. |
| CATT | OK | We think PDCP SN count is needed and we are not against the idea of adding an extra MBS QFI SN here to cover all possible scenarios.  For HANDOVER REQUEST the model verb should be “may”, considering both the case of gNB-CU-CP/UP split and the case that lossless is not needed for that bearer. It should be present in the SN STATUS TRANSFER message as for unicast.  The MBS QFI SN can be useful for the HANDOVER REQUEST message. Although it seems useless for the SN STATUS TRANSFER message, it is obviously not needed to define two separate structures of MBS progress. So we are fine with the TP. |
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* + 1. MBS Progress from Target to Source

In case data forwarding (to be discussed in section 3.5) is supported, to inform source gNB when to stop data forwarding, it is needed to provide the MBS Progress **(the information of the oldest packet available at the target NG-RAN node for the MRB)** from Target to Source. [6] [8] [9] [10]

In R3-222025 [1], it is proposed to ask RAN3 to discuss whether the MB-UPF can send a PDU containing the “next” N3mb QFI SN for each QoS flow, toward the gNB which just joins an MBS session, in order to reduce the number of forwarded packet. From moderator point of view, this is a kind of end marker from CN to RAN, which is not preferred based on R3-222254 [9].

**Proposal 5: Provide the MBS Progress (the information of the oldest packet available at the target NG-RAN node for the MRB) from Target to Source, in Handover Preparation.**

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| Company | Answer | Comments |
| Huawei | Support. |  |
| Nokia | OK. |  |
| Ericsson |  | there is no data forwarding of MRB data needed between supporting gNBs. |
| CATT | OK | We think PDCP SN count is needed and we are not against the idea of adding an extra MBS QFI SN here to cover all possible scenarios.  Likewise, the model verb should be “may” delivering MBS progress from the target to source (regardless of which SN). |
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* 1. MBS Data Forwarding

As it has already been discussed in many meeting, there are lots of companies propose to support MBS data forwarding from source to target, to be used especially for the case that Target gNB (without big buffer deployment) has a faster progress than the Source gNB, and in case the Target gNB has just started to provide the MBS sessions during/after the HO of this UE. For the latter case, setting up shared NG-U between the target gNB and 5GC before sending HO Request ACK is not preferred due to the extra delay for the HO preparation.

In R3-222084 [6], it is mentioned that at RAN3#114bis an alternative solution was proposed which is to use buffering at the target gNB assuming a tight requirement of 20 ms synchronization across gNB cells. However, this solution may not work in all deployments because:

• The tight synchronization requirement from SA1 only applies to certain applications and not to others,

• It requires specific backhaul and deployment to ensure the stringent synchronization,

• It relies on specific scheduling and buffering implementations of the nodes.

Therefore, in order to support a variety of other type of deployments, other implementations and other type of applications data forwarding should be supported. Similar proposal can also be found in R3-222168 [8].

In R3-222254 [9], operator also provide their view that buffer plan cannot satisfy all the scenarios, data forwarding, as always supported by us, commonly applies to most of scenarios and plays the role of eliminating the gap between source and target.

**Proposal 6: Support MBS data forwarding from source gNB to target gNB.**

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| Company | Answer | Comments |
| Huawei | Support. |  |
| Nokia | Support |  |
| Ericsson | not support | we have gone through many topics in our lengthy discussions and you have to admit that there is not a single issues left with not supporting data forwarding. we propose to close this discussion, which is also fully in line with the goal set for Rel-17 for mobility (see the WID), i.e. to support service continuity. we are already much better than that.  we do not agree with the interpretation of requirements as given above, this is just revealing that the basic requirements on system configuration and deployments for NR MBS have not been fully understood, but this comes to no surprise to us.  the buffer requirements are the most astonishing sort of arguments, as you all know that in order to achieve a certain throughput for flow control on F1-U, you have to implement quite substantial buffers in the CU. Stating now, that those represent an investment burden cannot be taken as a serious argument.  and no, you do not have full freedom in scheduling, this is simply not allowed for MBS, please accept that fact. |
| CATT | Support. | It is anyhow possible that the target RAN node triggers joining upon receiving the HANDOVER REQUEST message. |
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* 1. Common CU-UP aspects
     1. Coordination of MRB Configuration

In R3-222323 [11], for common CU-UP deployment, assume in this case: multiple CU-CP connects to one common CU-UP, there needs to be conflicts resolution in case different CU-CP configures different E1AP configurations to the common CU-UP. One possible way out is, the common UP acts as the coordination point, to relay the MRB configuration among possibly multiple CUCPs, e.g., CUCP1 and CUCP2. Compared to other possible coordination methods (say, based Xn or even NG-C), E1 solution is the one with minimum spec impacts, e.g., the UP entity is able to inform CUCP about the MRB configurations in the MRB context setup response. That is to say, the MRB configuration in the MRB SETUP RESPONSE can be different from the required MRB SETUP REQUEST.

**Proposal 7: The common UP is able to inform the CUCP about the MRB configuration in the MRB context setup response that is different from MRB configuration in the required MRB Setup request.**

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| Company | Answer | Comments |
| Huawei | ok |  |
| Nokia | NOK | This can be left to network implementation. |
| Ericsson |  | there is E1 impact on that, right |
| CATT | Disagree, but | Technically letting the gNB-CU-UP to make such decision may cause some problem, e.g. there are many radio bearers need to be setup and there is no enough room for MRB IDs, LCIDs etc.  And anyhow, we have agreed that the normal case should be that all gNB(-CU-CP)s within a region uses the same mapping rule. So the proposal raised in [11] is only an optimisation toward a rare case. (The word “optimisation” means that it anyhow works if we don’t introduce such change.)  A compromise method is acceptable for us: the gNB-CU-UP always performs as the gNB-CU-CP requests, but it may “recommend” a mapping in the response message for information. The gNB-CU-CP may send another request afterwards to “correct” the mapping. |
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* + 1. Shared NG-U Termination Information Exchanging

In R3-222063 [4], for common CU-UP deployment, it is proposed to provide the Shared NG-U Termination Information at source NG-RAN to the target NG-RAN node.

In R3-222025 [1], it is mentioned that For the case that multiple gNB-CU-CPs contact with the same MB-SMF, when a later gNB-CU-CP “joins” a MBS session to get necessary CP context from the MB-SMF, the DL TNL address (if IP multicast is used) it provided will be an old one to which the MB-UPF is already sending DL multicast data. For this case the MB-SMF should figure out such oldness and skip the MB-N4 signalling. And likewise, for the case of RAN node “leaving”, the MB-SMF shall only send an MB-N4 signalling to remove a DL TNL address only if this DL TNL address is not used by any gNB as far as the MB-SMF knows. For the case that multiple gNB-CU-CPs contact with different MB-SMFs but the MB-UPF is shared (we are not sure whether this case is supported as of SA2), it should be the MB-UPF to take the case of gNB-CU-UP sharing into consideration. The detail behaviour of the MB-UPF for this case is similar to the one of the MB-SMF for the prior case.

From moderator point of view, in common CU-UP deployment, the CU-CPs are aware of the common CU-UP via OAM configuration, exchanging this information over interfaces (NG, Xn, E1) are optimizations which are not essential.

**Proposal 8: No need to exchange the Shared NG-U Termination Information over interfaces (NG, Xn, E1).**

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| Company | Answer | Comments |
| Huawei | No need | Up to network implementation (OAM). |
| Nokia | No need. | This proposal has a lot of 5GC assumptions and impact for which SA2 has not been consulted. |
| Ericsson |  | please, do not play around with us. We were tasked to provide a solution that does not relay only on configuration. now we provided it and suddenly it seems that you dont like it. is it, because it works? or what is the reason. We cannot perform serious work if you behave like that. |
| CATT | Neutral | As explained in [1], it can work without either OAM configuration or signalling enhancement.  But for compromise, we are not against the enhancement proposed in [4]. |
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* 1. Others
     1. Xxx (to be added if anything missing)

Description and proposal…

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| Company | Answer | Comments |
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# 4. Reference

1. R3-222025 Supporting lossless handover while retaining flexible MRB mapping (CATT) discussion
2. R3-222026 (TP for TS 38.300) Lossless handover for multicast service (CATT) other
3. R3-222027 [Draft] Reply LS on latest progress and outstanding issues in SA WG2 (CATT) LS out To: SA2 CC:
4. R3-222063 [TP for BL CR 38.423] on mobility between supporting nodes (Ericsson) other
5. R3-222082 Introduction of NR MBS (Nokia, Nokia Shanghai Bell, Huawei, Qualcomm Incorporated) CR0034r, TS 38.415 v16.6.0, Rel-17, Cat. B
6. R3-222084 (TP for TS 38.300) Decision for Data Forwarding between two MBS Supporting Nodes (Nokia, Nokia Shanghai Bell, Huawei, Qualcomm Incorporated, Lenovo) other
7. R3-222167 (TPs to TS 38.423 and TS 38.413 BL CRs) MBS context exchange during mobility between MBS supporting nodes (Huawei, Nokia, Nokia Shanghai Bell, Lenovo, Motorola Mobility, Qualcomm Incorporated, CBN, China Unicom, China Telecom) other
8. R3-222168 (TPs to TS 38.423, TS 38.413 BL CRs) Support of data forwarding between MBS supporting nodes (Huawei, Nokia, Nokia Shanghai Bell, Lenovo, Motorola Mobility, Qualcomm Incorporated, CBN, China Unicom, China Telecom) other
9. R3-222254 Discussion on mobility with service continuity (CMCC) discussion
10. R3-222292 (TP to TS38.423 BL): Data forwarding for mobility between MBS supporting nodes (Samsung) other
11. R3-222323 Mobility between MBS Supporting Nodes with TP to BL CR for TS 38.300, 38.463 (ZTE) other