**3GPP TSG-RAN WG2 Meeting #115 R2-210XXXX**

**Electronic Meeting, August 09 – August 27, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **37.340** | **CR** |  | **rev** | **-** | **Current version:** | **16.6.0** |  |
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| *For* [***HELP***](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 37.340 for eIAB | | | | | | | | | |
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| ***Source to WG:*** | vivo | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_IAB\_enh-Core | | | | |  | ***Date:*** | | | 2021-08-12 |
|  |  | | | |  | |  | | |  |
| ***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)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | To capture the RAN2 agreements on NR\_IAB\_enh-Core WI:  **RAN2#113bis-e agreements**:   * SRB2 can be used for F1-C transport in CP/UP-separation scenario 1 (FFS other cases) * Split SRB2 can be used for F1-C transport in CP/UP-separation scenario 2 (FFS other cases) * R2-2100040 LS on CP-UP separation noted   **RAN2#114 agreements**:   * NR DLInformationTransfer and ULInformationTransfer messages can be enhanced to transfer F1-C related packets in CP/UP separation. * F1-C over RRC and F1-C over BAP should not be supported simultaneously on the same parent link. | | | | | | | | |
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| ***Summary of change:*** | | Introduction of CP-UP separation support in NR eIAB. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | CP-UP separation is not supported in NR eIAB. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1 Definitions  7.xx F1-C transfer over NR  10.15 F1-C Traffic Transfer | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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 Running CR is based on the version 16.6.0 of TS 37.340 | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*First Modified Subclause*

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

**Child node**: IAB-DU's or IAB-donor-DU's next hop neighbour IAB-node.

**Conditional PSCell Change:** a PSCell change procedure that is executed only when PSCell execution condition(s) are met.

**Donor node:** node providing F1-C protocol terminations towards the dual-connected IAB-MT.

**Non-donor node:** node that not providing F1-C protocol terminations towards the dual-connected IAB-MT.

**En-gNB:** node providing NR user plane and control plane protocol terminations towards the UE, and acting as Secondary Node in EN-DC.

**Fast MCG link recovery:** in MR-DC, an RRC procedure where the UE sends an MCG Failure Information message to the MN via the SCG upon the detection of a radio link failure on the MCG.

**IAB-donor:** gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-MT:** IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise.

**IAB-node:** RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes. The IAB-node does not support backhauling via E-UTRA.

**Master Cell Group**: in MR-DC, a group of serving cells associated with the Master Node, comprising of the SpCell (PCell) and optionally one or more SCells.

**Master node**: in MR-DC, the radio access node that provides the control plane connection to the core network. It may be a Master eNB (in EN-DC), a Master ng-eNB (in NGEN-DC) or a Master gNB (in NR-DC and NE-DC).

**MCG bearer**: in MR-DC, a radio bearer with an RLC bearer (or two RLC bearers, in case of CA packet duplication in an E-UTRAN cell group, or up to four RLC bearers in case of CA packet duplication in a NR cell group) only in the MCG.

**MN terminated bearer:** in MR-DC, a radio bearer for which PDCP is located in the MN.

**MCG SRB**: in MR-DC, a direct SRB between the MN and the UE.

**Multi-Radio Dual Connectivity:** Dual Connectivity between E-UTRA and NR nodes, or between two NR nodes.

**Ng-eNB**: as defined in TS 38.300 [3].

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [18], between two or more nearby UEs, using NR technology but not traversing any network node.

**Parent node:** IAB-MT's next hop neighbour node; the parent node can be IAB-node or IAB-donor-DU.

**PCell**: SpCell of a master cell group.

**PSCell**: SpCell of a secondary cell group.

**RLC bearer:** RLC and MAC logical channel configuration of a radio bearer in one cell group.

**Secondary Cell Group**: in MR-DC, a group of serving cells associated with the Secondary Node, comprising of the SpCell (PSCell) and optionally one or more SCells.

**Secondary node**: in MR-DC, the radio access node, with no control plane connection to the core network, providing additional resources to the UE. It may be an en-gNB (in EN-DC), a Secondary ng-eNB (in NE-DC) or a Secondary gNB (in NR-DC and NGEN-DC).

**SCG bearer**: in MR-DC, a radio bearer with an RLC bearer (or two RLC bearers, in case of CA packet duplication in an E-UTRAN cell group, or up to four RLC bearers in case of CA packet duplication in a NR cell group) only in the SCG.

**SN terminated bearer:** in MR-DC, a radio bearer for which PDCP is located in the SN.

**SpCell**: primary cell of a master or secondary cell group.

**SRB3**: in EN-DC, NGEN-DC and NR-DC, a direct SRB between the SN and the UE.

**Split bearer:** in MR-DC, a radio bearer with RLC bearers both in MCG and SCG.

**Split PDU Session (or PDU Session split):** a PDU Session whose QoS Flows are served by more than one SDAP entities in the NG-RAN.

**Split SRB**: in MR-DC, a SRB between the MN and the UE with RLC bearers both in MCG and SCG.

**User plane resource configuration:** in MR-DC with 5GC, encompasses radio network resources and radio access resources related to either one or more PDU sessions, one or more QoS flows, one or more DRBs, or any combination thereof.

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [19], between nearby UEs, using E-UTRA technology but not traversing any network node.

*Next Modificatcion*

## 7.11 F1-C transfer over E-UTRA

In EN-DC, the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet can be transferred between IAB-donor and IAB-node via E-UTRA, if configured by IAB-donor, as specified in TS 38.331 [4]. When both E-UTRA and NR are configured to transfer the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet, it is up to the IAB implementation when to select the E-UTRA. SRB2 is used for transporting the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet between IAB-MT and MN [10], and the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet is transferred as a container via X2-AP between MN and SN, see TS 36.423 [9].

## 7.XX F1-C transfer over NR

IAB-nodes operating in NR-DC can achieve CP-UP separation by allowing the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet over NR access link in FR1, e.g.,to improve the reliability and reduce the latency of F1-AP message transmission. Two scenarios are supported for CP-UP separation, as shown in figure 7.XX-1.



Figure 7.XX-1: CP-UP separation; a) Scenario 1; b) Scenario 2

Scenario 1: IAB-node exchanges F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet with the SN (donor node) using NR access link via MN (non-donor node), and exchange F1-U traffic using backhaul link(s) via SN. SRB2 is used for transporting the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet between IAB-MT and MN (see TS38.331 [4]), and the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet is transferred as a container via XnAP between MN and SN, see TS 38.423 [5].

Scenario 2: IAB-node exchanges F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet with the MN (donor node) using NR access link via SN (non-donor node), and exchange F1-U traffic using backhaul link(s) via MN. Split SRB2 is used for transporting the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet between IAB-MT and SN [4], and the F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet is transferred as a container via XnAP between SN and MN, see TS 38.423 [5].

Editor’s Note: FFS on the support of other SRBs on both Scenario 1 and Scenario 2.

F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet can be transferred either over RRC message or over BH RLC channel(s), but the two mechanisms cannot be supported simultaneously on the same parent BH link.

*Next Modificatcion*

## 10.15 F1-C Traffic Transfer

In EN-DC/NR-DC, the F1-C Traffic Transfer message is sent by the MN to the SN or by the SN to MN to transfer the F1-C traffic to and from an IAB-node.



Figure 10.15-1: F1-C Traffic Transfer procedure in EN-DC

1. When the IAB-MT sends a F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet, it sends it to the MN in a container within *ULInformationTransfer* as specified in TS 36.331 [10].

2. The MN initiates the F1-C Traffic Transfer procedure, in which it transfers the received F1-AP message encapsulated in (SCTP/)IP or F1-C related (SCTP/)IP packet as an octet string.

3. When the SN sends a F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet, it sends it to the MN as an octet string through the F1-C Traffic Transfer procedure.

4. The MN sends the received F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet to the IAB-MT in a container within *DLInformationTransfer* as specified in TS 36.331 [10].



Figure 10.15-2: F1-C Traffic Transfer procedure in NR-DC - Scenario 1: F1-C is transported between IAB-MT and SN (donor node)

1. The IAB-MT sends a F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet to the MN (non-donor node) via SRB2 in a container within *ULInformationTransfer* as specified in TS 38.331 [4].

2. The MN initiates the F1-C Traffic Transfer procedure, in which it transfers the received F1-AP message encapsulated in (SCTP/)IP or F1-C related (SCTP/)IP packet as an octet string.

3. The SN (donor node) sends a F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet to the MN as an octet string through the F1-C Traffic Transfer procedure.

4. The MN sends the received F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet to the IAB-MT via SRB2 in a container within *DLInformationTransfer* as specified in TS 38.331 [4].



Figure 10.15-3: F1-C Traffic Transfer procedure in NR-DC - Scenario 2: F1-C is transported between IAB-MT and MN (donor node)

1. The IAB-MT sends a F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet to the SN (non-donor node) via split SRB2 in a container within *ULInformationTransfer* encapsulated in a PDCP PDU as specified in TS 38.331 [4].

2. The SN initiates the F1-C Traffic Transfer procedure, in which it transfers the received PDCP PDU (F1-AP message) with encapsulated RRC message.

3. When the MN (donor node) sends a F1-AP message encapsulated in SCTP/IP or F1-C related (SCTP/)IP packet, it starts the procedure by initiating the F1-C Traffic Transfer procedure, if split SRB2 is determined to be used. The MN sends it to the SN in a container within *DLInformationTransfer* encapsulated in a PDCP PDU (ciphered with its keys) specified in TS 38.331 [4].

4. The SN forwards the received RLC SDU (DLInformationTransfer) to IAB-MT.

*End of Changes*

# Annex (not part of the specification) - collection of RAN2 agreements on NR IAB enhancements WI

Cyan highlight – agreement captured in this running CR

No highlight – agreement with no direct impact on specifications

## RAN2#115-e agreements

**Organizational**

* R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.
* LS is agreeable with the addition of the above assumption. Can consider one more round of details checking.

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation**

* The length of LCG to be extended to 8 bits (i.e., at most 256 LCGs).
* New Short (Truncated) BSR format to specified that has a fixed size and consists of an 8-bit LCG ID field and an 8-bit Buffer Size field.
* Exclude P1

**On Topology adaptation enhancements**

* A configured threshold of available buffer size based on flow control feedback is used to determine the congestion, for the purpose of local re-routing.
* For intra-CU cases, Support inter-donor-DU re-routing at least in the scenarios of NR-DC among donor-DUs, inter-donor-DU recovery and inter-donor-DU migration.
* Support inter-CU re-routing, i.e. IAB-node re-routes the data to its original donor-CU via the alternative BAP path over the topology in target CU.
* For inter-donor-DU re-routing, support the “previous routing ID to new routing ID” BAP header rewriting.
* RAN2 to further discuss the open issues for inter-CU routing:
* What’s the BAP address added in BAP header in the first topology (i.e. the BAP address of ingress data at the boundary node);
* How to differentiate the concatenated traffic and non-concatenated traffic;
* How to determine whether a data should be delivered to upper layer (for downstream);
* How to determine whether the BAP header of a data should be rewritten (i.e. whether being routed to another topology or its own topology).
* As baseline, support the 1:1 and N:1 mapping from “previous routing ID” to “new routing ID” for BAP header rewriting at the boundary node, in inter-CU routing.
* As baseline, support the 1:1 and N:1 mapping from “ingress BH link + ingress BH RLC ID” to “egress BH link + egress BH RLC ID” for bearer mapping at the boundary node, in inter-CU routing.

## RAN2#114-e agreements

**On Topology adaptation enhancements**

* RAN2 preference is to support inter-topology routing via BAP header rewriting based on BAP routing ID option 4
* Assume that the IAB-donor will configure (alternative) egress links that can be used at local re-routing (at least with same destination, FFS same routing ID)
* Local re-routing based on flow control feedback is allowed based on certain value of available buffer size. FFS further details. (Current hbh fc is for DL traffic.
* NR DLInformationTransfer and ULInformationTransfer messages can be enhanced to transfer F1-C related packets in CP/UP separation.
* A new IE named DedicatedInfoF1c can be defined to transfer F1-C related packets via NR RRC message
* F1-C over RRC and F1-C over BAP should not be supported simultaneously on the same parent link.
* The trigger to generate a type 2 RLF indication is at RLF detection. FFS whether for both: single and dual connection cases.
* The trigger for type 3 RLF indication transmission is successful recovery after BH RLF. FFS whether for both: single and dual connection cases.
* Type 2 and Type 3 BH RLF Indications are transmitted via BAP Control PDU.
* Upon reception of the type-2 indication, the IAB node does not initiate RRC re-establishment.
* If an IAB node with dual parents (via DC) receives type-2 BH RLF indication from one parent, IAB-node may trigger a local re-routing to the other parent. The detail of local re-routing and whether/how the action on type-2 indication is configurable is FFS.

## RAN2#113bis-e agreements

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation**

* LCG range to be extended for IAB-MT. Size of LCG and enhancements to BSR are FFS

**On Topology adaptation enhancements**

* The use cases for IAB-MT CHO should be migration and RLF recovery.
* RAN2 should have a common solution for intra-CU/intra-DU CHO and intra-CU/inter-DU CHO.
* condEventA3 and condEventA5 are applicable to IAB-MT
* FFS if other CHO execution condition is needed (e.g. whether type 2 RLF indication can be used as trigger)
* SRB2 can be used for F1-C transport in CP/UP-separation scenario 1 (FFS other cases)
* Split SRB2 can be used for F1-C transport in CP/UP-separation scenario 2 (FFS other cases)

## RAN2#113-e agreements

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation**

* RAN2 will not further discuss ways of evaluating success of any fairness mechanisms that may be introduced, beyond the already agreed definition of topology-wide fairness and its variants.
* Chair: On the agreed issues below, the agreement doesn’t mean that we have agreed that there need to be a solution for it in R17. Furthermore, liberal interpretation of the text is ok.
* ISSUES: eIAB work on topology-wide fairness will focus on the following issues
* IF-1: The scheduler of an IAB node does not have all the information needed (e.g. link quality across multiple hops) to make appropriate upstream or downstream scheduling decisions which take into account the overall route link quality (such as e.g. using downstream link quality measurements to adjust the scheduling weights so as to achieve proportional fairness for different bearers/RLC channels across multiple child-IAB nodes)
* IF-2: Congestion conditions on BH RLC channels carrying UE bearers with same or similar QoS requirements can be unbalanced and some channels may even be congested, thereby leading to some users experiencing longer latency and violating fairness requirement.
* IF-4: IAB node cannot give more resource to those BH RLC CHs that aggregate more bearers and/or carry bearers with higher load per bearer (i.e. IAB node cannot give more resource to those BH RLC CHs with higher aggregate load)
* ISSUES: In the first instance, eIAB work on multi-hop latency will focus on the following issues:
* IL-1: IAB node cannot help ensure that overall or remaining PDB is met for a packet (e.g. by prioritizing bearers with higher number of hops), as it does not have a latency reference for the packets being scheduled, resulting in packets with the same QoS requirement ending up with different latency
* IL-2: IAB node may need to report joint buffer status for LCHs which have rather differing QoS requirements, due to the current (Rel-16) limit on the number of LCGs
* IL-3: Buffer size calculation for pre-emptive BSR may differ for nodes of different vendors as it is left to implementation in Rel-16
* IL-5: The CU is unable to put bearers with lower PDB on routes with less congestion risk (higher resource efficiency) or which are RLF-free
* IL-6: The CU is unable to configure routing based on actual (real-time) latency per BH RLC channel

**On Topology adaptation enhancements**

* RAN2 to discuss CHO and start with intra-donor CHO until RAN3 has made progress on inter-donor IAB-node migration.
* R2 confirm the intention Rel-16 CHO is / can be used for IAB-MT (FFS whether any modification is needed).
* R2 assumes that Rel-16 specification is the baseline for the configuration of default route, IP address(es) and target path for intra-donor CHO.
* RAN2 to support type-2/3 RLF indication (FFS specified behavior(s) TS impact, FFS details).
* Type-2 RLF indication may be used to trigger local rerouting
* Type-2 RLF indication may be used to trigger deactivation of IAB-supported in SIB
* Type-2 RLF indication may be used to trigger deactivation or reduction of SR and/or BSR transmissions
* Local rerouting can be triggered by indication of hop-by-hop flow control. Further details, e.g., on trigger information, trigger conditions, role of CU configuration, are FFS.
* RAN2 considers inter-donor-DU local rerouting to be in scope

## RAN2#112-e agreements

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation:**

* R2 assumes Rel-17 IAB work will not define any new end-user QoS metrics on top of the existing 5G QoS framework.
* Rel-17 IAB work will comprise agreeing on a definition of topology-wide fairness.
* Topology-wide fairness provides mechanisms for the management of QoS so that the required QoS is met across the topology, regardless of where a UE attaches to the IAB network. Variants of this definition is not precluded. FFS how the success of such mechanisms is evaluated.
* RAN2 will not discuss enhancements to DL E2E flow control without input from RAN3
* FFS if RAN2 will deprioritize splitting data of a radio bearer into two or more paths (RAN3 agreements to deprioritize Multi-Route Support with data split in IAB)

**On Topology adaptation enhancements:**

* Consider enhancements to topology adaptation that improve:
  + Robustness, e.g., to rapid shadowing,
  + service-interruption,
  + load balancing among different IAB-nodes, IAB-donor-DUs and IAB-donor-CUs, and
  + reduction in signaling load.
* RAN2 to discuss enhancements to RLF indication/handling with the focus on the reduction of service interruption after BH RLF.
* CHO and potential IAB-specific enhancements of CHO is on the table.
* DAPS and potential IAB-specific enhancements of DAPS is not precluded for now (but as there is no PDCP it is not clear how to support DAPS).
* For message bundling, RAN2 at least wait for more progress to be made in RAN3 on topology adaptation procedures.
* RAN2 to discuss local rerouting, including the benefits over central route determination, and on how topology-wide objectives can be addressed.