3GPP TSG-RAN WG3 #116-e R3-223714

9 – 17 May, 2022

Agenda Item: 9.3.1

Source: Samsung (moderator)

Title: Summary of Offline Discussion on Mobility Between DC and SA

Document for: Approval

# Introduction

**CB: # 1\_DirectDataFwd\_DCtoSA**

**- For NR SA to EN-DC HO, in the case source NG-RAN node does not have a direct path to target MeNB but has a direct path to target SgNB, efficient DL data forwarding from source NG-RAN node to target MeNB through the target SgNB for MN terminated bearers?**

**- For EN-DC to NR SA HO, in the case target NG-RAN node does not have a direct path to source MeNB but has a direct path to source SgNB, efficient DL data forwarding from source MeNB to target NG-RAN node through the source SgNB for MN terminated bearers?**

**- LS to SA2?**

**- Try to close the topic, capture agreements and provide CRs if agreeable**

(Samsung - moderator)

Summary of offline disc [R3-223714](file:///E:\3GPP%20Standardization\RAN3\RAN3%23116-e\draft\CB%20%23%201_DirectDataFwd_DCtoSA\Inbox\R3-223714.zip)

It is proposed to divide the discussion into two phases:

- Phase 1:

Deadline: Please provide your views before end of Thur. May 12 UTC time

- Phase 2:

Deadline: tbd pending on the outcome of Phase 1

# For the Chairman’s Notes

**Propose to agree the following:**

# Discussion

## TNL address allocation for handover to EN-DC

IP address spaces (or sub-network) can be different for intra-system (X2-U) or inter-system or can be different for X2 and S1. Based on this assumption, RAN3 agreed the CR for handover to NG-RAN node in R3-214450, [R3-216097](file:///E:\\3GPP%20Standardization\\RAN3\\RAN3%23114-e\\agenda\\Inbox\\R3-216097.zip), R3-216096.

For handover to EN-DC, in order to let target to assign appropriate TNL address for data forwarding from the source in the following two scenarios, the target node who is responsible for assigning the TNL address needs to know inter-system or intra-system, direct or indirect.

Case A: LTE to EN-DC

Case B: NR to EN-DC

To support this, the proposal is to include

* Direct Forwarding Path Availability IE in the source eNB to the target eNB transparent container.
* Handover Type IE in the X2AP SGNB ADDITION REQUEST message.

With above change, the target eNB and en-gNB could assign corresponding TNL address for direct data forwarding from the source node i.e.

For intra-system and direct data forwarding, the IP address space for X2-U is used.

For inter-system and direct data forwarding, the IP address space for Xn-U is used.

For indirect data forwarding, the IP address space for S1-U is used.

One comment from last meeting is that “Not sure why the direct forwarding path availability will be needed. Handover type should be sufficient to select the forwarding tunnel endpoint.” If the target only knows Handover Type and doesn’t know Direct/Indirect, the target eNB cannot differentiate the following two cases and may not assign TNL for Xn-U for 1) or may assign Xn-U for 2)

1. Inter-system, Direct => TNL address for Xn-U
2. Inter-system, Indirect => TNL address for S1-U

So only know the handover type is not enough. That’s why RAN3 agreed to transmit Direct Forwarding Path Availability from 5GC to the target NG-RAN node for intra-5GS handover in R3-216096.

**Q1: Are you fine with the CRs in R3-223553 and R3-223554?**

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Yes. As other scenarios has been agreed. All scenarios for the same issue should be covered. |
| Nokia | This is all very confusing… It was agreed that in case of a HO from SA NR to EN-DC, the target SN decides if there is direct path or not (the source node ID is added in the ADD REQ on X2). If so, the SN knows if it is intra-LTE or inter-RAT HO, right? It can therefore allocate the right address based on the existing information, right?  Also, why the split is on the intra-LTE or inter-RAT HO? The difference is if the address is for other RAN node (X2) or the CN (S1). But you may have a intra-LTE HO over CN, right?  But if the above is correct, the same problem exists in NR, but it is not indicated in Xn ADD REQ what is the HO type, or which interface the address shall be allocated for. Why? |
| Huawei | In our understanding, for the following two cases:  Case A: LTE to EN-DC  Case B: NR to EN-DC  The target eNB should allocate **X2-U** addresses for the direct data forwarding. So not fully understand the intention to introduce Direct Forwarding Path Availability IE in the source eNB to the target eNB transparent container, to differentiate these two cases.  For the proposal to add “Handover Type IE in the X2AP SGNB ADDITION REQUEST message”, not sure if anything is needed. Note for SA->ENDC, we have introduced the source NG-RAN node ID (source gNB ID) in the X2 SN addition request message, so the target en-gNB can somehow derive the HO type? |
| Ericsson | Agree with Huawei that source node ID can be used to understand handover type. However, I have a comment/question: where is it stated that for case B, X2-U addresses shall be used? |
|  |  |

## Inter-system direct data forwarding between source SgNB and target gNB

In [4][5], it is proposed to change “the source eNB” to “the node” in TS38.300 to allow direct data forwarding between source SgNB and target gNB during EN-DC to SA HO.

**Q2: Do you agree the CRs in R3-223471 and R3-223472?**

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| --- | --- |
| Company | Comment |
| Samsung | Yes. |
| Nokia | All right. |
| Huawei | No need.  Here the original texts in 38.300 just focus on the single node handover. Hence there is no anything wrong.  For MR-DC related handover with direct data forwarding, we have agreed the R3-222819 for TS 37.340 at previous RAN3 meeting. So there is no need to have the change in 38.300, and the change in 38.300 is very marginal (also not easily to track the change is due to the MR-DC case) |
| Ericsson | Yes. Most of the direct data forwarding aspects found in 38.300 are also used for MR-DC direct data forwarding. Therefore, this text is not correct. Otherwise, we need to mention that 38.300 is used for only non-DC to non-DC HO and enhance 37.340 |
| CATT | Yes |
|  |  |

In [6][7], it is proposed to make the following changes in TS38.424 to allow direct data forwarding between source SgNB and target gNB during EN-DC to SA HO.

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### 9.2.1 GTP Tunnel Endpoint

The *GTP Tunnel Endpoint* IE identifies an X2 transport bearer or an Xn transport bearer (for inter-system direct data forwarding) or the S-GW endpoint of the S1 transport bearer associated to an E-RAB. It contains a Transport Layer Address and a GTP Tunnel Endpoint Identifier. The Transport Layer Address is an IP address to be used for the X2 user plane transport (see TS 36.424 [8]) or for the Xn user plane transport (see TS 38.424 [x]) or for the S1 user plane transport (see TS 36.414 [19]). The GTP Tunnel Endpoint Identifier is to be used for the user plane transport. The QoS Mapping Information is used to set the IP header of packets in case that the en-gNB serves the IAB, and the packets belonging to MN-terminated split bearer/SCG bearer are transmitted from MeNB to en-gNB.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description | Criticality | Assigned Criticality |
| Transport Layer Address | M |  | BIT STRING (1..160, ...) | For details on the Transport Layer Address, see TS 36.424 [8], TS 36.414 [19], TS 38.424 [x] | – |  |
| GTP TEID | M |  | OCTET STRING (4) | For details and range, see TS 29.281 [26] | – |  |
| QoS Mapping Information | O |  | 9.2.172 |  | YES | reject |

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**Q3: Do you agree the CRs in R3-223473 and R3-223474?**

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| --- | --- |
| Company | Comment |
| Samsung | Source SgNB is an E-UTRAN node. It is not Xn interface between SgNB and the target gNB. The change seems not needed. |
| Nokia | Same as Samsung: in what scenario this could be an Xn address?... |
| Huawei | We understand for inter-system EN-DC to SA HO, X2 addresses should be assigned by the target NG-RAN node. So the change is not needed. |
| Ericsson | Fine if common understanding is that X2 is used between source SgNB and target gNB. But this should be captured somewhere in that case |
| CATT | Same view with Samung |

## Direct data forwarding from MR-DC to eNB

How to support direct data forwarding from MR-DC to eNB is not clear.

For MR-DC to eNB handover, similar as handover from EN-DC to SA, SN modification procedure between source MN and source SN is not needed. So Option 3a is appropriate.

To support direct data forwarding from MR-DC to eNB with Option 3a, similar change as in R3-222746 for NGAP should be made in S1AP. The CR for S1AP is provided in [11].

**Q4: Do you agree the CR to S1AP in R3-223556 with similar change as in agreed CR for NGAP in order to support direct data forwarding from MR-DC to eNB?**

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| --- | --- |
| Company | Comment |
| Samsung | Yes. The mechanism has been agreed for EN-DC to SA handover. The same change can be made to S1AP to support handover from MR-DC to eNB. |
| Nokia | Fine in principle. But the CR is strange: is part of the ASN.1 missing? Also, why the Source SN ID defined in such complicated way? |
| Huawei | Agree. The ASN.1 should be corrected. |
| Ericsson | Ok on the principle. But CR definitely needs an update. It is a mix of NGAP and S1AP sections… |
| CATT | For MR-DC to eNB handover case, we think it should follow the principle of MR-DC to SA.The reason is that similar with MR-DC to SA,MN node anyway needs to contact source SN node to check whether data forwarding is needed or not for each flow. So, the same procedure could be used for MN to drive whether direct data forwarding is available or not between source SN and target eNB. |
|  |  |

## Scenario 3 (MN has no direct forwarding, SN has direct forwarding)

At RAN3#114bis-e meeting, there were the following working assumptions for scenario 3 as below:

**WA: Support direct data forwarding from the source NG-RAN node to the target SN in scenario 3. Continue to discuss the solutions. Whether the WA will be changed to the agreement is depending on the specification impact.**

**WA: Support direct data forwarding from the source SN to the target NG-RAN node in scenario 3. Continue to discuss the solutions. Whether the WA will be changed to the agreement is depending on the specification impact.**

At RAN3#115-e meeting, there were the following agreement for scenario 3:

**Scenario 3**

**For scenario from NR SA to EN-DC handover in Scenario 3:**

* **Source NG-RAN node doesn’t include Direct Forwarding Path Availability IE Handover Required message for handover from NR SA to EN-DC in scenario 3.**
* **The same as scenario 1 and scenario 2, it should be the target SN to decide whether direct forwarding path is available between the source NG-RAN node and the target SN**

To be continued on Scenario 3.

**Inter-system handover from NR SA to EN-DC**

There are two ways for supporting direct forwarding in scenario 3:

Option 1: For MN terminated bearers, indirect data forwarding is used i.e. source NG-RAN node -> UPF-> SGW->target MN.

For SN terminated bearers, direct data forwarding is used i.e. source NG-RAN node -> target en-gNB.

Option 2: For MN terminated bearers, indirect data forwarding is from source NG-RAN node -> target en-gNB -> target MeNB

For SN terminated bearers, direct data forwarding is used i.e. source NG-RAN node -> target en-gNB.

For SN terminated bearers, there is no difference for the two options. The difference is for MN terminated bearers.

**Q5: which option is reasonable in your understanding?**

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| --- | --- |
| Company | Comment |
| Samsung | It should be option 1.  For MN terminated bearers, it’s strange to forward data from source NG-RAN node to the target SN then to the target MN.  If option 2, there are additional complexity over X2. There are also impact on S1AP.  If option 1, the only specification impact is to add an indication in S1AP. |
| Nokia | Option 1  Forwarding to the MN via the SN is not feasible, the SN can be released at any time. |
| Huawei | We understand both options have impact on the CN (EPC and 5GC). When looking at the previous agreement:   * **Whether the WA will be changed to the agreement is depending on the specification impact.**   We doubt if this scenario 3 can be supported, without the CN involvement, and potential SA2 specification update.  Also we consider this scenario 3 is not essential for HO related to MR-DC, after we have agreed set of CRs for scenario1/2.  If anything is really needed for this scenario 3, we suggest this can be considered at later release, even after contacting with SA2. |
| Ericsson | Agree with Huawei. We do not see the need to support this use-case for now. |
| CATT | Option 2.  With option 1, it is needed for CN to decide whether indirect data forwarding tunnel should be allocated per E-RAB or per PDU session which is a new feature to CN. There would be impact to both SA2 and CT4  Option 2 restricts the impact within RAN side. We prefer the solution which only has RAN impact. |
|  |  |

If option 1, the specification impact for supporting handover from NR SA to EN-DC is as follow:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **E-RABs Admitted List** |  | *1* |  |  | YES | ignore |
| **>E-RABs Admitted Item IEs** |  | *1 .. <maxnoofE-RABs>* |  |  | EACH | ignore |
| >>E-RAB ID | M |  | 9.2.1.2 |  | - |  |
| >>Transport Layer Address | M |  | 9.2.2.1 |  | - |  |
| >>GTP-TEID | M |  | 9.2.2.2 | To deliver DL PDUs. | - |  |
| >>DL Transport Layer Address | O |  | 9.2.2.1 |  | - |  |
| >>DL GTP-TEID | O |  | 9.2.2.2 | To deliver forwarded DL PDCP SDUs. | - |  |
| >>UL Transport Layer Address | O |  | 9.2.2.1 |  | - |  |
| >>UL GTP-TEID | O |  | 9.2.2.2 | To deliver forwarded UL PDCP SDUs. | - |  |
| >>Direct Forwarding Available | O |  | 9.2.3.15 | Indicates that direct forwarding path is available for SN terminated bearers | - |  |

**Q6: If option 1, do you agree that the above specification change is needed and enough?**

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Yes.  Then core network node could skip to assign indirect data forwarding tunnels for SN terminated bearers with the indication. |
| Nokia | Likely yes. But does it have to be indicated per E-RAB? I assume, direct path availability concerns all E-RABs anchored at given node, right? |
| Huawei | See our comments to Q5. |
| Ericsson | No needed. See Q5 |
|  |  |

If option 2, [9] proposed the specification impact for TS36.423.

**Q7: If option 2, do you agree that the specification impact in [9] is needed and enough?**

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| --- | --- |
| Company | Comment |
| Samsung | The change is needed. But it is not enough. Additional change to X2AP and S1AP is needed.  The SN should also assign data forwarding tunnels for MN terminated bearers and sends the assigned data forwarding tunnels to the MN. There is impact on SN addition response message. There are also impact on S1AP as option 1 or add additional data forwarding tunnel to the Target to Source Transparent container. |
| Huawei | See our comments to Q5. |
| Ericsson | Not needed. See Q5 |
| CATT | The change is needed. |
|  |  |

**Inter-system handover from EN-DC to SA**

Similar as the other direction, there are two ways for supporting direct forwarding in scenario 3:

Option 1: For MN terminated bearers, indirect data forwarding is used i.e. source MN -> SGW->UPF-> target NG-RAN node.

For SN terminated bearers, direct data forwarding is used i.e. source SN -> target NG-RAN node.

Option 2: For MN terminated bearers, indirect data forwarding is from source MN-> source SN-> target NG-RAN node

For SN terminated bearers, direct data forwarding is used i.e. source SN -> target NG-RAN node.

For SN terminated bearers, there is no difference for the two options. The difference is for MN terminated bearers.

**Q8: which option is reasonable in your understanding?**

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | It should be option 1.  For MN terminated bearers, it’s strange to forward data from source MN-> source SN-> target NG-RAN node.  If option 1, once the change to support direct data forwarding from NR SA to EN-DC is agreed, direct forwarding from the source SN to the target node from handover from EN-DC to NR SA can be supported as well.  If option 2, there are additional complexity over X2. There are also impact on S1AP. |
| Nokia | Option 1, the same reasons as in Q5. |
| Huawei | See our comments to Q5. |
| Ericsson | None. See Q5 |
| CATT | Option 2  For option 2, only signalling exchange between source SN and source MN is needed while option 1 bring impact on CN implementation. We prefer the solution which does not have impact to CN node. |

# Conclusion, Recommendations [if needed]

If needed

# References

[1] R3-223552, Direct Data forwarding address allocation for handover to EN-DC (Samsung, Verizon Wireless, ZTE)

[2] R3-223553, Direct forwarding address allocation for handover to EN-DC (Samsung, Verizon Wireless, ZTE)

[3] R3-223554, Direct forwarding address allocation for handover to EN-DC (Samsung, Verizon Wireless, ZTE)

[4] R3-223471, Inter-system direct data forwarding between source SgNB and target gNB (Ericsson)

[5] R3-223472, Inter-system direct data forwarding between source SgNB and target gNB (Ericsson)

[6] R3-223473, Xn UP transport for HO from EN-DC to SA (Ericsson)

[7] R3-223474, Xn UP transport for HO from EN-DC to SA (Ericsson)

[8] R3-223121, SN direct data forwarding in inter-system handover (Qualcomm Incorporated)

[9] R3-223132, Direct data forwarding in NR SA to EN-DC handover (CR to 36.423) (Qualcomm Incorporated)

[10] R3-223555, Direct data forwarding for mobility between DC and SA (Samsung, Verizon, China Telecom)

[11] R3-223556, Direct data forwarding for mobility from MR-DC to eNB (Samsung, Huawei, China Telecom, Verizon Wireless)

[12] R3-223557, Direct data forwarding for mobility between DC and SA (Scenario 3) (Samsung, China Telecom, Verizon Wireless)

[13] R3-223540, Direct data forwarding for mobility between DC and SA (Scenario 3) (China Telecom, Samsung, Verizon Wireless)

[14] R3-223558, LS to SA2 on direct data forwarding between DC and SA (Samsung)