**3GPP T****SG-RAN WG3 Meeting #112-e R3-212625**

**Electronic Meeting, May 17th – May 28th, 2021**

**Agenda item: 9.3.4.2**

**Source: Qualcomm Incorporated (moderator)**

**Title:** **Summary for CB: # 29\_DirectDataFwd\_DC-SAmobility**

**Document for: Discussion and Decision**

# 1 Introduction

This is to discuss CB #29:

|  |
| --- |
| **CB: # 29\_DirectDataFwd\_DC-SAmobility****- (QC,CATT,CT) A signaling based solution is needed so that target MeNB knows whether target SgNB has a direct path to the source NG-RAN node. FFS on the signaling solution to use; a signaling based solution is needed so that source MeNB knows whether source SgNB has a direct path to the target NG-RAN node. FFS on the signaling solution to use****- (SS,HW) Add Source Node ID to the Source NG-RAN Node to the Target NG-RAN node transparent container message; Add Direct Forwarding Path Availability to the Target NG-RAN node to Source NG-RAN node transparent container**(QC - moderator)Summary of offline disc [R3-212625](file:///D%3A%5C3gpp%E4%BC%9A%E8%AE%AE%5CRAN3%5CRAN3%23112%5Coffline%5CCB%20%23%2029_DirectDataFwd_DC-SAmobility%5CInbox%5CR3-212625.zip) |

# 2 For the Chairman’s Notes

**SN direct forwarding availability information acquisition**

* Candidate solutions:
	+ 0. Current solution, based on OAM configuration
	+ 1. Use interface setup/update signaling
	+ 2. Use SN modification procedure
	+ 3. Use source to target transparent container
* FFS: whether signaling based solution is needed and which solution to use if needed.

**Agreements on SN data forwarding solution:**

Scenario 1 (both MN and SN have direct forwarding): Direct data forwarding to/from SN is supported.

* In SA to NSA HO, target MN receives the SN forwarding address from SN Addition Request Ack and provides the address to source for direct data forwarding.
* In NSA to SA HO, Source MN sends the received direct forwarding address for SN terminated bearer to source SN e.g. in SN Release Request.

Scenario 2 (MN has direct forwarding, SN does not have direct forwarding): SN data is forwarded via MN.

* In SA to NSA handover, target MN provides its own forwarding address to source and forwards received data to SN.
* In NSA to SA handover, source MN provides its own address to source SN for data forwarding e.g. in SN Release Request.

Scenario 3 (MN does not have direct forwarding, SN has direct forwarding): It is FFS whether enhancement is needed

Scenario 4 (Neither MN nor SN has direct forwarding): no room for further enhancement.

In inter-system handover, source node does not consider the availability of SN direct forwarding in setting “Direct Forwarding Path Availability” IE of S1/NG Handover Required message.

**To be continued:**

* **Required clarification or change in standard for above agreement**
* **SN direct forwarding availability information acquisition**

# 3 Phase 1 Discussion

The following discussion is regarding the observations and proposals from the following contribution papers: Qualcomm Incorporated, CATT, China Telecom [1744], Qualcomm Incorporated, CATT [1745], Samsung, Huawei [1954], Huawei, Samsung [2458].

The goal in the above contributions is to extend the signaling support that currently exists for direct forwarding in inter-system handovers between two standalone network nodes to direct forwarding in MR-DC scenarios and to develop a unified framework for inter-system and intra-system handovers in MR-DC scenarios.

In the previous RAN3 #111-e meeting [1], [2], it was agreed that solutions should be developed for the following four identified scenarios of handover between SA and NSA, both inter-system and intra-system.

**RAN3 #111-e agreement: Consider solution for all the following data forwarding scenarios of handover between SA and NSA:**

**- Scenario 1: both MN and SN have direct forwarding.**

**- Scenario 2: MN has direct forwarding, SN has no direct forwarding.**

**- Scenario 3 (FFS): MN has no direct forwarding, SN has direct forwarding.**

**- Scenario 4: neither MN nor SN has direct forwarding.**

## 3.1 Supporting direct data forwarding for inter-system HO from NR SA to EN-DC

In the email discussion [1] companies preferred that a signaling based solution be developed to enable relevant nodes to know direct forwarding path availability for all the above four scenarios to avoid the OAM burden of configuring neighbor’s neighbor information on direct forwarding path availability, which may be especially relevant in the inter-vendor case.

In NR SA to EN-DC handover it is sufficient that the target MeNB knows whether target SgNB has a direct path to the source NG-RAN node, as the discussion in [1744] shows. The following are observations and a proposal in [1744] related to the discussion above.

**Observation 1: A signaling based solution needs to be developed to enable relevant nodes to know direct forwarding path availability for all scenarios of handover between SA and NSA to avoid the OAM burden of configuring neighbor’s neighbor information for direct data forwarding, which may be especially relevant in the inter-vendor case.**

**Observation 2: In NR SA to EN-DC HO, it is sufficient to develop a signaling based solution so that target MeNB knows whether target SgNB has a direct path to the source NG-RAN node.**

**Proposal 1: A signaling based solution is needed so that target MeNB knows whether target SgNB has a direct path to the source NG-RAN node. FFS on the signaling solution to use.**

### **Question 1: Do companies agree with Observations 1, 2, and Proposal 1 [1744]?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes |  |
| Samsung | Yes |  |
| Nokia | No | We’re fine to seek a solution that eleminates the need to use OAM. However, here, instead of configuring MeNB, the operator has to configure the gNB (or en-gNB). This does not change anything! So, please, we need to seek another one. |
| ZTE | Yes |  |
| Ericsson | No | This does not make things simpler |

As discussed in [1744], for the signaling solution in Proposal 1, the following are two possible candidates:

**Signaling solution Alternative 1:** Target MeNB obtains from target SgNB information regarding the RAN nodes to which target SgNB is directly connected, i.e., the RAN neighbor nodes of target SgNB; e.g., this can be obtained using EN-DC X2 Setup procedure by adding RAN neighbor node information in the EN-DC X2 Setup Response message.

**Signaling solution Alternative 2:** During the handover procedure, in SgNB Addition Request message, target MeNB includes the source NG-RAN node ID and requests the target SgNB to check if it has a direct path to the source NG-RAN node. If target SgNB has a direct path to the source NG-RAN node, it includes in SgNB Addition Request Acknowledge an SN Direct Forwarding indicator. This solution is also proposed in [2458] for the more general case of SA to MR-DC handover.

### **Question 2: Which of the above alternatives do companies think can provide a signaling solution to enable target MeNB to know whether target SgNB has a direct path to the source NG-RAN node [1744], [2458]? If companies have a signaling solution in mind that is different from the above alternatives, please indicate in the comments.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt. 1/Alt. 2** | **Comments** |
| CATT | Alternative 2 |  |
| Huawei | Alternative 2 |  |
| Samsung | Alternative 2 |  |
| Nokia | Neither | Both of the solutions assume that configuring en-gNB or gNB is easier than configuring the MeNB. This assumption has not been acknowledged in RAN3 and thus the proposed solution must be considered as not helping configuration whatsoever.  |
| ZTE | Alternative 2 |  |

For the scenarios identified in the RAN3 #111-e agreement, we have the following observation from [1744] which states how the existing Direct Forwarding Path Availability IE in NG-AP Handover Required message can be used. The IE is present if there is a direct path from source NG-RAN node to target MeNB. The scenarios are as follows:

* Scenario 1: Source NG-RAN node has a direct path to target MeNB and to target SgNB.
* Scenario 2: Source NG-RAN node has a direct path to target MeNB, but not to target SgNB.
* Scenario 3: Source NG-RAN node has a direct path to target SgNB, but not to target MeNB.
* Scenario 4: Source NG-RAN node does not have a direct path to target MeNB or to target SgNB.

**Observation 3: For scenarios 1 and 2, NG-AP Handover Required message includes the Direct Forwarding Path Availability IE indicating that there is a direct path available from source NG-RAN node to target MeNB. For Scenario 4, Handover Required does not include the Direct Forwarding Path Availability IE. For Scenario 3, it is FFS whether this IE is included.**

### **Question 3: Do companies agree with the above observation [1744] indicating the use of the existing Direct Forwarding Path Availability IE in NG-AP Handover Required message for the scenarios listed above? If not, please indicate in the comments whether and how the IE should be used in the scenarios listed above.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes |  |
| Samsung | Yes |  |
| ZTE | Yes |  |

We now discuss further signaling support for Scenarios 1, 2, and 4.

For Scenario 1, we have the following proposal from [1744]. This proposal does not involve any changes (i.e., introduction of new IEs, etc.) in the definition of the message involved: Handover Request Acknowledge.

**Proposal 2: In case of Scenario 1, in** **Handover Request Acknowledge message to the MME, target MeNB includes the data forwarding addresses provided by target SgNB for the E-RABs corresponding to SN terminated bearers.**

### **Question 4: Do companies agree with the above proposal [1744] regarding signaling support for Scenario 1? If not, please indicate in the comments if you have other proposals regarding signaling support for Scenario 1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes | S1AP spec already supports this.  |
| Samsung | Yes |  |
| ZTE | Yes |  |

For Scenarios 2 and 4, we have the following proposals and observations from [1744]. These observations and proposals also do not involve any changes in the definition of the message involved: Handover Request Acknowledge.

**Proposal 3: In case of Scenario 2, target MeNB forwards data from source NG-RAN node to the target SgNB, for the SN terminated bearers.**

**Observation 4: In case of Scenario 2, in Handover Request Acknowledge message to the MME, target MeNB includes its own data forwarding addresses for all E-RABs.**

**Observation 5: No further changes are required in the standards to support Scenario 4, and no room for any improvements in data forwarding is foreseen.**

### **Question 5: Do companies agree with the above observations and proposal [1744] regarding signaling support for Scenarios 2 and 4? If not, please indicate in the comments if you have other proposals regarding signaling support for Scenarios 2 and 4.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes |  |
| Samsung |  | Agree Proposal 3 and Observation 4.Just to clarify observation 5 to make things clear, in order to identify Sceanrio 4, alternative 2 in Question 2 is needed. But no more change is needed. |
| ZTE | Yes |  |

It is indicated in [1744] that Scenario 3 is left FFS for now, and the focus is on developing a solution for Scenarios 1, 2, and 4.

**Observation 6: Signaling solution to support Scenario 3 is FFS.**

On the other hand, in [2458] the companies indicate that Scenario 3 should be excluded from analysis since this scenario may have impact on the CN.

**Proposal 4: Scenario 3 is excluded from the analysis.**

### **Question 6: Would companies like to keep Scenario 3 as FFS and focus on discussing solutions to Scenarios 1, 2, and 4 in the current meeting (Observation 6) [1744]? If companies would like to exclude Scenario 3 (Proposal 4) [2458] or have other preferences, please indicate in the comments.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | It is OK to focus on scenario 1,2,4 first |  |
| Huawei | Yes |  |
| Samsung | Yes | For Scenario 3, indirect forwarding from Source NG-RAN node to target MeNB and to target SgNB. |
| ZTE | Yes |  |

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### **Summary**

 TBD

## 3.2 Supporting direct data forwarding for inter-system HO from EN-DC to NR SA

In the case of EN-DC to NR SA handover, the following are the data forwarding scenarios to consider:

* Scenario 1: Both source MeNB and source SgNB have direct path to target NG-RAN node.
* Scenario 2: Source MeNB has direct path to target NG-RAN node, but source SgNB does not.
* Scenario 3: Source MeNB does not have direct path to target NG-RAN node, but source SgNB does.
* Scenario 4: Both source MeNB and source SgNB do not have direct path to target NG-RAN node.

As in the case of NR SA to EN-DC handover, in order to avoid the OAM burden of configuring neighbor’s neighbor information for direct data forwarding, in [1744] an observation similar to Observation 2 and a proposal similar to Proposal 1 is provided, as below.

**Observation 7: In EN-DC to NR SA HO, it is sufficient to develop a signaling based solution so that source MeNB knows whether source SgNB has a direct path to the target NG-RAN node.**

**Proposal 5: A signaling based solution is needed so that source MeNB knows whether source SgNB has a direct path to the target NG-RAN node. FFS on the signaling solution to use.**

### **Question 7: Do companies agree with Observation 7 and Proposal 5 [1744]?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes |  |
| Samsung | Yes |  |
| Nokia | Yes | This solution must bring benefit over the current need to use OAM. In other words, we do not accept the assumption that configuring MeNB is somehow more difficult than configuring the en-gNB or the gNB. The solution that may be considered would need to eliminate configuration altogether or limit it in any node. |
| ZTE | Yes |  |
| Ericsson | No | No benefit compare to existing methods |

As discussed in [1744], for the signaling solution in Proposal 5, there are the following two possible candidates:

**Signaling solution Alternative 1:** In the previous RAN3 contribution [3], the solution proposed is that source MeNB uses the SN Modification procedure to obtain from source SgNB information regarding whether source SgNB has a direct path to the target NG-RAN.

**Signaling solution Alternative 2:** The EN-DC X2 Setup procedure may also be enhanced for this purpose as in NR SA to EN-DC handover case discussed in the previous section. For example, source MeNB can obtain from source SgNB information regarding the RAN nodes to which source SgNB is directly connected, i.e., the neighbor nodes of source SgNB.

In [2458], [1954], another signaling solution is provided, which is proposed for the more general MR-DC to SA HO.

**Signaling solution Alternative 3:** The source MN provides the source SN ID to the target node. The target node provides the direct data forwarding availability indication to the source MN. The messaging is carried out in the Source NG-RAN Node (Target NG-RAN node) to the Target NG-RAN node (Source NG-RAN node) transparent containers in NG/S1 handover preparation messages.

### **Question 8: Which of the above alternatives do companies think can provide a signaling solution to enable source MeNB to know whether source SgNB has a direct path to the target NG-RAN node [1744], [2458], 1954]? If companies have a signaling solution in mind that is different from the above alternatives, please indicate in the comments.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt. 1/Alt. 2/Alt. 3** | **Comments** |
| CATT | Alternative 1 |  |
| Huawei | Alt3 | Note that we already take similar approgach for the ENDC to SA handover with shared SgNB/gNB case.  |
| Samsung | Alt3 | Alt 1 will downgrade handover performance at least for full configuration.  |
| Nokia | None | All of the proposed solutions assume the en-gNB or the gNB has mysteriously information about direct path, while the MeNB does not. This assumption has never been acknowledged in RAN3 so we must assume that configuring any of the nodes require the same effort. So, none of the above solutions helps here. |
| ZTE | Alt3 | It is preferable to reuse similar approach for efficient specification. |

In [1744], there is a similar observation as Observation 3.

**Observation 8: For scenarios 1 and 2, S1-AP Handover Required message includes the Direct Forwarding Path Availability IE indicating that there is a direct path available from source MeNB to target NG-RAN node. For Scenario 4, Handover Required does not include the Direct Forwarding Path Availability IE. For Scenario 3, it is FFS whether this IE is included.**

### **Question 9: Do companies agree with the above observation [1744] indicating the use of the existing Direct Forwarding Path Availability IE in S1-AP Handover Required message for the scenarios listed above? If not, please indicate in the comments whether and how the IE should be used in the scenarios listed above.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes |  |
| Samsung | Yes |  |
| ZTE | Yes |  |

We now discuss further signaling support for Scenarios 1, 2, and 4, as discussed in [1744].

**Scenario 1**

**Proposal 6: In case of Scenario 1, source MeNB forwards the data forwarding addresses for the SN terminated bearers received in the Handover Command message, to the source SgNB.**

Source MeNB may use the SN Modification procedure for this purpose; please see the CR in [1745]. Source SgNB uses these addresses for direct data forwarding to the target NG-RAN node.

### **Question 10: Do companies agree with the above proposal [1744] regarding signaling support for Scenario 1? If not, please indicate in the comments if you have other proposals regarding signaling support for Scenario 1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei |  | We agree with the proposal 6. But the CR in 1745, this seems not needed, since the existing IEs can be used.  |
| Samsung |  | Agree with HW.  |
| ZTE |  | Agree with HW.  |

**Scenario 2**

**Proposal 7: In case of Scenario 2, source MeNB forwards data for SN terminated bearers from source SgNB to the target NG-RAN node.**

This proposal does not involve any specification changes.

### **Question 11: Do companies agree with the above proposal [1744] for Scenario 2? If not, please indicate in the comments if you have other proposals regarding signaling support for Scenario 2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes |  |
| Samsung | Yes |  |
| ZTE | Yes |  |

**Scenario 4**

**Observation 9: No further changes are required in the standards to support Scenario 4, and no room for any improvements in data forwarding is foreseen.**

### **Question 12: Do companies agree with the above proposal [1744] regarding signaling support for Scenario 4? If not, please indicate in the comments if you have other proposals regarding signaling support for Scenario 4.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | Yes |  |
| Huawei | Yes |  |
| Samsung |  | In order to identify Sceanrio 4, soluton in Question 8 is needed. But no more change is needed. |
| ZTE | Yes |  |

### **Question 13: Would companies like to keep Scenario 3 as FFS and focus on discussing solutions to Scenarios 1, 2, and 4 in the current meeting [1744]? If companies would like to exclude Scenario 3 [2458] or have other preferences, please indicate in the comments.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT | It is ok to focus on scenario 1,2,4 first |  |
| Huawei | Yes |  |
| Samsung | Yes |  |
| ZTE | Yes |  |

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### **Summary**

TBD

# 4 Supporting direct data forwarding for intra-system HO and SN change scenarios

Huawei, Samsung [1954, 2458] consider the following intra-system scenarios.

* Intra-system handover between EN-DC and LTE connected with EPC, or between the MR-DC and SA connected with 5GC.
* Intra-system SN change for EN-DC and MR-DC connected with 5GC, as depicted in section 10.5 in TS 37.340.

In [1954, 2458], the following signaling solutions are proposed for the intra-system scenarios described above. The solution proposed is similar for the scenarios. In [1954, 2458], the CRs are also provided.

**For SA to MR-DC handover:**

- The target MN provides the source RAN node ID to the target SN;

- The target SN notifies the direct data forwarding availability indication to the target MN.

**For SN change:**

- The MN provides the source SN ID to the target SN;

- The target SN notifies the direct data forwarding availability indication to the MN.

**For MR-DC to SA handover:**

- The source MN provides the source SN ID to the target node;

- The target node provides the direct data forwarding availability indication to the source MN.

### **Question 14: Do companies agree with the signaling solutions as described above for the intra-system scenarios involving HO and SN change [1954, 2458]?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei | Yes |  |
| ZTE | Yes |  |
|  |  |  |

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### **Summary**

TBD

# 5 Conclusion

TBD

# 6 Reference

[1] R3-210963: RAN3 email discussion on Direct Data Forwarding in inter-system handovers.

[2] Chairman’s notes, RAN3 #111-e.

[3] R3-206673: Discussion on inter-system handover from EN-DC to SA.

|  |  |  |
| --- | --- | --- |
| [R3-211744](file:///D%3A%5C3gpp%E4%BC%9A%E8%AE%AE%5CRAN3%5CRAN3%23112%5Coffline%5CCB%20%23%2029_DirectDataFwd_DC-SAmobility%5CDocs%5CR3-211744.zip) | S-node direct data forwarding in handover between NSA and SA (Qualcomm Incorporated, CATT, China Telecom) | discussion |
| [R3-211745](file:///D%3A%5C3gpp%E4%BC%9A%E8%AE%AE%5CRAN3%5CRAN3%23112%5Coffline%5CCB%20%23%2029_DirectDataFwd_DC-SAmobility%5CDocs%5CR3-211745.zip) | SN direct data forwarding (Qualcomm Incorporated, CATT) | CR1596r, TS 36.423 v16.5.0, Rel-16, Cat. B |
| [R3-211954](file:///D%3A%5C3gpp%E4%BC%9A%E8%AE%AE%5CRAN3%5CRAN3%23112%5Coffline%5CCB%20%23%2029_DirectDataFwd_DC-SAmobility%5CDocs%5CR3-211954.zip) | Direct data forwarding for mobility between DC and SA (Samsung, Huawei) | CR0595r, TS 38.413 v16.5.0, Rel-16, Cat. F |
| [R3-212458](file:///D%3A%5C3gpp%E4%BC%9A%E8%AE%AE%5CRAN3%5CRAN3%23112%5Coffline%5CCB%20%23%2029_DirectDataFwd_DC-SAmobility%5CDocs%5CR3-212458.zip) | Direct data forwarding for mobility between DC and SA (Huawei, Samsung) | CR0553r1, TS 38.423 v16.5.0, Rel-16, Cat. F |
| [R3-211746](file:///D%3A%5C3gpp%E4%BC%9A%E8%AE%AE%5CRAN3%5CRAN3%23112%5Coffline%5CCB%20%23%2029_DirectDataFwd_DC-SAmobility%5CDocs%5CR3-211746.zip) | SN direct data forwarding (Qualcomm Incorporated, CATT) | CR0595r, TS 38.423 v16.5.0, Rel-16, Cat. B |