3GPP TSG-RAN WG3 #115-e R3-222393

Feb 21st – Mar 3rd, 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: # 4\_DirectDataFwd\_DCtoSA**

**- Adopt option 2a for EN-DC/MR-DC to SA handover scenario which could support scenario 1, 2 and 3? CATT, Qualcomm, CMCC**

**- Agree option 3a as way forward for handover from EN-DC/MR-DC to SA i.e. the target node decides direct forwarding path availability between the source SN and the target node? Agree the following in order to support direct forwarding: 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? Samsung, Huawei, ZTE, Verizon Wireless**

**- Solution down-selection, try to close this topic**

**-Provide CRs if agreeable**

(Samsung - moderator)

Summary of offline disc [R3-222393](file:///E%3A%5C3GPP%20Standardization%5CRAN3%5CRAN3%23115-e%5Cdraft%5CCB%20%23%204_DirectDataFwd_DCtoSA%5CInbox%5CR3-222393.zip)

It is proposed to divide the discussion into two phases:

- Phase 1: try to conclude a solution for the issue in 3.1, 3.2 and 3.3

 Deadline: Please provide your views before end of Wednesday Feb. 23 UTC time

- Phase 2: discuss the CRs

 Deadline: tbd pending on the outcome of Phase 1

# For the Chairman’s Notes

**Propose to agree the following:**

# Discussion (1st Round)

## TNL address allocation for handover to EN-DC

The operator may configure different IP address spaces for X2-U and Xn-U (e.g. IPv4 for X2-U and IPv6 for Xn-U, or X2-U is deployed on the legacy LTE transport network).

In the following two scenarios, the target eNB and en-gNB should assign corresponding TNL address for direct data forwarding from the source node. E.g. TNL address for X2-U in case A, TNL address for Xn-U in case B.

Case A: LTE to EN-DC

Case B: NR to EN-DC

In [1][2][3], two problems were identified for supporting direct data forwarding for handover in the above two scenarios:

* Problem 1: The target eNB does not know Direct Forwarding Path Availability between the source node and the target eNB. Only the source RAN node and the core network knows direct data forwarding or indirect data forwarding.
* Problem 2: The target SN is not aware of EPS to EPS handover or 5GS to EPS handover. Only the target M-eNB knows such information. The target M-eNB knows the handover is intra-system handover or inter-system based on the Handover Type IE.

To solve the two problems, 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.

**Q1: Do you agree the proposal?**

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| Company | Comment |
| Samsung | Yes.Otherwise, the target eNB and en-gNB cannot assign corresponding TNL address for direct data forwarding.  |
| Nokia | No.IPv4 and IPv6 can be allocated in parallel and sent in the same TNL address info. Our understanding is that other applications are part of the discussion on the dynamic ACL.[Samsung] From your response, it seems more clarification is needed.This issue is not related with ACL discussion.Similar issue has been discussed for handover to NG-RAN. RAN3 agreed to let the target NG-RAN node (or target CU-UP) to know two information (direct data forwarding or indirect data forwarding, inter-system handover or intra-system handover). The CR was agreed in R3-214450, R3-216097, R3-216096. Philippe.G handled the topic. Better to check with Philippe. G. The proposal is to solve the same issue in different scenarios. |
| Huawei | No so far.Our concern is that for the first proposal (to allow the target eNB to differentiate the direct or indirect), the existing eNBs deployment has already its own solutions to tackle this, no need to introduce new solutions for legacy LTE case. [Samsung] Proposal 1 will not impact legacy LTE eNB. The IE will be defined as optional. So if you have a implementation based method, the IE can be ignored.  |
| Qualcomm | FFSIt is not clear why target eNB/en-gNB assign different tunnel for different source (gNB, eNB, PGW). If it is related with ACL as Nokia said, we need to study further and take dynamic ACL discussion into consideration.[Samsung] Pls kindly check our clarification to Nokia. The same issue has been discussed in the “Direct Data Forwarding Between NG-RAN and E-UTRAN: E1 Aspects”. We are trying to cover other scenarios for the same issue. |
| ZTE | Agree with Samsung |
| Ericsson | Yes for the Handover Type. IP address spaces (or sub-network) can be different for intra-system (X2-U) or inter-system even if only IPv4 or only IPv6 is used on both sides.Not sure why the direct forwarding path availability will be needed. Handover type should be sufficient to select the forwarding tunnel endpoint. |
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**Q2: If the answer to Q1 is yes, any comment on the CR in R3-222299 and R3-222230 [2][3]**

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## NR SA to MR-DC connected to 5GC Handover or SN change

The CR for TS38.423 in R3-220674 have been agreed at last RAN3#114bis-e meeting for supporting direct forwarding from NR SA to MR-DC connected to 5GC or during SN change.

It was observed that the new format in 9.2.2.aaa was not needed, since the existing *Global NG-RAN Node ID* IE can be used.

A CR in R3-221976[4] was submitted to replace the agreed CR in R3-220674.

**Q3: Do you agree R3-221976 to replace the agreed CR in R3-220674?**

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| Company | Comment |
| Samsung | Yes.  |
| Nokia | Yes |
| Huawei | Yes, thanks Nokia for pointing out this.  |
| Qualcomm | Yes |
| ZTE | Yes |
| Ericsson | Yes |
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## Direct data forwarding from EN-DC to NR SA HO in Scenario 1 and Scenario 2

The following agreements have been made for handover from EN-DC to SA.

EN-DC to NR SA Handover:

direct data forwarding is possible between the source SN and the target NG-RAN node.

The source SN or the target NG-RAN node has information on the direct forwarding path between itself and neighboring nodes

The open question is whether the source SN or the target node decides direct forwarding path availability between the source SN and the target node for handover from EN-DC to SA. There are the following two options:

Option 2a: The source SN decides direct forwarding path availability between the source SN and the target node.

The source MN queries the source SN to get this information. The source MN transmits the information to the SMF. The SMF further transmits the information to the target node.

Option 3a: The target node decides direct forwarding path availability between the source SN and the target node. The target node transmits the information to the source in target node to source node transparent container.

The signaling flow for Option 2a:



Figure 1: The signaling flow for Option 2a:

The signaling flow for Option 3a:



Figure 2: The signaling flow for Option 3a:

**Q4: Is option 2a or option 3a your preferred solution for direct data forwarding from EN-DC to SA NR?**

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| Company | Comment |
| Samsung | Option 3aThere are two benefits of Option 3a:1. The same principle is used for NR SA to EN-DC handover and for EN-DC to NR SA handover i.e. the target node decides direct forwarding path availability with the SN.

The solution for NR SA to EN-DC handover has been agreed. In the agreed solution, the source node sends the source node ID to the target and the target decides direct forwarding path availability between the SN and the source.Option 3a use the same principle, the source node sends the source SN ID to the target and the target node decides direct forwarding path availability with the source SN.1. The benefits of Option 3a is that the existing overall handover signaling flow is not impacted.

While for Option 2a, a new procedure is inserted between Handover Required and Handover Command message. New state machines have to be designed in implementation. Currently, the Source MeNB is waiting for Handover Command message after sending out Handover Required message.The main argument for Option 3a is based on Scenario 3. To support scenario 3, both Option 2a and Option 3a should be enhanced. The current solution as it is cannot work. Technically, there is no blocking point for supporting scenario 3 no matter Option 2a or Option 3a is concluded.To support scenario 3, one solution should be used. In [9], it was proposed to further split scenario 3 to two cases and use more than one solution for scenario 3 which bring additional complexity. If scenario 3 should be supported, both directions i.e. NR SA to EN-DC and EN-DC to NR SA should be supported, not only consider the direction from EN-DC to SA. With above clarification, it could be observed that Option 3a has benefits without drawback. While Option 2a introduce additional procedure in overall handover signaling flow and use different principles for two directions.  |
| CATT | Option 2aNormally, we first discuss scenarios that should be supported and then make decision on solutions for all supported scenarios. Here, we would like to adopt the similar procedure.On the scenarios, we have already agree to support scenario 3 if there is no big specification impact with the existing solutions in last RAN3 meeting. To facilitate the discussion, scenario 3 is further divided into 2 sub-scenarios.Scenario 3a: MN has no direct forwarding while SN has direct forwarding. At the same time, only flows/DRBs terminated in SN node needs to do data forwarding.Scenario 3b: MN has no direct forwarding while SN has direct forwarding. At the same time, flows/DRBs terminated in both MN node and SN node needs to do data forwarding.It is obvious that option 3a could support neither scenario 3a nor scenario 3b unless introduce extra impact to CN node. The impact to spec is significant. What’s more, with current option 3a, if there is no indirect data forwarding path available in core network, data forwarding between source SN and target node could not be supported in option 3a even there is direct path between source SN and target node.Then for option 2a, obviously, in scenario 3a,it could support direct data forwarding between source SN and target node without any extra effort. In scenario 3b,if the source MN and source SN belong to the same vendor, it is still possible to support direct data forwarding between source MN and target node via implementation, i.e. MN could forwards the data to SN via implementation and then SN forward to the target node directly. However, if the source MN and source SN belong to different vendor, then further Xn impact on top of current option 2a is foreseen to support scenario 3b.It depends on the group whether further enhancement on option 2a is acceptable.In summary, the current option 2a could support scenario 1,2,3a in all cases and also scenario 3b by implementation. On the other hand, current option 3a could only support scenario 1 and 2.With that,we propose to adopt option 2a which applied to all scenarios. |
| Nokia | Neutral, either solution is technically feasible. One may note that querying SN before a HO was challenged in other discussions (e.g. in the one on SCG UHI) as delaying the HO. We don’t think it is a problem though, especially that such querying is simple.[CATT]:As we stated in previous discussion, the query on direct data forwarding availability is completely different with query of SN UHI.For query of direct data forwarding availability, it could be implemented after HANDOVER REQUIRED message is sent which would not delay the Ho procedure. While the query of SN UHI has to be done before the HO which may delay the HO procedure.The figure 1 above already provide the signaling flow for option 2a. |
| Huawei | Option 3a. Same view as Samsung. But for option 2, as CATT further explained about the procedure, it seems to us this is new sequence flow. We would rather to stick to the legacy sequence flow (before the handover procedure to query the SN configuration for delta configuration if any need).[CATT]:I could not quite understand the comments here.Of course,if delta configuration is needed,it is natural to query the SN configuration before handover.In this case,there is no extra efforts to query the information on direct data forwarding availability.The signaling flow here is that in case delta configuration is not needed,the query procedure on direct data forwarding availability could be initiated after handover procedure since this information is used only after the source MN receives handover command message.And note the above statement only applied to EN-DC to SA handover.For MR-DC to SA handover,since anyway the source MN needs to query the data forwarding proposal on SN termincated flows/DRB,query of direct data forwarding availability could be realized via the same message.About the potential way forward, see our answer to next question. |
| Qualcomm  | Option 2aAs CATT said, if we consider scenario 3 together, option 2a is a common solution. In option 3a for scenario 3, indirect data forwarding may be established but not used.[Samsung] why indirect data forwarding tunnel will be establishment but not used? |
| ZTE | Agree with Samsung. Prefer a unified solution for NR SA to EN-DC handover and for EN-DC to NR SA. Anyway, there is scenario, e.g. delta config no enabled, option 2a needs to introduce new sequence flow.  |
| Ericsson | Prefer option 3a. But both options are technically feasible. |
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If down selection of the two options cannot be achieved, a possible compromised way forward is as follow:

* For EN-DC to NR SA handover, Option 3a is used.
* For MR-DC connected to 5GC to NR SA handover, Option 2a variant (SgNB modification procedure before handover required message) is used.

The rational for this compromise is based on the existing differences between inter-system handover and intra-system handover.

For inter-system handover from EN-DC to NR SA, SgNB modification procedure between source MeNB and source SgNB is not needed. Because the source MeNB doesn’t need to contact with the source SgNB currently. In order to not increase the handover latency and not impact the overall handover signaling flow, Option 3a is appropriate.

For intra-system handover from MR-DC connected to 5GC to NR SA, SN modification procedure between the source NG-RAN node and source SN may be needed in case of e.g. for getting the Qos flow to DRB mapping for SN terminated bearers or for delta configuration. In the two cases, SN modification procedure before Handover Required message may be needed. So for intra-system handover from MR-DC connected to 5GC to NR SA, option 2a variant could be used.

**Q5: Is this compromise way forward acceptable for your company?**

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| Company | Comment |
| Samsung | Considering the reasons explained above, we can accept the compromised way forward.  |
| CATT | Yes. To make progress, we could accept the compromise |
| Nokia | Strange… The motivation to enable 2a for MR-DC to NR SA is that the MN-initiated modification may still be needed. Fine, but it is not sure. So, if this is the only reason, what if the modification is not needed? [CATT]:It is definitely needed.We have the principle that data forwarding for SN terminated PDU session is decided by SN itself in MR-DC.This is why in 37.340 it is captured that before HO procedure,MN would ask for the data forwarding proposal towards SN via SN modification procedure.So,for MR-DC,if there is SN terminated PDU session for the UE,there would be a SN modification procedure before HO to query on data forwarding related proposal which could be used for query on direct data forwarding availibilty as well.Can the 3a be still used then?I’m don’t think using the MN-initiated modification is a problem, but there has to be a better motivation for agreeing two different solutions to the same problem…[Samsung] For EN-DC to NR SA handover, modification procedure is not needed. There is no such requirement.For MR-DC to SA handover, modification procedure is needed in some scenarios e.g. to get the Qos flow to DRB mapping in the SN, for delta configuration. This are the existing difference between EN-DC to SA and MR-DC to SA handover. Based on this existing difference, the compromised solution was proposed. For one scenario, only one solution, not two. Hope this clarify. |
| Huawei | Yes, agree with the moderator’s way forward.  |
| Qualcomm | Yes, agree with the compromise and WF. |
| ZTE | Yes |
| Ericsson | This WF looks like the compromise from last meeting, when 2 solutions for the same issue was proposed. As this is not a critical issue (see responses to next question) we prefer not to agree 2 solutions when 1 is sufficient. |

If down selection of the two options cannot be achieved and the compromised way forward is not acceptable for your company, any other idea for moving forward?

**Q6: If down selection of the two options cannot be achieved and the compromised way forward is not acceptable for your company, any other idea for moving forward?**

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| Company | Comment |
| Nokia | This issue is not critical. It is not a problem that blocks Rel.16 implementation, routing via the MN is always possible. So, if RAN3 cannot agree a single solution, this problem shall be suspended until a consensus is reached. |
| Ericsson | Agree with Nokia |
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## Scenario 3 (MN has no direct forwarding, SN has direct forwarding)

The scenario 3 had been marked with FFS as follows. This is applicable both for EN-DC to NR SA handover, and NR SA to EN-DC handover.

***- Scenario 3 (FFS): 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.

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

In inter-system handover from NR SA to EN-DC case, the open point for scenario 3 is the specification impact to support direct data forwarding from the source NG-RAN node to the target en-gNB in the following scenario.

* Source NG-RAN node has no direct data forwarding path with the target eNB
* Source NG-RAN node has direct data forwarding path with the target en-gNB

In this case, the source NG-RAN node should not include the Direct Forwarding Path Availability IE in the NG-AP Handover Required message because direct forwarding path is not available between the source NG-RAN node and the target MeNB. The source NG-RAN node does not know whether the target MeNB will add a secondary node and which SN will be added when Handover Required message is sent. Therefore, the source NG-RAN cannot determine whether it has direct path to the target SN before initiating the handover.

**Observation 1: 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 consequence is that it should be the target SN to decide whether direct forwarding path is available between the source NG-RAN node and the target SN (the same as scenario 1 and scenario 2).

**Observation 2: 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.**

**Q7: Do you agree with observation 1 and observation 2?**

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| Company | Comment |
| Samsung | Yes.  |
| CATT | Yes |
| Nokia | Yes for Obs.1For Obs.2, it is correct only in case the HO concerns SN-terminated bearers. If there are MN-terminated bearers, the target SN will not be even aware of them and can’t decide (nor can help) any forwarding.[Samsung] You are right. If there is no SN terminated bearers, then we don’t need to consider/discuss whether direct data forwarding path is available between the source and the SN. |
| Huawei | Yes. But we don’t want solutions impacting the CN.  |
| Qualcomm | Yes |
| ZTE | Yes |
| Ericsson | Yes |
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The AMF/SMF/MME doesn’t receive Direct Forwarding Path Availability IE from the source side. Without any additional information, the MME will ask the SGW to assign indirect data forwarding tunnel when the MME receives Handover Request Acknowledge message. The SMF will ask UPF to assign indirect data forwarding tunnel.

So if the target SN decides that direct forwarding path is available between the source NG-RAN node and the target SN, the information should be informed to the MME/SMF. Otherwise, the indirect data forwarding tunnel will be assigned in core network and transmitted to the source NG-RAN node.

**Observation 3: After the target SN decides that direct forwarding path is available between the source NG-RAN node and the target SN, the Direct Forwarding Path Availability information should be informed to MME/SMF from the target side in order to support direct data forwarding from the source NG-RAN node to the target SN.**

**Q7: Do you agree with observation 3?**

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| Company | Comment |
| Samsung | Yes. Otherwise, direct data forwarding from the source NG-RAN node to the target SN cannot be achieved. Because indirect data forwarding tunnel will be assigned by core network node and transmitted to the source NG-RAN node. |
| CATT | Technically it works. However, it depends on whether we would like to support the scenario with the impact to CN. |
| Nokia | No. As discussed above, it addresses a very specific scenario where only SN-terminated bearers are handed over. Obs.3 does not discuss other HO scenarios.[Samsung] We agree with you in general i.e. if scenario 3 needs to be supported, then all cases in scenario 3 should be supported, not only consider one particular case.Observation 3 is also valid for the case if there are both MN terminated bearers and SN terminated bearers. |
| Huawei | Observation is correct. But we don’t want solutions impacting CN for this particular case (as commented by Nokia).  |
| Qualcomm | We also prefer not to impact CN. |
| ZTE | Yes |
| Ericsson | No. Prefer not to support this very specific scenario if CN is impacted |
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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.

**Q8: 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, to support data forwarding from source NG-RAN -> target SN-> target MN, there are additional complexity over X2. E.g. the target MN should send the E-RAB list terminated at the target MN which has been accepted for data forwarding to the target SN to request data forwarding tunnel, then the target SN assigns data forwarding tunnel between source NG-RAN node and target SN for both MN terminated bearers and SN terminated bearers. The target SN sends those data forwarding tunnel information to the target MN.If option 1, the target sends an indicator to the core network for SN terminated bearers. Then core network node could skip to assign indirect data forwarding tunnels. |
| CATT | It seems both of the options could work. If we would like to consider update our spec to further support SA to ENDC/MR-DC scenario, it could be further discussed. |
| Nokia | Opt. 1 seems, at least at the first glance, technically correct.Opt. 2 is technically wrong. As far as we know, data forwarding for MN-terminated bearers can only be done between MNs (i.e. it can’t be done via the SN, which may be released at time). RAN3 would need to accept the general principle that data forwarding can be done via the SN. |
| Huawei | Both options will have impact on the CN. And Option2 will have additional signaling for data forwarding of MN terminated bearers via the SN. So our view is that this scenario 3 in this direction should be dropped.  |
| Qualcomm | Option 2.To support forwarding MN data via SN, we need some X2 signaling enhancement as Samsung said. The SN internal processing (e.g., data forwarding for a E-RAB not terminated in SN) could be up to implementation.Option 2 has no core network impact. Source node can simply indicate direct forwarding path available to CN. |
| ZTE | Option 1 |
| Ericsson | None. Both options have CN impact (because source node does not know if SN will be added by target MeNB, see observation 1). Option 2 has additional impact on legacy data forwarding |
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### Inter-system handover from EN-DC to SA

In inter-system handover from EN-DC to NR SA case, the open point for scenario 3 is the specification impact to support direct data forwarding from the source SN to the target NG-RAN node in the following scenario.

* Source eNB has no direct data forwarding path with the target NG-RAN node
* Source en-gNB has direct data forwarding path with the target NG-RAN node

It’s better to use the same principle for scenario 3 as scenario 1 and scenario 2. The specification impact can be evaluated after the solution for scenario 1 and scenario 2 is concluded in 3.3. Therefore, the moderator propose to evaluate the specification impact for scenario 3 after the solution for scenario 1 and scenario 2 are concluded in phase 1.

# Conclusion, Recommendations [if needed]

If needed

# References

[1] R3-222298, Direct Data forwarding address allocation for handover to EN-DC (Samsung, Verizon Wireless, ZTE)

[2] R3-222299, Direct forwarding address allocation for handover to EN-DC (Samsung, Verizon Wireless, ZTE)

[3] R3-222230, Direct forwarding address allocation for handover to EN-DC (Samsung, Verizon Wireless, ZTE)

[4] R3-221976, Direct data forwarding for mobility between DC and SA (Huawei, Samsung, China Telecom, ZTE)

[5] R3-222295, Discussion on direct data forwarding for mobility between DC and SA (Samsung, Huawei, ZTE)

[6] R3-222296, Direct data forwarding for mobility between DC and SA (Samsung, Huawei, ZTE, Verizon Wireless)

[7] R3-222297, Direct data forwarding for mobility between DC and SA (Samsung, Huawei, ZTE, Verizon Wireless)

[8] R3-221749, SN direct data forwarding in inter-system handover (Qualcomm Incorporated)

[9] R3-222003, Discussion on direct data forwarding for mobility between DC and SA (CATT,Qualcomm,CMCC)

[10] R3-222004, Support of direct data forwarding for mobility from MR-DC to SA (CATT,Qualcomm,CMCC)

[11] R3-221844, Direct data forwarding in EN-DC to NR SA handover (CR to 36.413) (Qualcomm Incorporated, CATT, CMCC)

[12] R3-221845, Direct data forwarding in EN-DC to NR SA handover (CR to 36.423) (Qualcomm Incorporated, CATT, CMCC)

[13] R3-222271, CR on data forwarding from MR-DC to SA\_NGAP (CMCC. CATT, Qualcomm)

[14] R3-222272, CR on data forwarding between EN-DC MR-DC and SA handover (CMCC. CATT, Qualcomm)