

RAN-R18-WS-crossFunc-KDDI - Version 0.0.4

RAN

3GPP TSG RAN Rel-18 workshop

RWS-210626

Electronic Meeting, June 28 - July 2, 2021

Title: Email discussion summary for [RAN-R18-WS-crossFunc-KDDI]

Agenda item: 4.3 Cross-Functionalities for both eMBB and Non-eMBB Evolution

Source: Moderator (KDDI)

Document for: Discussion

1 Input documents covered in this email discussion

RWS-210140, Considerations on inter-gNB coordination for NR, KDDI Corporation

2 Round 1 Questions/Comments

Feedback Form 1: 2.1 Company general comments

Feedback Form 2: 2.2 Company comments/questions on RWS-210140

1 – China Telecommunications

Ø To enable inter-gNB/gNB-DU CA and multi-TRP operation could improve the flexibility of operator network deployment and the user throughput with multiple fragmented bands, we support this work. We suggest to start from SI first to evaluate the backhaul latency impact on the performance of inter-gNB/gNB-DU coordination, based on the result we could design the protocol structure and mechanism to support the coordination function.

2 – Intel Technology India Pvt Ltd

(1) In page 2, regarding Triple CU: each gNB-DU is in different carriers? Seems the figure is one on CC1, two on CC2.

(2) In page 3, why does the primary gNB need to forward the CSI report to the secondary gNB for TB size determination? Any benefit for the primary gNB handling CSI report and HARQ, while the secondary gNB handling DL transmission?

(3) In page 3/4, how CSI reporting and TB size determination is related to CA/triple connectivity? Should this be managed similar to traditional CA and TB size in DC (i.e. two separate TB)?

(4) In page 5, for DU-DU interface, how do you envision this new application protocol co-exist with the existing F1 interface?

(5) In page 9, other than the resiliency use case, do you also consider load balancing between two CUs?

3 – InterDigital Germany GmbH

For CA cases that are inter-DU with a DU-DU interface or even inter-CU with an Xn interface, are you assuming a no-delay interface or will you propose CA changes to mitigate the extra delays with the interfaces?

4 – Ericsson LM

Thanks for the paper. We have the below questions:

Question 1: In Slide 2, are the gNB-CUs supposed to be part of one single logical gNB?

Question 2: In slide 4, the DL/UL Data forwarding between the two gNB-DUs, is it normal operation, or is it exception handling, e.g. retransmission?

In slide 8 and 9:

Question 3: Will a logical gNB consisting of the multiple gNB-CUs be perceived differently than a logical gNB consisting of One gNB-CU (current)? i.e. do we see changes on NG and Xn interface?

Question 4: Will the multiple gNB-CUs have a hierarchy structure?

5 – Beijing Xiaomi Mobile Software

Thanks for the paper.

2 questions:

1) Page3: can we configure the PUCCH in Secondary gNB-DU to save UCI forwarding?

2) It seems the target is to could improve the flexibility of operator network deployment. We want to ask what is the impact to UE? Do we need some enhancement in UU?

6 – CATT

Thank you for the good contribution. Some questions from our side are as blow:

1) For inter-gNB/inter-DU CA, there would be two MAC entities located in the two DUs. In page 4, based on what information the RLC layer decide the distribution of traffic to different DUs? Another question is should the PDCP/RLC only located in Primary gNB or not.

2) For multiple TRP, in page 7, multiple DCI is used. In this case, since PDSCH in each DU is scheduled by itself, we are wondering whether current architecture could already support this case without introduction of new interface. For single DCI case, we think it could be discussed based on the evaluation in RAN1.

3) For multiple CU, the figure depicts that one DU is connected with primary CU and secondary CU, does it mean the maximum CU that one DU connected is two?

7 – Huawei Tech.(UK) Co.. Ltd

Thank you for the contribution

We do understand that the motivation for inter-gNB/gNB-DU carrier aggregation is motivated for less RRC signaling compare to DC solution, does our understanding is correct? If not please clarify

How to understand "CA with Uu interface changes"? If anyway Uu interface is changed, why don't we reuse DC for this inter-DU aggregation? What's the benefit compared to DC?

Based on assumption above (preference of CA on DC) the inter-gNB/gNB-DU carrier aggregation required intensive traffic to coordinate the scheduler. This traffic required ideal backhaul and heavy CP load. Does

the associated costs of this traffic on the network, for CA, when we deployed effort to save energy make sense compare to a share cost with the UE in DC?

Other technical aspect could be difficult like how to guarantee the timing requirements between two gNBs for e.g. HARQ scheduling?

The the inter-gNB/gNB-DU carrier aggregation required the scheduler coordination, how the different scheduler developed by different vendor could be tight coordinated in efficient way? Does the intention here is to “make uniform” the product of vendor at his level?

8 – Samsung Electronics Polska

Thank you for the contributions. We have few questions:

Q1) What is the difference between inter-gNB/gNB-DU CA and inter-gNB/gNB-DU multi-TRP, e.g., aiming scenario (inter-freq., vs, intra-freq.), scheduling, inter-gNB coordination level (semi-static, or dynamic, etc.)?

Q2) Is the “multiple CUs” focused on non-RAN-sharing case (i.e., two gNB-CUs belong to the same PLMN)?

Q3) In slide 10, for the failure operation for option 1&2, the left UE is changed from “red” to “green”, which means that the UE can be impacted due to the failure of one CU, while for option 3, the left UE is not impacted. Which impact to UE is expected in option 1 & 2? Why the impacted to UE is only applied to option 1 & 2?

Q4) Some use cases for multiple CUs are unclear, e.g., multiple CUs from different vendors for traffic offload, multiple CUs for dedicated central unit, single carrier component shared by multiple CUs. Those cases may not be related to the Resiliency. Could you please clarify the relationship with resiliency for those scenarios?

9 – CATT

Thank you for the contribution. Some questions from our side are as below:

1) For inter-gNB/inter-DU CA, there would be two MAC entities located in the two DUs. In page 4, based on what information the RLC layer decide the distribution of traffic to different DUs? Another question is should the PDCP/RLC only located in Primary gNB or not.

2) For multiple TRP, in page 7, multiple DCI is used. In this case, since PDSCH in each DU is scheduled by itself, we are wondering whether current architecture could already support this case without introduction of new interface. For single DCI case, we think it could be discussed based on the evaluation in RAN1.

3) For multiple CU, the figure depicts that one DU is connected with primary CU and secondary CU, does it mean the maximum CU that one DU connected is two?

10 – Apple Benelux B.V.

According to the call flow in slide 4, the new intra-DU interface appears to be data plane (for data forwarding), whereas the protocol stack figure on slide 5 shows the new interface protocol stack as control plane (it is referred to as “application protocol” and uses a protocol stack typical for control plane network interfaces). Can you please explain if the proposed new interface is user plane, control plane, or both?

3 Round 1 Answers/Responses

Thank you very much for the questions/comments/supports. Please find our responses below

1 China Telecommunications

<Q>

We suggest to start from SI first to evaluate the backhaul latency impact on the performance of inter-gNB/gNB-DU coordination, based on the result we could design the protocol structure and mechanism to support the coordination function.

<A>

Thank you for the suggestion. For the case where radio resources are shared by multiple nodes, we may want to evaluate backhaul latency impact on the performance as you mention.

2 Intel Technology India Pvt Ltd

<Q1>

In page 2, regarding Triple CU: each gNB-DU is in different carriers? Seems the figure is one on CC1, two on CC2.

<A1>

It's a typo, should be CC3 not CC2

<Q2>

In page 3, why does the primary gNB need to forward the CSI report to the secondary gNB for TB size determination? Any benefit for the primary gNB handling CSI report and HARQ, while the secondary gNB handling DL transmission?

<A2>

It's just an example. We need further discussion. We just propose to have the discussion what should be done in primary and what should be done in secondary, how the interface between gNBs looks like and others.

<Q3>

In page 3/4, how CSI reporting and TB size determination is related to CA/triple connectivity? Should this be managed similar to traditional CA and TB size in DC (i.e. two separate TB)?

<A3>

That is relevant to physical layer procedure and should be discussed in the Rel-18 work.

<Q4>

In page 5, for DU-DU interface, how do you envision this new application protocol co-exist with the existing F1 interface?

<A4>

I'm afraid, but I may not get the point of your question. Could you elaborate your question? Do you see any problem for having new interface between DU-DU?

<Q5>

In page 9, other than the resiliency use case, do you also consider load balancing between two CUs?

<A5>

Yes. We think that load balancing/traffic offload is a possible use case.

3 InterDigital Germany GmbH

<Q>

For CA cases that are inter-DU with a DU-DU interface or even inter-CU with an Xn interface, are you assuming a no-delay interface or will you propose CA changes to mitigate the extra delays with the interfaces?

<A>

Basically we want to avoid the changes in UU interface to mitigate the delay requirement among the DUs. But in the case where it's identified as not feasible, we may want to change UU interface to relax delay requirements among the DUs.

4 Ericsson LM

<Q1>

In Slide 2, are the gNB-CUs supposed to be part of one single logical gNB?

<A1>

No. We assume gNB-CUs are separate two logical gNBs

<Q2>

In slide 4, the DL/UL Data forwarding between the two gNB-DUs, is it normal operation, or is it exception handling, e.g. retransmission?

<A2>

Slide 4 is just as an example for normal operation.

<Q3>

Will a logical gNB consisting of the multiple gNB-CUs be perceived differently than a logical gNB consisting of One gNB-CU (current)? i.e. do we see changes on NG and Xn interface?

<A3>

It depends on use cases. For traffic offload/load balancing, it seems better not to impact on NG/Xn interface to avoid the impacts on core side and other gNBs. For dedicated central unit, there may be some advantage on changes on NG and Xn interface. Anyway we need further discussion.

<Q4>

Will the multiple gNB-CUs have a hierarchy structure?

<A4>

We slightly prefer to assume a hierarchy structure, but need further discussion.

5 Beijing Xiaomi Mobile Software

<Q1>

Page3: can we configure the PUCCH in Secondary gNB-DU to save UCI forwarding?

<A1>

It seems to be interesting idea, but we admit that it has some drawbacks, impacts on UE side and operators cannot use this feature to accommodate legacy UEs because of the UU interface changes.

<Q2>

It seems the target is to could improve the flexibility of operator network deployment. We want to ask what is the impact to UE? Do we need some enhancement in UU?

<A2>

Please refer to our response to InterDigital above.

6 CATT

<Q1>

For inter-gNB/inter-DU CA, there would be two MAC entities located in the two DUs. In page 4, based on what information the RLC layer decide the distribution of traffic to different DUs? Another question is should the PDCP/RLC only located in Primary gNB or not.

<A1>

It's just an example, and need further discussion, but as you mention RLC layer decide the distribution of traffic to different DUs would be most straight forward solution. For CA, the PDCP/RLC only located in Primary gNB work. But having the PDCP/RLC in Secondary gNB or not is a different discussion which is relevant to architecture, so it should be discussed also.

<Q2>

For multiple TRP, in page 7, multiple DCI is used. In this case, since PDSCH in each DU is scheduled by itself, we are wondering whether current architecture could already support this case without introduction of new interface. For single DCI case, we think it could be discussed based on the evaluation in RAN1.

<A2>

We don't have clear answer now either. So need further discussion with RAN1 experts.

<Q3>

For multiple CU, the figure depicts that one DU is connected with primary CU and secondary CU, does it mean the maximum CU that one DU connected is two?

<A3>

We don't have any intention to limit to two, figures are just examples. Need further discussion.

7 Huawei Tech.(UK) Co.. Ltd

<Q1>

We do understand that the motivation for inter-gNB/gNB-DU carrier aggregation is motivated for less RRC signaling compare to DC solution, does our understanding is correct? If not please clarify.

<A1>

No. Our intention is not reduce RRC signaling. With regard to motivation, please refer to the docomo's paper RWS-210327 Motivation of Study on Inter-gNB Coordination

<Q2>

How to understand "CA with Uu interface changes"? If anyway Uu interface is changed, why don't we reuse DC for this inter-DU aggregation? What's the benefit compared to DC?

<A2>

DC has following challenges, that is the background for the proposal, please refer docomo's paper RWS-210327 for details

- Service area of DC is smaller than that of CA in some scenarios due to the need for two UL paths
- DC requires additional UE capability, e.g. two ULs

<Q3>

Based on assumption above (preference of CA on DC) the inter-gNB/gNB-DU carrier aggregation required intensive traffic to coordinate the scheduler. This traffic required ideal backhaul and heavy CP load. Does the associated costs of this traffic on the network, for CA, when we deployed effort to save energy make sense compare to a share cost with the UE in DC?

<A3>

Could you elaborate your question? Do you mean that vendors have own proprietary interfaces for CA and re-designing new interfaces for the same purpose doesn't make sense?

<Q4>

Other technical aspect could be difficult like how to guarantee the timing requirements between two gNBs for e.g. HARQ scheduling?

<A4>

One possible solution is to define delay requirement.

<Q5>

The inter-gNB/gNB-DU carrier aggregation required the scheduler coordination, how the different scheduler developed by different vendor could be tight coordinated in efficient way? Does the intention here is to "make uniform" the product of vendor at his level?

<A5>

We think that first we should identify issues impact on the efficiency, then we can discuss solutions and interfaces to address those issues. But we also understand that from vendor's perspective, revealing issues to public would not be acceptable sometimes.

8 Samsung Electronics Polska

<Q1>

What is the difference between inter-gNB/gNB-DU CA and inter-gNB/gNB-DU multi-TRP, e.g., aiming scenario (inter-freq., vs, intra-freq.), scheduling, inter-gNB coordination level (semi-static, or dynamic, etc.)?

<A2>

That is the point to be discussed in the work.

<Q2>

Is the "multiple CUs" focused on non-RAN-sharing case (i.e., two gNB-CUs belong to the same PLMN)?

<A2>

We don't have an intention to limit the scope to same PLMN case. We are fine with extending to RAN sharing case. Need further discussion.

<Q3>

In slide 10, for the failure operation for option 1&2, the left UE is changed from "red" to "green", which means that the UE can be impacted due to the failure of one CU, while for option 3, the left UE is not impacted. Which impact to UE is expected in option 1 & 2? Why the impacted to UE is only applied to option 1 & 2?

<A3>

We are not sure, because this slide is an excerpt from docomo's paper RP-210168 New SID on inter-gNB coordination for NR. But we guess they assume Re-establishment/Re-direction procedure for CU changes.

<Q4>

Some use cases for multiple CUs are unclear, e.g., multiple CUs from different vendors for traffic offload, multiple CUs for dedicated central unit, single carrier component shared by multiple CUs. Those cases may not be related to the Resiliency. Could you please clarify the relationship with resiliency for those scenarios?

<A4>

We propose to discuss and identify use cases first. We see some commonality between resiliency and other scenarios in terms of same multiple CUs architecture can be a solution.

10 Apple Benelux B.V.

<Q>

Can you please explain if the proposed new interface is user plane, control plane, or both?

<A>

It shows an example for C-plane.

4 Round 2 Questions/Comments

Feedback Form 3: 4.1 Company general comments

Feedback Form 4: 4.2. Company comments/questions on RWS-210140

1 – Huawei Tech.(UK) Co., Ltd

Thank you for the response.

Here is the clarification on Q3 from Huawei, this is not related to private implementation but related to the

overall cost of such solution where CP signaling will increase energy consumption and cost on network, which will not be reflected on customer. The DC provide same solution and quality for customer with cost share with the customer. Does this reasoning is correct for you?

5 Round 2 Answers/Responses

Thanks for further questions/comments from Huawei colleague. Please find our response below.

<Question>

Here is the clarification on Q3 from Huawei, this is not related to private implementation but related to the overall cost of such solution where CP signaling will increase energy consumption and cost on network, which will not be reflected on customer. The DC provide same solution and quality for customer with cost share with the customer. Does this reasoning is correct for you?

<Answer>

I'm afraid but the reasoning is not correct.

1. DC requires UE to transmit two uplink, this makes service area of DC is much smaller than that of CA.
2. For DC, two DUs are not collocated and it requires backhaul having enough capacity, so CP signaling increase can be a big problem as you mention. But for CA, two DUs are usually collocated, so CP signaling increase would not be a big problem. In our understanding, vendor proprietary solutions address this issue, so we think there is no reason why a standardized solution cannot address the same issue.

6 Moderators' summary

9 companies provided the feedback. Based on the discussion we recognize that the following aspects should be clarified to develop Rel-18 SI objectives for inter-gNB coordination.

1. Whether to have an objective evaluating the backhaul latency impact on the performance of inter-gNB/gNB-DU coordination (China telecom)
2. Whether to change the current UU interface for CA to relax delay requirements among the DUs/Whether impact on UE side (Interdigital/Xiaomi)
3. High level architecture assumption to identify possible changes on NG and Xn interface (i.e. Whether gNB-CUs are separate multiple logical gNBs or supposed to be single gNB, Whether assume a hierarchy structure) (Ericsson)
4. High level design of the coordination for CA, i.e. what is done in primary DU and what is done in secondary DU, scheduler aspects, U-plane handling mechanism in DUs (Intel, CATT)
5. Use cases and intention for multiple CUs, not RAN sharing, but load balancing/traffic offload and others.(Samsung, Intel)

Other than that above, motivation and justification for the study were also discussed and clarified.