RAN1-106-e-NWM-NR-Maintenance-Others-01 - Version 0.0.5
RAN1

3GPP TSG RAN WG1 #106-e R1-2108472

e-Meeting, August 16th – 27th, 2021

Source: moderator (vivo)

Title: Summary of RAN1-106-e-NWM-NR-Maintenance-Others-01

Agenda Item: 7.2.12

Document for: Discussion and Decision

1 Introduction

According to guidance from Mr. Chair, this is kick-off discussion on following:

[106-e-NR-Maintenance-Others-01] Reply LS to R1-2106431 (LS on UL MIMO coherence for Tx switching between two carriers, RAN4) – Rakesh (vivo)

As part of the discussion, RAN1 to first determine whether a reply LS is needed or not by **August 18.** If reply LS is needed, finalize response by **August 23**.

Since RAN4 asked to check if there is any RAN1 spec impact, potential RAN1 CR is also part of the discussion.

2

RAN4 sent LS in [1] informing their agreements on UL MIMO coherence for Tx switching between two carriers as below and asked RAN1 to check if there is RAN1 spec impact.

Table 1: Summary of RAN4 LS

- Introduce UE capability to indicate support of the uplink codebook subset for the carrier capable of two antenna connectors, when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and uplink switching is triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 between last transmitted SRS and scheduled PUSCH transmission.
- UE capability is defined as per band combination when also for band combinations with a carrier capable of one-port transmission + a carrier capable of two-port transmission are indicated with capability ULTxSwitchingBandPair-r16. For band combinations with 2Tx to 2Tx switching, RAN4 will further discuss on how to handle the above new capability in Rel-17.
- If the above capability is absent, the existing per band UE capability *pusch-TransCoherence* is applicable to the scenario when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and uplink switching is triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 between last transmitted SRS and scheduled transmission.
- If UE indicates the above capability as nonCoherent and the existing per band UE capability *pusch-TransCoherence* as fullCoherent or partialCoherent, when UE is configured with uplink switching with parameter uplinkTxSwitching-r16 and uplink switching is triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 between last transmitted SRS and scheduled PUSCH transmission, UE is not expected to receive TPMI for coherent codebook subset.

2.1 Reply LS to RAN4

Question1: Do you think reply LS to RAN4 is needed?

*Note: this question is to be resolved by **Aug. 18***

Feedback Form 1: Whether reply LS to RAN4 is needed?

1 – vivo Communication Technology Yes, reply LS is needed
2 – Guangdong OPPO Mobile Telecom. Yes
3 – HUAWEI TECHNOLOGIES Co. Ltd. No. Because there is no reply that is requested by the LS. It is unclear what potential information is needed to inform RAN4.
4 – Apple GmbH Yes, we prefer rely LS. Instead of the solution proposed by RAN4, we think it is cleaner to further allow UE to report RAN1 FG2-31, i.e., pusch-TransCoherence, as per FS (per band per BC). Currently, FG2-31 is per band.

5 – ZTE Corporation

It seems the more important issue is whether there is any RAN1 spec impact. If there is RAN1 spec impact, then we may need to reply LS. From our perspective, we see some potential RAN1 spec impact, thus OK to send the reply LS.

More comments for the following questions may be added later.

6 – CATT

Before we decide whether reply LS to RAN4 is needed or not. We need discuss about whether there is RAN1 spec impact or not.

7 – vivo Communication Technology

main purpose of this discussion is to determine whether reply LS is needed, RAN4 didn't ask doesn't mean that RAN1 cannot send, of course we need consesus in RAN1. At least, the UE capability on coherence needs discussion, and "UE is not expected to receive TPMI for coherent codebook subset" this statement could be misunderstood, because codebook subset is configured to UE {fullyAndPartialAndNonCoherent, partialAndNonCoherent, nonCoherent}, and field size in DCI also depends on the configure subset. And, it is not clear in spec whether/how 4Tx partial coherent UE is/can be configured with 2Tx codebook.

8 – Qualcomm India Pvt Ltd

Yes, we support to send LS. Beyond UL Tx switching, there is a more fundamental issue RAN1 should agree to introduce UL coherence as a per band per band combination capability before making any further decision on UL Tx switching.

The UE may support 2Tx or 4 Tx in the same band in different band combinations. This is a well-accepted principle. But there is no reason to believe that the UE's coherence capability would be the same for 4 Tx as it is for 2 Tx. The UE can be coherent capable for 2Tx but not coherent capable (not even partial coherent capable) for 4Tx.

9 – Ericsson LM

Agree with ZTE and CATT that we should first discuss spec impact, and if it will also affect RAN4's work. So my first preference would be to defer this question. If the procedure is rigid and we have to have an answer now without the discussion of spec impact, then the conservative answer would be that no response is needed. We can anyway send an LS later if needed.

10 – Nokia Corporation

Agree with Ericsson that we need to first agree on what we are going to do and only then it makes sense to decide on the LS response.

Redoing the Rel-15 UE capability signalling of FG2-31 in Rel-16 when we are already far into Rel-16 maintenance would seem something that is beyond straight forward maintenance (as e.g. Apple is suggesting), and would not be a matter of just sending an LS to RAN2 and asking them to do so.

11 – Intel Corporation (UK) Ltd

LS reply is needed

2.2 Content of reply LS

If the answer to question1 in section 2.1 is Yes, then what should RAN1 reply to RAN4 ? There are two contributions [3][5] discussing reply LS to RAN4. If reply LS is needed, text to be finalized by **Aug 23.**

RAN1 agreed to introduce a new UE capability indicating UL MIMO coherence per band per band combination (regardless of UL Tx switching)

According to Rel-15 power scaling behaviour, nonCoherent codebook subset doesn't achieve full transmission power as indicated by power class especially for lower rank transmission, hence UL full power transmission is introduced in Rel-16 where there are 3 modes of operations, namely fullpower, fullpowerMode1 and fullpowerMode2. Different full power modes have different power scaling behaviours and additional TPMI precoder(s) is introduced on top of nonCoherent precoders for fullpowerMode1. Which means the applicable precoders are different when the new capability indicated as nonCoherent with or without fullpowerMode1 capability.

When the UE indicates the new capability as nonCoherent, it may also report one of the full power modes as capability, if the UE doesn't report full power capability along with the new capability then Rel-15 behaviour is applied.

Feedback Form 2: Content of reply LS to RAN4

1 – vivo Communication Technology At least following should be informed to RAN4, the relation with UL full power capability should be clarified. When the UE indicates the new capability as nonCoherent, it may also report one of the full power modes as capability, if the UE doesn't report full power capability along with the new capability then Rel-15 behaviour is applied.
2 – Apple GmbH We can follow proposed LS reply as in [3] For the full power transmission, currently, the corresponding FG is already per FS (FG16-5a/5b/5c-x), which already considered the potential UE RF/hardware impact for the same band in different BC. We think no change is fine

3 – ZTE Corporation

From our perspective, full power and UL tx switching are separate UE capabilities and they can of course be configured together. Based on the draft CR from vivo, it seems the only difference is that the applicable TPMI table maybe different.

If this is the correct understanding, then we can even try to not mention the detailed table in the CR, e.g.,

When a UE is configured with uplink switching with parameter uplinkTxSwitching-r16 and the capability [uplinkTxSwitching-PUSCH-TransCoherence] is indicated as ['nonCoherent'], if uplink switching is triggered between last transmitted SRS and scheduled PUSCH transmission based on the conditions defined in Clause 6.1.6, the UE shall not expect to be indicated a TPMI for coherent codebook subsets for the PUSCH.

4 – Qualcomm India Pvt Ltd

RAN1 would like to thank RAN4 for the LS. RAN1 is discussing the need for a new UE capability signaling indicating UL MIMO coherence per band per band combination (regardless of UL Tx switching). If this is agreed, no further change is needed to address the coherence capability with UL Tx switching.

2.3 RAN1 spec change

Question2: Do you think RAN1 spec change is needed?

Feedback Form 3: Whether RAN1 spec change is needed?

1 – vivo Communication Technology

Yes, RAN1 spec change is needed.

2 – Guangdong OPPO Mobile Telecom.

Yes

3 – Apple GmbH

Assume we introduce per FS UL coherency UE capability, for the following three important UL MIMO related UE capabilities, they are all at least per FS. (1) maximum # of UL MIMO layers which is per FSPC (2) UL coherency which will be per FS (3) UL full power which is per FS.

We feel the specification change is not that critical or we fail to see the need of specification change

4 – CATT

If UE indicates the above capability as nonCoherent, it seems that UE transmission scheme is already specified in sub-clause 6.1.1 of TS 38.214. We hope proponent to clarify why there is RAN1 spec impact.

5 – vivo Communication Technology

@CATT, this question is arising from "If UE indicates the above capability as nonCoherent and the **existing per band UE capability *pusch-TransCoherence* as fullCoherent**", the UE is reporting different coherent capabilities in different occasions.

6 – ZTE Corporation

We see the necessity to clearly capture the UE behaviour in RAN1 spec.

7 – Qualcomm India Pvt Ltd

The only change needed is per band per band combination signaling defined by RAN2. There would be no RAN1 specification impact.

8 – HUAWEI TECHNOLOGIES Co. Ltd.

Our reply that was provided with the other replies is lost, and is recapped here.

No RAN1 spec impact is needed for the following reasons,

1) There is no new UE behavior. According to the CR **R4-2109582**, the new UE capability is only about the applicability of one RAN4 RF requirement (difference of relative phase error between SRS and succeeding PUSCH). It simply means that no RAN4 requirement is applied when a UE does not report such capability, i.e. the performance of UL MIMO in term of difference of relative phase error is not required as high as the other cases. Therefore, the UE can still perform UL MIMO functionality but may have no high enough performance, which does not introduce any new UE behavior.

2) In the CR R4-2109582, there have been already other condition of applicability in current RAN4 specs, as copied below. They don't introduce new UE behavior either so that there is no corresponding RAN1 spec impact. For example, DCI based BWP switching, and CA reconfiguration. It is unnecessary to make an exception for UL Tx switching.

R4-2109582

"

The above requirements when all the following conditions are met within the specified time window:

- *UE is not signaled with a change in number of SRS ports in SRS-config, or a change in PUSCH-config*
- *UE remains in DRX active time (UE does not enter DRX OFF time)*
- *No measurement gap occurs*
- *No instance of SRS transmission with the usage antenna switching occurs*
- *Active BWP remains the same*
- *EN-DC and CA configuration is not changed for the UE (UE is not configured or de-configured with PSCell or SCell(s))"*

3) Since no new UE behavior is introduced by the RAN4 CR, it is unnecessary to restrict any gNB configuration as the proposed TP below.

In shorts, we would like to suggest to reach common understanding on the RAN4 CR R4-2109582 first.

9 – Nokia Corporation

We don't immediately see the RAN1 impact, as also explained by Qualcomm and Huawei.

10 – vivo Communication Technology

Yes, from the RAN4 CR (excerpt below), when uplink switching is not triggered UE coherence requirement is to be met if existing per band capability is full or partial coherent, that means coherent codebook subset is configured to the UE and "UE is not expected to receive TPMI for coherent codebook subset." In this case, UE power scaling could be differnt with or without UL full power capability,

The above requirements when all the following conditions are met within the specified time window:

....

or when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16*, the capability *[uplinkTxSwitching-PSUCH-TransCoherence]* is indicated as ['non-coherent'], and uplink switching is not triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 [10] between last transmitted SRS and scheduled transmission.

11 – Intel Corporation (UK) Ltd

It should be first discussed whether RAN1 wants to address UL Tx switching issue only or more general scenario as mentioned by QC. In case there is no consensus in RAN1 to address more general case, RAN1 should agree with RAN4 solution and discuss full power aspects mentioned by vivo that may have RAN1 impact

2.4 TP/Draft CR for 38.214

If the answer to question2 in section 2.3 is Yes, then how to change? There are two contributions [2][6] proposing TP/Draft CR for 38.214 as below. (underlined text below is TP)

Option1:

————————38.214 section 6.1.1.1————————

<unchanged part omitted>

A UE shall not expect to be configured with the higher layer parameter *codebookSubset* or the higher layer parameter *codebookSubsetForDCI-Format0-2* set to 'partialAndNonCoherent' when higher layer parameter *nrofSRS-Ports* in an *SRS-ResourceSet* with *usage* set to 'codebook' indicates that the maximum number of the configured SRS antenna ports in the *SRS-ResourceSet* is two.

When a UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and the capability [*uplinkTxSwitching-PUSCH-TransCoherence*] is indicated as ['nonCoherent'], if uplink switching is triggered between last transmitted SRS and scheduled PUSCH transmission based on the conditions defined in Clause 6.1.6, the UE shall not expect to be indicated a TPMI for coherent codebook subsets for the PUSCH**.**

<unchanged part omitted>

————————————————end————————————————-

Option2:

————————38.214 section 6.1.6————————

<unchanged part omitted>

The UE does not expect to perform more than one uplink switching in a slot with $\mu_{UL} = \max(\mu_{UL,1}, \mu_{UL,2})$, where the $\mu_{UL,1}$ corresponds to the subcarrier spacing of the active UL BWP of one uplink carrier before the switching gap and the $\mu_{UL,2}$ corresponds to the subcarrier spacing of the active UL BWP of the other uplink carrier after the switching gap.

When the UE capability indicates support of the uplink codebook subset as nonCodebook and

ul-FullPowerTransmission is not configured or configured to *fullpowerMode2* or configured to *fullpower* for the carrier capable of two antenna connectors, when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and the existing per band UE capability *pusch-TransCoherence* as fullCoherent or partialCoherent, the UE is expected to receive the TPMI precoders which correspond to noncoherent precoders in Table 7.3.1.1.2-2 or Table 7.3.1.1.2-3 or Table 7.3.1.1.2-4 or Table 7.3.1.1.2-5 in [5].

When the UE capability indicates support of the uplink codebook subset as nonCodebook and *ul-FullPowerTransmission* configured as *fullpowerMode1* for the carrier capable of two antenna connectors, when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and the existing per band UE capability *pusch-TransCoherence* as fullCoherent or partialCoherent, the UE is expected to receive the TPMI precoders which correspond to noncoherent precoders in Table 7.3.1.1.2-2A or Table 7.3.1.1.2-2B or Table 7.3.1.1.2-3A or Table 7.3.1.1.2-4A or Table 7.3.1.1.2-5A in [5].

<unchanged part omitted>

————————————end————————————-

Feedback Form 4: TP for 38.214

1 – vivo Communication Technology

above 2 options can be starting point for discussion, it should be noted that coherent codebook subset also contains noncoherent precoders and the intention of the RAN4 agreement is about the usable precoders in this scenario without dynamically changing TPMI field size in DCI.

2 – Guangdong OPPO Mobile Telecom.

A simple spec change is as below:

A UE reporting its UE capability of 'nonCoherent' transmission indicated by [new-RRC-parameter] shall not expect to be configured by either *codebookSubset* or *codebookSubsetForDCI-Format0-2* with 'fullyAndPartialAndNon if it is configured with *uplinkTxSwitching-r16*.

3 – HUAWEI TECHNOLOGIES Co. Ltd.

As commented before, no need.

4 – Apple GmbH

The essence in our view is not to tie the UL coherency capability to certain SRS carrier switching band pairs, instead making the capability per FS to solve the fundamental issue, i.e., UE RF and hardware configuration can be different for the same band under different BC. Therefore, the propose TP seems to be unnecessary.

However, we still have two issues we have not resolved in current MIMO

1. UL coherency when gNB performs downgrade configuration of maximum PUSCH layers. The most prominent issue is UE reports UE supports 4-layer partial coherent PUSCH and gNB down grades UE to two layer PUSCH

2. The UE full power transmission related capability when gNB performs downgrade configuration of maximum PUSCH layers/coherency. We proposed this issue multiple times in Rel-16, and companies did not want to resolve the issue at all

5 – CATT

Before discussion about detail CR, first of all, we need discuss about whether there is RAN1 spec or not.

6 – Qualcomm India Pvt Ltd

none of the options is our preference as both of them are on UL Tx switching. As we commented above, we propose to focus on the fundamental issue and define per band per band combination capability.

Option 1 introduces a new mode, where in the UE switches between coherent and non-coherent mode based on UL Tx switching state change. This would be a new functionality, that has not been discussed so far.

Option 2 introduces clarifications on how to interpret codebook entries, which is actually not related to the issue at hand. Even though this could be also discussed, we would like to focus on the basic per band per combination signaling in the context of LS reply.

7 – HUAWEI TECHNOLOGIES Co. Ltd.

Our analysis was lost and is recapped to the previous question.

The TP introduces unnecessary restriction for gNB implementation. Please note that there is no such restriction for the cases of BWP switching and CA reconfiguration which have been the conditions of applicability of a RF requirement in current RAN4 spec for long time. Similarly, there should be no such restriction for the concerned new UE capability either, because it is only about a new condition of the applicability, according to RAN4 CR R4-2109582.

8 – Nokia Corporation

We don't see a necessity for RAN1 spec change.

3 Summary after intial round of discussion

Although the first deadline has past, RAN1 to first determine whether a reply LS is needed or not by August 18.

Looking at the current situation views are diverging on necessity of LS reply to RAN4.

Option1: LS reply is needed, only include clarification on "not expect to receive TPMI for coherent subset"

Option2: LS reply is not needed.

On RAN1 spec change,

Option a: clarify in RAN1 spec along "not expect to receive TPMI for coherent subset"

Option b: no RAN1 spec change

Regarding new UE capability of per band combination, it seems there is no consensus here, following 3 alternatives can be considered

Alt1: agree in RAN1 and send LS to RAN2, RAN4

Alt2: do not agree

Alt3: discuss in UE feature AI

I would like to continue discussion on above until UTC 11:59 AM August 20.

Feedback Form 5: Options for further discussion

1 – Ericsson LM

For the reply LS, we think option 2 is enough. The terminology in RAN4's LS may not really align with the RAN1 & RAN2 specs, but the behavior is clear enough.

On the RAN1 spec change, we agree with Huawei's argumentation that the CR to 38.101 section 6.4D.4 addressed by the LS can be supported by gNB implementation without changing the RAN1 specs. So we prefer option b.

For the UE capability issue, we prefer Alt 2. We do understand that UE capability can vary, and that UE vendors would like as much flexibility as possible. However, determining what combination of capabilities to configure for the UE is actually pretty painful for the gNB. In order for the network to select what to configure for MIMO, we have to check all band combinations for combinations of MIMO layers on pcell/scells, DL/UL, etc. Furthermore, it is not clear how common the example UE architecture under discussion will be, and the gains of 2 Tx coherent over 2 or 4 Tx non-coherent operation supported by this UE are not likely to be dramatic, so we wonder if the gains will be large enough and available enough in networks to be really beneficial. Again, I can certainly understand the desire from a UE product perspective, and would like to be supportive. However, managing/configuring these highly grained UE capabilities is quite complicated, and further increasing this by adding another parameter to this effectively exponential search complexity should be thoroughly justified.

2 – CATT

1. For LS reply to RAN4, we slightly prefer Option 2 because we fail to see RAN4's LS has any RAN1 spec impact based on our previous discussion.

2. For On RAN1 spec change, we prefer Option b because for CR R4-2109582, if the capability as noncoherent is reported, the performance of relative phase error between SRS and PUSCH needn't be guaranteed. In addition, it is also up to gNB implementation to avoid the case happening and if this case really happens and PUSCH transmission is failure, gNB can schedule retransmission to this PUSCH.

RegardingnewUEcapabilityofperbandcombination, We have the same view on determining what combination of capabilitiestoconfigurefortheUEisactuallyprettypainfulforthegNB with Ericsson. So we support Alt.2

3 – Qualcomm India Pvt Ltd

1. On necessity of LS reply to RAN4, we want to propose Option 3, which is LS reply is needed, to inform RAN4 and other WGs that RAN1 is trying to solve the fundamental issue with defining per band per band combination capability with or without UL Tx switching. It seems that multiple companies might support this option.

2. On RAN1 spec change, our input to the question is that no RAN1 specification change is needed for the Qualcomm proposal on per band per band combination MIMO coherence capability signaling. The

same proposal also automatically solves the UL Tx switching case because the UE can independently signal whether it is coherent or not in the band combination(s) with UL Tx switching. Regarding Option a, we don't know what it means 'not expect to receive TPMI for coherent subset'. Is it never to expect, as proposed by vivo? Or is it not to expect only after a switching occurred, as proposed by Huawei? We don't know what we are trying to agree with Option a.

3. Regarding new UE capability of per band combination, we support Alt1, however, we would not agree with an LS according to Option 1. We are also fine with Alt3 if this is majority view.

4 – Intel Corporation (UK) Ltd

Considering current situation we prefer to discuss QC proposal in UE feature AI (Alt 3) with the goal to find good tradefoff between flexibility and complexity of the NW. Considering this, we don't think LS reply would be needed at this stage (Option 1).

5 – Guangdong OPPO Mobile Telecom.

for LS reply: Option 2. We share similar view as Ericsson

for RAN1 spec change: Our first preference is to clarify in RAN1. But the current version of Option a is quite vague and we failed to get what the exact meaning is. We are also open to Option b.

for UE capability: We prefer Alt.3

6 – ZTE Corporation

Thanks for the discussion.

Regarding the TPMI field size issue raised by vivo, after some internal further check, it seems the TPMI field size will be kept the same as the legacy one if RAN1 spec is kept as it is. If companies have common understanding on this aspect, then it seems no necessity to clarify this issue. But if companies have different understanding on this aspect, we are open to clarify it.

Regarding the RAN1 spec change, if majority companies think that it can be handled by network implementation, we are also fine with no spec change.

Regarding defining per band per band combination capability with or without UL Tx switching, is it the correct understanding that this proposal is trying to propose two new per band per BC UE capabilities, one UE capability for the case when UL Tx switching is triggered between the last transmitted SRS and the scheduled UL transmission, and another UE capability for the other cases (e.g., UL Tx switching is not triggered)?

7 – Apple GmbH

Regarding the need of LS reply

If per band per BC UL coherency capability is introduced, we definitely need RAN4 LS reply

Otherwise, we are neural.

Regarding RAN1 spec change,

We are neural

Regarding new UE capability of per band combination,

We prefer Alt1: agree in RAN1 and send LS to RAN2, RAN4

or we allow Alt3: handle the discussion in UE feature AI

4 Conclusions

In this discussion, following three issues were discussed, 1) whether reply LS to RAN4 is needed; 2) whether there is RAN1 spec change; 3) whether to introduce a new UE capability.

- There is no consensus on need for reply LS to RAN4.
- There is no consensus on need for RAN1 spec change.
- There is no consensus on need for introducing new UE capability, however is it up to proponents to bring this issue in UE feature agenda item.

5 References

[1] R1-2106431, LS on UL MIMO coherence for Tx switching between two carriers, RAN4 (China Telecom)

[2] R1-2106786, Discussion on RAN4 LS on UL MIMO coherence for Tx switching between two carriers,ZTE

[3] R1-2107307, Discussion of RAN4 LS on UL MIMO coherence for Tx switching between two carriers, Qualcomm

[4] R1-2107960, Discussion on LS on UL MIMO coherence for Tx switching between two carriers, vivo

[5] R1-2107961, [Draft] Reply LS on UL MIMO coherence for Tx switching between two carriers, vivo

[6] R1-2107962, [Draft] CR on UL MIMO coherence for Tx switching between two carriers, vivo