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RAN1

3GPP TSG-RAN1 Meeting # 105-e

Electronic Meeting, May 19-27, 2021

R1-210XXXX

Agenda item: 8.7.1.1

Source: Moderator (MediaTek)

Document for: Discussion

1 Introduction

We will use NWM to allow companies to continue ”dialogues” for a topic since the feedback format can be continuously updated by companies ”in parallel”.

In the following, feature lead (FL) will initial questions on proposals provided in the draft folder: https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1?login=1

Companies can response to FL questions and add proper ”tags” for their feedback. The tag naming will specify it is to response to whose question and whether there is further question to FL or another company. If there is further question or any company want to further response to the feedback, additional feedback with tag name inherent from the target feedback can be added. In this way, we hope companies can exchange views as much as possible before the final decision on PEI physical-layer candidate.

The following is an example on how the feedback form can be utilized for ”dialogues”:

FL-[Q1.1-1]

Conclusion: For PDCCH-based PEI, coexistence with legacy UE is based on sharing CORESET-0

Feedback Form 1: Companies’ views and dialogues on FL-[Q1.1-1]

1 – MediaTek Inc. **FL-[Q1.1-1]-CompanyA-[R-1]** We are supportive to capture this conclusion for more specific understanding on how coexistence can be realized with PDCCH-based PEI.
2 – MediaTek Inc. **FL-[Q1.1-1]-CompanyB-[R-1][Q-1]** Thanks feature lead for the proposal. While the proposal looks fine for us, we are wondering why only CORESET-0 is specifically mentioned. Can another different CORESET be used as well?

3 – MediaTek Inc.

FL-[Q1.1-1]-CompanyB-[R-1][Q-1]-FL-[R-1]

Thanks companyB for the feedback and question. According to TS 38.306, Rel-15 UE is only mandated to support CORESET-0 and one additional CORESET. Since the additional CORESET can exceed the reception bandwidth of an idle/inactive UE, sharing CORESET-0 looks the only universal way to coexist with legacy UEs. Hopefully this can clarify your question.

4 – MediaTek Inc.

FL-[Q1.1-1]-CompanyB-[R-1][Q-1]-FL-[R-1]-CompanyC-[Q-1]

On this dialogue, we are wondering if SSS-based PEI should share only CORESET 0 for dynamic resource sharing as well. If it is the case, there can be excess resource in CORESET 0 not used by a narrowband SSS-based PEI. Can those REs be shared by legacy PDCCH? If not, what is the impact to the resource overhead of SSS-based PEI?

5 – MediaTek Inc.

FL-[Q1.1-1]-CompanyB-[R-1][Q-1]-FL-[R-1]-CompanyC-[Q-1]-FL-[R-1]

Thanks companyC for the questions. Yes, for the same reason, SSS-based PEI,

if applying CORESET-based dynamic rate-matching, can only share CORESET 0 as well. If there is non-occupied REs in CORESET0, they cannot be shared with other legacy UEs. Please refer to Figure 1 of R1-2102451 for more information. On the other hand, for PDCCH-based PEI, there is no such issue.

Regarding impact to resource overhead estimation of SSS-based PEI, the minimum #REs with CORESET-based rate-matching will be at least 576 REs since CORESET-0 size is one or multiple of 576 REs.

We hope the above example illustrates how dialogues can be realized in feedback form so as to clarify companies questions as much as possible. Note that, you can ask question to a specific company, e.g, by tagging as follows: **FL-[Q1.1-1]-CompanyA-[Q-1]-CompanyD** –> Company A asks a specific question to companyD.

*** Please remember to add a proper tag before each of your feedback ***

* For ease of reading companies' feedbacks, exporting to PDF is suggested *

2 Characteristics of PEI Physical-Layer Candidate Designs from RAN1 #104-bis-e Observations

2.1 Coexistence and Resource Sharing/Overhead

The following feedback forms are based on **Section 2.1** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 2: Companies' views and dialogues on FL-[Q2.1-1]

1 – Nokia Germany

We are OK with the FL proposal, except don't see that the last bullet ('DCI payload size carried by PDCCH-based PEI should be different from DCI format 1_0') would be needed in this context.

2 – MediaTek Inc.

FL-[Q2.1-1]-Nokia-[R-1]-FL-[R-1][Q-1]

Thanks Nokia/Jorma for the feedback. On the last bullet, the goal is to avoid confusion to legacy UEs. in this regard, how about changing it to the following?

- FFS how to avoid confusion of paging to legacy idle/inactive mode UEs

3 – Qualcomm Technologies Int

We have the same question as Nokia. The FFS proposed by the FL is better.

We do not support "Network can configure Behv-A or Behv-B to Rel-17 idle/inactive mode UEs". Hence, we think this should not be captured in the conclusion.

Besides, does this "prioritize PEI or legacy PDCCH, respectively" mean "network decides whether PEI or legacy PDCCH is transmitted"?

4 – Samsung Research America

In general, we don't think the conclusion is needed. We already spent much time in last meeting discussing these details. It seems to be repeated the discussion. But, if it's wanted by the majority. We have the following comments.

For the first bullet, we suggest to remove the second subbullet, as it's irrelevant and not needed. Whether or not to support both Behv-A and Behv-B can be discussed separately. Also, it's not clear to us how Behv-A and Behv-B can prioritize different PDCCH transmissions. The conclusion for NW implementation is not needed.

For the second bullet, additional CORESET0 is confusing to us. There may be more than one CORESETs per BWP, but only one CORESET0. For the second/third sub-bullet. It should be clarified that NW can indicate the additional CORESET but not in RE level. The third bullet should be under the second sub-bullet.

For the last bullet, it's not relevant.

5 – HiSilicon Technologies Co. Ltd

[Huawei, HiSilicon]

1) For the sentence of "PDCCH-based PEI can share existing CORESET 0 as a Rel-15 PDCCH", it is in general true and should be move as a higher level of bullet.

2) It is not clear for us what additional CORESET0 is. So we propose to remove the part relating with "additional".

3) We also think the last bullet is not needed.

Conclusion:

If PDCCH-based PEI is selected for Rel-17 paging enhancement, either of the following two schemes for coexistence with legacy Rel-15/16 UEs can be utilized as per network configuration:

· PDCCH-based PEI can share existing CORESET 0 as a Rel-15 PDCCH

· Without additional gNB DCI indication to legacy UEs:

~~o PDCCH-based PEI can share existing CORESET 0 as a Rel-15 PDCCH~~

o Network can configure Behv-A or Behv-B to Rel-17 idle/inactive mode UEs and prioritize PEI or legacy PDCCH, respectively

· With additional gNB DCI indication to legacy UEs:

o PDCCH-based PEI can occupy one PDCCH candidate and dynamically share ~~an additional~~ CORESET 0 ~~provided by additional search space set(s) associated with CORESET 0~~ and set to *rateMatchPattern-ToAddModList* in *PDSCH-Config* or *ServingCellConfigCommon* for legacy UEs

o When PDCCH-based PEI is not transmitted, network can indicate the REs of the ~~additional~~ CORESET 0 are available for PDSCH scheduled by DCI format 1_1

o For PDSCH scheduled by other DCI formats, UE assumes the REs of the ~~additional~~ CORESET 0 are not available for the PDSCH

~~· DCI payload size carried by PDCCH-based PEI should be different from DCI format 1_0~~

6 – ZTE Corporation

We are supportive of the conclusion in general. Similar comment with Samsung and Huawei, there is only one CORESET 0 across BWPs.

Regarding the following bullet, we think it is one of the way for PDCCH based PEI co-exist with other channel by adopting Behav-B and prioritize the transmission of other channel/signal. We suggest to keep it .

o Network can configure Behv-A or Behv-B to Rel-17 idle/inactive mode UEs and prioritize PEI or legacy PDCCH, respectively

7 – Intel Corporation (UK) Ltd

[Intel]-FL-[Q2.1-1]

Given the conclusions from RAN1 #104b-E, it is unclear as to what these observations are likely to achieve towards any meaningful progress.

Nevertheless, some comments to the proposed observations:

· The categorization "w/ or w/o "gNB DCI indication to rel-15/16 UEs" is unnecessary and should be removed. The categorization is basically same as that of semi-static vs. dynamic rate-matching options and some dynamic indication would be expected for the latter.

· Statements like "Network can configure Behv-A or Behv-B to Rel-17 idle/inactive mode UEs and prioritize PEI or legacy PDCCH, respectively" do not convey any meaningful information in the context of coexistence analysis. It would be no different from saying that PEI can be configurable feature and can be turned off.

· The statement "PDCCH-based PEI can share existing CORESET 0 as a Rel-15 PDCCH" should be clarified as "PDCCH-based PEI can semi-statically share PDSCH REs of legacy UEs via CORESET-level rate-matching around existing CORESET 0 as a Rel-15 PDCCH" to say things the same way for all candidates.

· "For PDSCH scheduled by other DCI formats" should be changed to "For PDSCH scheduled by ~~other~~ DCI format~~s~~ 1*0" since whatever is possible via format 1*1 is also possible for format 1_2.

· For TRS/CSI-RS, the last sub-bullet should be updated as "For PDSCH scheduled by other DCI formats, UE assumes the REs of ~~the additional CORESET 0~~ **configured resources in *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*** are always available for the PDSCH".

The definition of "additional CORESET #0" is not clear at all. An "additional CORESET" cannot be provided by "additional search space set(s)". It is not clear what is intended here for both PDCCH- and SSS-based PEI.

8 – Apple Italia S.R.L.

We are fine with the conclusion in general, with a few comments:

1. We also think Behv-A vs Behv-B should be separately discussed.
2. As commented by other companies, "additional CORESET 0" is confusing.
3. On the last bullet, we think it is better to put it as an FFS.

9 – CATT

We don't agree with moderator's proposed conclusion. The search space and CORESET for DCI-based PEI does not need to tight with CORESET 0. DCI-based PEI would be used by multiple cells. It would be very challenged in the deployment to configured DCI-based PEI at CORESET 0. Thus, the whole conclusion is not necessary and the configuration of CORESET and search space of DCI-based PEI is the gNB implementation.

10 – MediaTek Inc.

FL-[Q2.1-1]-QC-[R-1][Q-1]-FL-[R-1]

Thanks Qualcomm for the feedback and questions. 2nd subbullet can be made FFS as it requires further discussion. For "Prioritize", it means when there is conflict between PEI and legacy PDCCH in CORESET 0, network can choose which one to be transmitted. Hope this can clarify.

11 – MediaTek Inc.

FL-[Q2.1-1]-SS-[R-1]-FL-[R-1]

Thanks Samsung for the feedback. 2nd subbullet can be made FFS as it requires further discussion. by "additional CORESET 0" we mean additional monitoring occasions associated with CORESET-0 setting and provided by additional search space set. Since Rel-15 UE is only mandated to support CORESET-0 + one additional CORESET, CORESET-0 is the only choice to ensure the same idle-mode reception bandwidth for PDCCH-based PEI. This is the reason we emphasize CORESET-0.

12 – MediaTek Inc.

FL-[Q2.1-1]-HW,HiSi-[R-1]-FL-[R-1][Q-1]

Thanks Huawei, HiSilicon for the feedback. By "additional CORESET 0" we mean **additional monitoring occasions** associated with CORESET-0 setting and provided by additional search space set. Since it is additional resource for PDCCH-based PEI, it can be dynamically off via RB-symbol rate-matching. If there is legacy PDCCH using the resource, it should belong to the case without RB-symbol rate-matching. Overall, we are wondering if changing "additional CORESET-0" to "additional CORESET-0 monitoring occasions" can clarify.

13 – MediaTek Inc.

FL-[Q2.1-1]-ZTE-[R-1]-FL-[R-1]

Thanks ZTE for the feedback. We suggest 2nd subbullet can be made FFS as it requires further discussion.

14 – MediaTek Inc.

FL-[Q2.1-1]-Intel-[R-1]-FL-[R-1][Q-1]

- If the conclusion is valid, there looks **no need of semi-static resource sharing for PDCCH-based PEI** since the PEI can share either existing or new monitoring occasions associated with CORESET-0, both will not occupy resource when PEI is not transmitted

- When Behv-B is applied, gNB can **temporally** not transmit PEI when there is resource conflict with legacy PDCCH. But it doesn't means PEI is not configured. This allows better flexibility for UEs to handle PEI coexistence with legacy channels.

- The statement "PDCCH-based PEI can share existing CORESET 0 as a Rel-15 PDCCH" is to say **dynamic resource sharing as a Rel-15 PDCCH. The resource can be utilized for other Rel-15 PDCCHs if not occupied**.

- Will change "For PDSCH scheduled by other DCI formats" to "For PDSCH not scheduled by DCI format 1*1 or 1*2"

- Will revise TRS/CSI-RS proposal accordingly

- Will change "Additional CORESET-0" to "Additional CORESET-0 monitoring occasions" to clarify the meaning.

Please kindly let us know if the above update can make the conclusion clear and acceptable for you?

15 – MediaTek Inc.

FL-[Q2.1-1]-Apple-[R-1]-FL-[R-1]

Thanks Apple for the feedback. We suggest 2nd subbullet can be made FFS as it requires further discussion. By "additional CORESET 0" we mean **additional monitoring occasions** associated with CORESET-0 setting and provided by additional search space set. We will change "Additional CORESET-0" to "Additional CORESET-0 monitoring occasions" to clarify the meaning.

16 – MediaTek Inc.

FL-[Q2.1-1]-CATT-[R-1]-FL-[R-1][Q-1]

Since Rel-15 UE is only mandated to support CORESET-0 + one additional CORESET, CORESET-0 is the only choice to ensure the same idle-mode reception bandwidth for PDCCH-based PEI. **Do you have alternative solution when Rel-15 UEs only support CORESET-0 and one additional (UE-specific) CORESET?**

For paging across multiple cells, paging message is the same but physical signal in each cell can be different. For NB-IOT GWUS, it has been the case where GWUS assignment for different paging probability can be different in different cell. **We would like to first align our understanding here.**

17 – Ericsson India Private Limited

Regarding [Q2.1-1]

The main bullet should be updated as "For the purpose of comparison of PEI candidate designs,....." or text shoudl be updated to "at least below two schemes for coexistence" – these may not be the only options from NW implementation point of view.

Regarding “additional CORESET 0”, we are OK with FL-suggested wording update i.e. ”additional CORESET 0 monitoring occasions”.

We also do not see need for last bullet regarding DCI payload size. FFS regarding confusion is also not needed in our view as the configuration details can be left up to gNB implementation. If FFS is to be kept, suggest update as below.

FFS Study whether/how to handle confusion (if any) of paging to legacy idle/inactive mode UEs.

18 – Spreadtrum Communications

FL-[Q1.1-1]-Spreadtrum-[R-1]

1) Behv-A and Behv-B can be discussed separately

2) ”an additional CORESET 0 provided by additional search space set(s) associated with CORESET 0” could be ”a CORESET sharing resource with CORESET 0”

19 – China Mobile Com. Corporation

FL-[Q2.1-1]-CMCC-[R-1]

1) Support moderator‘s update about ”additonal CORESET 0 monitoirng occasion’.

2) Regarding the last bullet, if the PDCCH monitoirng occasions of PEI is different fromDCI foramt 10, it is not needed to restrict the PEI DCI payload size not be same as DCI foramt 1_0□ thus, the last bulllet can be removed.

20 – LG Electronics Inc.

FL-[Q2.1-1]-LG-[R-1]

We are fine with the conclusion, with updates :

- we prefer update about “additional CORESET-0 monitoring occasions” as suggested by FL.
- we do not need to restrict DCI payload size at this moment. So prefer to remove the last sub-bullet

21 – Guangdong OPPO Mobile Telecom.

1□For the first bullet, the second sub-bullet means Behv-A and Behv-B are configured by Network. It has not been agreed or concluded. We suggest to remove this sub-bullet until some conclusions on Behv.A or Behv-B are drawn.

2□For the second bullet, it is better to put the “additional CORESET 0” as an FFS.

3□On the last bullet, we think whether or not the payload size for DCI-based PEI is different from DCI format1_0 need to be FFS.

22 – Sony Europe B.V.

FL-[Q2.1-1-3]-Sony-[R-1]

It is not very clear why “With additional gNB DCI indication to legacy UEs” has been included to the three conclusions. Does that additional gNB DCI indication mean that some legacy DCI is used or does it assume that legacy UEs are upgraded?

23 – vivo Communication Technology

(1) It is not clear what does 'Without additional gNB DCI indication' and 'With additional gNB DCI indication' impact to UE or network performance benefits perspective. Network providing additional gNB DCI indication to Rel-15/16 UEs does not cause much complexity and implementation issues.

(2) In general, co-existence is important, we have spent most of the time to understand the co-existence issue and give the conclusion in the last meeting. Unless there are some critical issues, we think the previous conclusions in the last meeting is enough to conclude that the co-existence with the legacy system for 3 schemes are feasible.

24 – PANASONIC R&D Center Germany

1. Okay with the first two bullets.
2. The last bullet is irrelevant with this observation, which can be discussed separately.
3. A more general comment is that we may not need to spend too much time on Q2.1-1, 2, 3, as the coexistence with legacy UEs is basically not an issue for all the candidate solutions. Spending too much time on debating the details on the observations how gNB implementation is not that helpful for the progress in our view.

25 – Intel Corporation (UK) Ltd

[Intel 2]
Responses to FL-[Q2.1-1]-Intel-[R-1]-FL-[R-1][Q-1]

- If the conclusion is valid, there looks **no need of semi-static resource sharing for PDCCH-based PEI** since the PEI can share either existing or new monitoring occasions associated with CORESET-0, both will not occupy resource when PEI is not transmitted

[Intel] This is not correct since when we are talking about resource sharing it is about sharing with PDSCH resources - for sharing with PDCCH, it is always dynamically possible for any option since the legacy UE can always monitor for a PDCCH but not find one.

- When Behv-B is applied, gNB can **temporally** not transmit PEI when there is resource conflict with legacy PDCCH. But it doesn't means PEI is not configured. This allows better flexibility for UEs to handle PEI coexistence with legacy channels.

[Intel] This is not correct since behavior A vs. B cannot be changed dynamically. So, fundamentally it is same as turning off PEI.

- The statement "PDCCH-based PEI can share existing CORESET 0 as a Rel-15 PDCCH" is to say **dynamic resource sharing as a Rel-15 PDCCH. The resource can be utilized for other Rel-15 PDCCHs if not occupied**.

[Intel] This is misleading since for the other PEI designs, we are talking about resource sharing with PDSCH, and the exact same characterization as suggested above should be used (repeated below for convenience). Dynamic resource sharing with other Rel-15 PDCCH is always possible for any PEI option. We should focus on PDSCH resource sharing as done for FL-[Q.2.1-2] and FL-[Q.2.1-3].

-

The statement "PDCCH-based PEI can share existing CORESET 0 as a Rel-15 PDCCH" should be clarified as "PDCCH-based PEI can **semi-statically** share **PDSCH REs of legacy UEs via CORESET-level rate-matching around** existing CORESET 0 as a Rel-15 PDCCH".

Feedback Form 3: Companies' views and dialogues on FL-[Q2.1-2]

1 – Nokia Germany

We are OK with the with the FL proposal FL-[Q2.1-2], with the note that the signal design (as per FFS) needs to avoid impact to initial access in general as well as other functionalities e.g. RRM measurements.

2 – MediaTek Inc.

FL-[Q2.1-2]-Nokia-[R-1]-FL-[R-1]

Thanks for Nokia/Jorma's feedback. On the note, we will revise it as:

-

FFS: Signal design that avoids impact to initial access and RRM measurements of legacy UEs

3 – Qualcomm Technologies Int

For SSS-based PEI, the same rate matching technique of PDCCH PEI can be used if a CORESET is used to mimic the PDCCH based PEI's resource occupation. I.e.,, the rate matching only needs to reflect resource usage but does not have to reflect whether the resource is occupied PDCCH or not. Based on this, we think CORESET based rate matching pattern can also be included for the case "Without additional gNB DCI indication to legacy UEs".

4 – Samsung Research America

Same as for [Q2.1-1], "additional CORESET0" is confusing to us.

5 – HiSilicon Technologies Co. Ltd

Huawei, HiSilicon:

We are in generally fine with the following revision:

1) Similarly, we suggest remove the "additional" of "additional CORESET0".

2) For the last bullet of FFS, we really don't want to open the door to change current signal design to increase UE and network complexity. Considering this, we suggest to change the last bullet and emphasize existing SSS should be used:

· FFS: ~~Signal design that can~~ How to avoid impact to initial access of neighbour cell UEs for PEI based on existing SSS sequence and pattern

6 – ZTE Corporation

[ZTE, Sanechips]

We are supportive of the conclusion in general. Some minor changes are suggested as below.

(1)Similar comment with Samsung and Huawei, there is only one CORESET 0 across BWPs.

(2) In addition to initial access, it should also avoid impact on neighbour cell measurement.

(3) A typo. "*ateMatchPatternToAddModList* in *PDSCH-Config*"→ "*RateMatchPatternToAddModList* in *PDSCH-Config*"

7 – Intel Corporation (UK) Ltd

[Intel]

Our response to FL-[Q2.1-1] covers all three proposals FL-[Q2.1-1] through FL-[Q2.1-3]. Repeated below with relevant parts for the current proposal for convenience:

[Intel]-FL-[Q2.1-1]

Given the conclusions from RAN1 #104b-E, it is unclear as to what these observations are likely to achieve towards any meaningful progress.

Nevertheless, some comments to the proposed observations:

· The categorization "w/ or w/o "gNB DCI indication to rel-15/16 UEs" is unnecessary and should be removed. The categorization is basically same as that of semi-static vs. dynamic rate-matching options and some dynamic indication would be expected for the latter.

· "For PDSCH scheduled by other DCI formats" should be changed to "For PDSCH scheduled by ~~other~~ DCI format~~s~~ 1*0" since whatever is possible via format 1*1 is also possible for format 1_2.

· The definition of "additional CORESET #0" is not clear at all. An "additional CORESET" cannot be provided by "additional search space set(s)". It is not clear what is intended here for both PDCCH- and SSS-based PEI.

8 – Apple Italia S.R.L.

We are fine with the conclusion in general, with a few comments:

1. "additional CORESET 0" is confusing.

2. isn't it the case that both CORESET-based rate matching and RB-level rate matching can be used either with or without additional gNB DCI indication to legacy UEs? A bit puzzled why RB-level is mentioned for the case without DCI indication and CORESET-based is mentioned for the case with DCI indication.

9 – CATT

We don't understand why CORESET 0 would be used for coexistence with SSS-based PEI. We have strong technical concern on the proposed conclusion.

10 – Ericsson India Private Limited

[Q2.1-2]

Same comment as Q2.1-1 for main bullet.

Suggest same update as Q2.1-1 for additional CORESET 0?

OK with latest FFS bullet update from HW.

11 – Spreadtrum Communications

FL-[Q2.1-2]-Spreadtrum-[R-1]

"an additional CORESET 0 provided by additional search space set(s) associated with CORESET 0" could be "a CORESET sharing resource with CORESET 0"

12 – China Mobile Com. Corporation

FL-[Q2.1-2]-CMCC-[R-1]

Support Huawei's update about the last FFS

13 – LG Electronics Inc.

FL-[Q2.1-2]-LG-[R-1]

we support the modified version from Huawei.

14 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are in generally fine with the conclusion. Similarly, it is better to put the "additional CORESET 0" as an FFS.

15 – vivo Communication Technology

For issue 1(i.e., optional UE capability in FR1 for Rel-15 UEs to support more than one additional CORESET to CORESET 0), at least for PDCCH PEI and SSS-like PEI, it is easy to handle since the frequency-time resources for the PEI is contiguously allocated. From network scheduling perspective, the network can handle this easily, e.g., not schedule such UE on the frequency-time resources collided with PEI.

For issues 2 (i.e., CORESET 0 applies interleaved resource allocation, and localized SSS-based PEI will extensively occupy CORESET 0). It seems to be less flexible to put PEI overlap with CORESET 0. To avoid this, other CORESET is also possible for the purpose of coexistence.

16 – PANASONIC R&D Center Germany

1. Behv-A/B can also be configurable in this case to let gNB decide the prioritization, without DCI indication to legacy UEs. Behv-B corresponds to semi-static sharing with PDSCH.

2. *ateMatchPatternToAddModList* should be ***R****ateMatchPatternToAddModList*.

Feedback Form 4: Companies' views and dialogues on FL-[Q2.1-3]

1 – Nokia Germany

We are OK with the proposal FL-[Q2.1-3]

2 – Qualcomm Technologies Int

For "Without additional gNB DCI indication to Rel-15/16 UEs", CORESET and RB-symbol level semi-static rate matching can be used for TRS/CSI-RS based PEI. This may not be the optimal solution for resource sharing between PEI and legacy channels, but it has additional flexibility for the connected mode UE to not exceed the number limit of ZP CSI-RS rate matching resources.

Similarly, for "With additional gNB DCI indication to Rel-15/16 UEs", CORESET based dynamic rate matching can be used for TRS/CSI-RS based PEI.

3 – Samsung Research America

We want to clarify that gNB can support a combination of both. So, we suggest to replace "either" by "any" in the main text.

Two more comments for the second bullet.

1) For the first sub-bullet, legacy UEs can be configured by more than one aperiodic-*ZP-CSI-RS-ResourceSetsToAddMod*
For instance, when FDM is considered to UE subgroup indication.

2) The third sub-bullet seems to be irrelevant for dynamic RM for CSI-RS

4 – HiSilicon Technologies Co. Ltd

[Huawei, HiSilicon]

1) It should be "configuring aperiodic-*ZP-CSI-RS-ResourceSet*" not "aperiodic-*ZP-CSI-RS-ResourceSetsToAddModLis* because PEI may be not transmitted, but other *A-ZP-CSI-RS-Resourceset* may be available. gNB can trigger *aperiodic-ZP-CSI-RS-ResourceSet* respectively.

2) If there is more than one TRS based PEI needs to be transmitted for e.g. multiple PO or multiple sub-groups, the multiple TRS based PEI resource needs to be configured inside the same one *aperiodic-ZP-CSI-RS-ResourceSet* considering the budget of number of *aperiodic-ZP-CSI-RS-ResourceSet*, especially in case of more than 3 subgroups or more than 3 POs need to indicate TRS based PEI.

3) We should make clear that TRS based PEI outside CORESET0 bandwidth shall not be received/-transmitted, considering IDLE mode UE shall not receive the signal outside the bandwidth of CORESET0. This is important because we see some companies gave results based on 48 RB/50RB TRS, which shall not be received by IDLE mode UE in case of 24RB CORESET0 deployement.

4) The last bullet seems have copy and paste error. The "additional CORESET0" should be "aperiodic-ZP-CSI-RS-ResourceSetsToAddModList" according to the following specification text:

When receiving PDSCH scheduled by DCI format 1*0 or PDSCHs with SPS activated by DCI format 1*0, the
REs corresponding to configured resources in aperiodic-ZP-CSI-RS-ResourceSetsToAddModList are available for PDSCH.

Conclusion:

If TRS/CSI-RS-based PEI is selected for Rel-17 paging enhancement, either of the following two schemes for coexistence with legacy Rel-15/16 UEs can be utilized as per network configuration:

· Without additional gNB DCI indication to Rel-15/16 UEs,

o TRS/CSI-based PEI can semi-statically share PDSCH REs of legacy UEs by configuring one *sp-ZP-CSI-RS-ResourceSets~~ToAddModList~~* or *p-ZP-CSI-RS-ResourceSet* in *PDSCH-Config* for legacy UEs

· With additional gNB DCI indication to Rel-15/16 UEs,

o TRS/CSI-based PEI can dynamically share PDSCH resources of legacy UEs by configuring one aperiodic-*ZP-CSI-RS-ResourceSets~~ToAddModList~~* in *PDSCH-Config* for legacy UEs**, which associates the resources of multiple TRS/CSI-based PEI of different POs or sub-groups.**

o When TRS/CSI-based PEI is not transmitted, network can indicate the resources corresponding to the aperiodic-*ZP-CSI-RS-ResourceSets~~ToAddModList~~* are available for PDSCH scheduled by DCI format 1_1

o For PDSCH scheduled by other DCI formats, UE assumes the REs of ~~the additional CORESET 0~~ **corresponding to configured resources in *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*** are always available for the PDSCH

· **TRS/CSI-RS based PEI is not expected to be transmitted/received outside the bandwidth of CORESET0.**

5 – ZTE Corporation

[ZTE, Sanechips]

We are supportive of the conclusion in general. Some minor changes are suggested as below.

(1)We don't think the CORESET can be dynamically shared by TRS-based PEI considering the number of PRB, and resource mapping rule, etc.

(3) A typo. “the REs of the additional CORESET 0” in the last sub-bullet should be “the REs of aperiodic-*ZP-CSI-RS-ResourceSetsToAddModList*

6 – Intel Corporation (UK) Ltd

[Intel]

Our response to FL-[Q2.1-1] covers all three proposals FL-[Q2.1-1] through FL-[Q2.1-3]. Repeated below with relevant parts for the current proposal for convenience:

Given the conclusions from RAN1 #104b-E, it is unclear as to what these observations are likely to achieve towards any meaningful progress.

Nevertheless, some comments to the proposed observations:

· The categorization “w/ or w/o “gNB DCI indication to rel-15/16 UEs” is unnecessary and should be removed. The categorization is basically same as that of semi-static vs. dynamic rate-matching options and some dynamic indication would be expected for the latter.

· “For PDSCH scheduled by other DCI formats” should be changed to “For PDSCH scheduled by ~~other~~ DCI format~~s~~ 1*0” since whatever is possible via format 1*1 is also possible for format 1_2.

· For TRS/CSI-RS, the last sub-bullet should be updated as “For PDSCH scheduled by other DCI formats, UE assumes the REs of ~~the additional CORESET 0~~ **configured resources in *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*** are always available for the PDSCH”.

7 – Apple Italia S.R.L.

We are fine with the conclusion in general, except that ”the REs of the additional CORESET 0” in the last bullet needs to be changed.

8 – CATT

TRS-based PEI has nothing to do with CORESET 0. CATT’s contribution R1-2104532 showed that TRS-based PEI could not only co-exist with PDSCH semi-statically or dynamically but also shared the resource with TRS/CSI-RS used by legacy UE.

9 – Ericsson India Private Limited

[Q2.1-3]

Same comment as Q2.1-1 for main bullet.

Last subbullet : Replace ”CORESET 0” with ”TRS/CSI-RS” ?

10 – China Mobile Com. Corporation

Ok with proposal FL- [Q2.1-3]

11 – LG Electronics Inc.

FL-[Q2.1-3]-LG-[R-1]

support the proposal.

12 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are fine with the conclusion.

13 – PANASONIC R&D Center Germany

Behv-A/B can also be configurable to let gNB decide priority.

2.2 PEI and PO Mapping

The following feedback forms are based on **Section 2.2** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 5: Companies' views and dialogues on FL-[Q2.2-1]

1 – Nokia Germany

We are OK with the proposal FL-[Q2.2-1]

2 – Qualcomm Technologies Int

In "For a target PO, UE is indicated to monitor the PO from one detected PEI", does "one" mean paging indication for the PO is only transmitted in a single PEI? This seems the intension.

3 – Samsung Research America

The proposal looks like supporting UE-specific configuration of PEI. But, only cell-specific configuration is possible for idle mode.

4 – HiSilicon Technologies Co. Ltd

Huawei, HiSilicon: we support the proposal. We agree that the time gap between PEI MO(s) and PO should be taken care of. But, it is not clear whether it is necessary to explicitly introduce it in the specification. Therefore, we would like to make the following revisions:

Proposal:

· For a target PO, UE is indicated to monitor the PO from one detected PEI

FFS: Determination of PEI monitoring occasion(s) (MO(s)), ~~including the range on the time gap between PEI MO(s) and PO,~~ and how UE interprets the detected PEI

5 – ZTE Corporation

[ZTE, Sanechips]

We are okay to formulate the proposal from UE's perspective. However, it is suggested to capture the following note to make it clearer.

Note: the PEI can carry information for one or more POs by network configuration.

6 – Intel Corporation (UK) Ltd

[Intel] Do not agree.

This proposal is no different from saying “1 PEI to N PO mapping is supported with “N” FFS”, just in a more convoluted way. We do not think the proposal moves us forward.

There is no meaningful benefit in supporting the feature of PEI when PEI is associated with multiple POs for a UE. Beyond unnecessarily complicating the design, it undermines the potential of UE power savings since the UE would be “kept awake” or “woken up” for all POs most of the time.

If OH from PEI is a concern for a system, then, PEI can simply be disabled. However, we do not think OH from PEI can be a real concern in any practical system for practical paging rates. For artificially high paging rates leading to extensive paging loads, the appropriateness of paging and DRx cycle configurations for such cases should be examined.

7 – Apple Italia S.R.L.

We are ok with the proposal in principle. But ”from one detected PEI” seems not accurate, because the UE may or may not detect the PEI. The essence is that the UE only monitors one PEI for a target PO, so we suggestion the following:

For each target PO, UE monitors only one PEI occasion.

FFS: Determination of the PEI occasion, and how UE interprets the detected PEI

8 – Ericsson India Private Limited

[Q2.2-1]

We are OK FL proposal with update suggested by Huawei.

9 – Spreadtrum Communications

FL-[Q2.2-1]-Spreadtrum-[R-1]

We are fine for the proposal. It is in high level. ”one detected PEI” can be understood as a sequence for PEI, a bit in PEI PDCCH, a PDCCH PEI.

10 – China Mobile Com. Corporation

Support in general. One question about ”one detected PEI”, does it means the PEI associated with one PO only have one PDCCH monitoring occasion? In current Paging design, one PO consists ”S” PDCCH moitoirng occasions aim for beam sweeping, I wonder if PEI supports beam sweeping as well.

11 – Sony Europe B.V.

FL-[Q2.2-1]-Sony-[R-1] We support this proposal.

12 – LG Electronics Inc.

FL-[Q2.2-1]-LG-[Q-1]

In case of Behv-B, no PEI detection can indicate UE to monitor the PO. Since we have not make decision on UE behavior when it does not detect PEI, main bullet should be adjusted. for example, we can modify the proposal as bellow:

For a target PO, UE is indicated to monitor the PO ~~from one detected~~ based on one PEI

-

FFS: Determination of PEI monitoring occasion(s) (MO(s)), including the range on the time gap between PEI MO(s) and PO, and how UE interprets the detected PEI

13 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are OK with the proposal in principle.

For Behv-A and Behv-B, if UE detects a PEI, whether or not to monitor the PO is different. The "detected" seems to support Behv-A. But we still do not have an agreement on the UE behaviour.

14 – DOCOMO Communications Lab.

We are OK with the proposal FL-[Q2.2-1]

15 – vivo Communication Technology

In principle we are fine. Note that the configuration of PEI occasion should satisfy that the gap between PEI and the first indicated PO contains M SSB bursts, where the value of M can be 1, 2, 3.

16 – PANASONIC R&D Center Germany

We are okay with the proposal.

17 – CATT

We also have the question on " For a target PO, UE is indicated to monitor the PO from one detected PEI". Does it implies that it could be more than one PEI transmitted by gNB or one PEI transmitted from multiple PEI occasions? The intention is not clear. The FFS point would be considered after the main point is clarified.

2.3 Support of Behv-A and/or Behv-B

The following feedback forms are based on **Section 2.3** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 6: Companies' views and dialogues on FL-[Q2.3-1]

1 – Nokia Germany

For proposal FL-[Q2.3-1] we are not sure if we need point a) for the proposal. We are OK with point b) and c).

2 – MediaTek Inc.

FL-[Q2.3-1]-Nokia-[R-1]-FL-[R-1]

Thanks Nokia/Jorma's feedback. Given that PEI monitoring occasion details remains to be designed, we will remove item a) for this proposal.

3 – Qualcomm Technologies Int

For the first bullet "a) A PEI monitoring occasion (MO) is defined as the REs in a slot where UE monitors one PEI for a target PO.", this implies that within a slot, there is no more than one PEI MO. We think this should jointly further discussed with PEI beamforming. I.e., whether PEI from two different beams can be transmitted in the same slot, and whether two PEIs from same beam can be transmitted in the same slot.

For the second bullet "b) UE is not required to monitor the target PO if UE does not detect any PEI from all associated PEI MO(s) for the target PO." This requires the UE to monitor all PEI MO(s) for a target PO. We think which PEI MO(s) the UE wants to detect is up to UE implementation. For example, a UE in good DL channel condition may only decides to detect one PEI MO only in the best beam. Based on this, we do not support b).

For the third bullet, we do not support network configured selection of Behv-A and Behv-B. So we suggest to remove this bullet.

So in general, we do not support this proposal.

4 – Samsung Research America

For a), A MO is time domain concept. There can be multiple MOs within a slot, similarly as SSB. So we suggest to modify a) as a PEI monitoring occasion (MO) is a slot or consecutive symbols within a slot where UE monitors a PEI for a target PO.

For c), we think it's too early to agree on that. We suggest to agree on Behv-A first as no objection for that.

5 – HiSilicon Technologies Co. Ltd

[Huawei, HiSilicon]

In our view, Behv-B is generally needed regardless of the PEI physical layer candidates. Even for TRS based PEI, gNB may still have no resource to transmit TRS based PEI in some cases. However, as compromise, we can live with:

At least for PDCCH-based PEI, network can configure that UE is required to monitor the target PO if UE does not detect any PEI from all associated PEI MO(s) for the target PO.

6 – ZTE Corporation

[ZTE, Sanechips]

In our opinion, the Behave-B can be supported by both DCI-based PEI and sequence-based PEI. And Behav-B has less impact on the delivery of paging message when the transmission other signal/channel is prioritized by network, otherwise, with Behav-A, the network implementation would be limited to always prioritize the PEI transmission to reduce the additional resource overhead and latency of paging message. Moreover, the resource overhead of Behav-A would exceed Behav-B in the case of large paging rate. Hence, Behav-B is needed for both sequence based PEI and PDCCH based PEI. If we have to make a compromise, we can only go with the suggestion by Huawei with the following update

At least for PDCCH-based PEI, network can configure that UE is required to monitor the target PO if UE does not detect any PEI from all associated PEI MO(s) for the target PO.

FFS: for sequence-based PEI.

7 – Intel Corporation (UK) Ltd

[Intel]

We can agree to bullets a) and b). We do not see anything changing for PDCCH-based PEI to justify Behavior-B. It should be clarified if there is any technical significance of PDCCH-based PEI to justify bullet c).

The categorization of company preferences actually indicates that Behavior-A-only is the preference even for multiple companies supporting PDCCH-based PEI, and this further corroborates the above point.

Further, our reading of proposals from **Panasonic** does not indicate that they support Behavior-B (perhaps they can confirm this further). Their "Proposal 3" is referring to a scenario when the PEI configuration itself does not apply. We need to first discuss whether to optimize for such scenarios and how. So, their "Proposal 3" should not be interpreted as being supportive of "Behavior-A and Behavior-B".

8 – CATT

The proposal is not clear. Behv-B would not work in the practical deployment since it forces network to send the PEI to all cells within registration area at one time.

For PEI monitoring occasion, it is not frequency resource allocation but a time domain resource allocation. Thus, bullet (a) is NOT technical correct.

We have not decided if only one or more than one PEI occasion is configured for each PO at each DRX cycle. How PEI is configured in single beam, multi-beam configuration, and multiple paging PDCCH monitoring occasion within a PO needs to be discussed first.

Thus, bullet (b) is not clear from different system configuration

Bullet (c) is not needed since we have not decide the PEI candidate yet.

9 – Apple Italia S.R.L.

The first bullet seems a bit problematic considering multi-beam operation.

We share the concern from QC on the 2nd bullet because it seems to imply that the UE needs to detect the PEI in all the beams in multi-beam operation, even though I believe that is not the intention.

We still do not see the need to make it configurable between Behv-A and Behv-B. Behv-A should be sufficient because the overall PEI overhead is quite small even considering high paging load.

10 – Ericsson India Private Limited

OK to delete a) for now.

OK with b).

For c), Behv-B is important to reduce OH from NW perspective - so it should be supported. We are OK with suggested updated wording from Huawei or ZTE.

11 – Spreadtrum Communications

FL-[Q2.3-1]-Spreadtrum-[R-1]

For a), MO is a time domain concept, so "REs" should be changed to like "symbol"

For b) and c), they are related to Behv-A and Behv-B. In our view, Behv-A is too optimistic for resource sharing assuming the dynamic resource sharing in CORESET0. In the worst case, it will double the resource

for paging PDCCH. In multi-beam deployment, paging PDCCH may have resource overhead issue due to beam sweeping, where a round of beam sweeping may not complete in a slot and the number of PO in a PF is restricted. Some gNB vendors have expressed the strong concern of resource overhead for Behv-A. The WUS of eMBB is highly different from that of NB-IoT in which PO is sparse in real deployment. On the other hand, in our view, Behv-A and Behv-B are mainly used for evaluation purpose. In R16 WUS for connnected mode, Behv-A and Behv-B can be controled by gNB by a high layer parameter. This principle can be reused for R17 PEI design. We suggestv combining b) and c) and changing to ”network can configure that whether UE is required to monitor the target PO or not if UE does not detect any PEI from all associated PEI MO(s) for the target PO”.

12 – Nordic Semiconductor ASA

a) what is MO is already clear from current spec, so this point is not needed

b) OK

c) Huawei wording is preferred

13 – China Mobile Com. Corporation

Support in general.

Also support consider Behv-B for sequenence-based PEI.

14 – Sony Europe B.V.

FL- [Q2.3-1] -Sony-[R-1]

We are fine with (a) and (b), but we DO NOT support (c). Candidate design for PEI are not decided yet.

15 – LG Electronics Inc.

FL-[Q2.3-1]-LG-[R-1]

as pointed out several company, (a) can be removed in this proposal.

We are fine with (b).

For (c), updated version from Huawei is preferred.

16 – Guangdong OPPO Mobile Telecom.

[OPPO]

1) For b), does it mean UE monitor the target PO under Behv-A?

2) For c), it seems UE monitor the target PO under Behv-B if b) is not supported at the same time. When b) is also supported, it seems UE always monitor the target PO.

3) It is too early to agree on b) and c), they should be discussed after determining the UE behaviour. If both Behv-A and Behv-B are supported in the last, there is necessary to add a note “b) and c) can not be configured at the same time”.

17 – vivo Communication Technology

It is confused to us for subbullet b) and c), does it mean to down select from them or for other intention, e.g., configurable? Since UE behaviour for b) and c) are contradict to each other.

To make a choice , it is important to know the pros and cons of each alternative. Based on our evaluations, behaviour B will consume 64.6% 80% more resources than Behavior A to achieve the same power saving gain in the low per PO paging rate cases (e.g., 10% paging rate is endorsed by all companies in R16 power saving WI). In addition, when the per PO paging rate is high, it has be no benefits for power saving by using PEI BehavB.

Hence, we only support a) and b) unless clearly benefits are identified.

18 – DOCOMO Communications Lab.

We are fine with (b).

For (c), we support updated version from Huawei.

In the case other signal/channel rather than PEI is prioritized by network, Behav-B is needed for both sequence based PEI and PDCCH based PEI to has no impact on default paging performance.

19 – PANASONIC R&D Center Germany

It is better to clarify the technical merits to conditionally support Behv-B only for PDCCH-based PEI. We are supportive of Behv-A and B regardless with PDCCH or sequence-based PEI.

2.4 Further PEI Characteristics/Comparisons without UE Sub-Grouping

The following feedback forms are based on **Section 2.4** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 7: Companies' views and dialogues on FL-[Q2.4-1]

1 – Qualcomm Technologies Int

Thanks FL for summarizing companies' results. We think the summary does not really reflect the entire picture of different candidate solutions.

For example, PDCCH based PEI can have a power saving gain as high as 37.0%. However, the company who submitted this result did not provide results for TRS/SSS based PEIs. We have to assume that different companies results can be different even for the same intended simulation setup and PEI candidate. Then it is not meaningful to compare one company's result PEI design A (e.g., PDCCH based) and another company's PEI design B (e.g., SSS based).

2 – Samsung Research America

Our results for 2/3 SS bursts before PO were not captured. First, we want to clarify that the number of SS bursts before PO should be the configuration for baseline, i.e. legacy case without PEI. Because, the time alignment between PEI and PO are depends on L1 signal/channel design of PEI. We understand for PDCCH based design, it's ideal to consider a big gap between PEI and PO when more SSBs are needed for synchronization. But, that's the necessary for RS based PEI. The large gap between PEI and PO could results multiple wake-up times or large wake-up duration, which is not ideal for UE power saving.

Also, we have same PSG results for SSS based PEI and TRS/CSI-RS based PEI as they both are RS based PEI based on non-coherent detection.

3 – HiSilicon Technologies Co. Ltd

Some companies assume sequence based PEI can replace one or more SS bursts for time/frequency tracking. However, we don't think it is true for the simulated sequence based PEI. For example:

1) For SSS based PEI, companies assume 2 symbol of SSS for PEI. However, one SSB has 4 symbols transmission. Threfore, a 2-symbol SSS based PEI cannot have the same time/frequency performance as that of one SSB. We didn't see any simulation to support this.

2) For TRS based PEI, 48RBs or 50 RBs in one slot are assumed. However, we need to emphasize, in Rel-15 for FR1, two slots TRS is needed for time/frequency tracking. Also, regarding the frequency domain, IDLE mode UE shall not receive signals outside the bandwidth of CORESET0. There are several cases supported in Rel-15 to have 24 RB CORESET0. In case of 24RB CORESET0 deployment, 50RB TRS cannot be used anymore. in this case, it is difficult to say TRS inside CORESET0 bandwidth and one slot can replace two or three SS bursts for time/frequency tracking. At least this is not justified. Furthermore, we want to also point out that at least based on HW's results and Samsung's results, it shows that 24RB TRS even cannot fulfill the link level performance requirement of PEI.

3) Some companies proposed TDM+FDM pattern with CDMed cover code to support multiple sub-groups. However, according to our understanding, it requires more strict requirement on the orthogonality if CDMed cover code is introduced. In this case, can the CDMed RS based PEI still work with loosen time/frequency accuracy? We didn't see any support on this.

4 – ZTE Corporation

[ZTE,Sanechips]

Regarding the comments from Samsung that "We understand for PDCCH based design, it's ideal to consider a big gap between PEI and PO when more SSBs are needed for synchronization. But, that's the necessary for RS based PEI. The large gap between PEI and PO could results multiple wake-up times or large wake-up duration, which is not ideal for UE power saving", we have to say that we have different views.The power saving gain from RS based PEI with a small gap between PO is that it is assumed that the RS based PEI can be used to replace two SSB for synchronisation. However, in our understanding, the sequence-based PEI is not an always-on signal as SSB, UE needs to detect the sequence-based PEI by blind detection. If gNB does not send the sequence-based PEI but FAR occurs, the UE would take noise as PEI and use it for synchronization, which will degrade the synchronization performance of the entire system and more SSBs are needed for synchronization compensation in the next paging cycle. Hence, it seems questionable to assume RS based PEI can replace SSB for synchronization.

On the other hand, if SSB is used for synchronization, two symbols comprising SSS and PSS are utilized. If DMRS in the PBCH is further considered, more accurate synchronization can be provided. Therefore, even if the sequence-based PEI with **more than 2 symbols** can provide the synchronization function, no more than one SSB can be replaced considering the comparable number of symbols and REs.

5 – CATT

We have commented that 1 or 2 SSBs for DCI-based PEI is not a realistic assumption. From RAN4 LS on LS on temporary RS for efficient SCell activation in NR CA in R1-2104170, RAN4 states that AGC and time acquisition could not be done within one SSB as follows,

Minimum gap between the RS symbol(s) for AGC and the RS symbols for time/frequency acquisition is needed to account for UE AGC application time delay. The minimum gap length is,

Option 1: 2 slots

Option 2: 2 ms

Another assumption made by DCI-based PEI to back to sleep after 1st SSB with high SINR is also contradict to RAN4 response since UE could not achieve time/frequency synchronization after 1st SSB.

6 – Apple Italia S.R.L.

Even though the proposal collected the evaluation results from all the companies, it can be difficult to compare the different options because we do not know e.g. whether 14.8% for PDCCH and 15.4% for TRS/CSI-RS correspond to the same simulation setup or not. To make it easier to interpret, it may be helpful to collect the relative power saving difference between different options when the same setup is used by the same company.

We also have some reservation on assuming that e.g. TRS can replace 2 SSBs to achieve the same time/freq tracking accuracy. There is also the effect of blind detection of TRS, which could create issue for the tracking loop if there is a false alarm. We have agreed not to support blind detection of TRS/CSI-RS in AI 8.3.1.2, and it would make sense that we stick with the same principle here because the issues are the same (blind detection complexity and performance).

7 – Ericsson India Private Limited

OK.

8 – Spreadtrum Communications

FL-[Q2.4-1]-Spreadtrum-[R-1]

For the potential issue of large gap b/w PEI and PO for 1 to N mapping, in our evaluation, the reduction of the power saving gain is slight, since in the gap UE can stay in light sleep which has small power consumption.

For SSS based PEI, it may not provide the fine frequency tracking, because the fine frequency tracking needs the wideband TRS with multi columns.

9 – Sony Europe B.V.

FL-[Q2.4-1]-Sony-[R-1]

Looking at the "Note", *this is not a fair energy saving comparison* as it does not capture the important advantage of sequence-based signal, i.e. they can be detected non-coherently. The assumption basically says all the signals need to be detected coherently since one SS burst can be received for time-frequency synchronization before detecting PEI. For this reason, the power saving gains of the three designs become very similar to each other. However, in practice, sequence-based signals can be detected/decoded non-coherently which consequently reduces the total monitoring energy cost and thereby results in a higher power saving gain compared to a DCI-based PEI.

10 – vivo Communication Technology

In principle we can agree with the observation.

11 – ZTE Corporation

[ZTE, Sanechips]

In response to the companies' views that the power saving gain from sequence based PEI would be larger due to the non-coherent detection, we need to note that UE detects PEI once per paging cycle, the contribution of PEI detection with a smaller bandwidth should be pretty small compared with the ramp-up/ramdown(450 units of power), RRM measurement,etc. Similar observations are drawn in Apple's Tdoc.

Moreover, many companies assume that the RB occupied by TRS-based PEI is 48, or 50 RBs, which would be largest among the three candidates, hence, the detection power consumed by TRS based PEI should be the largest, which would potential results in the least power saving gain.

Regarding the detection method of PDCCH based PEI, a CORESET with narrow bandwidth can be considered. Furthermore, if the payload size is small (for example, no less than 12), ML decoding instead of Polar code decoding can be applied, which can further reduce the detection complexity/power and also improve the performance, as it is provided in our Tdoc.

3 Physical-Layer Designs and Comparison with UE Subgrouping

3.1 Subgroups Indication Design

The following feedback forms are based on **Section 3.1** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 8: Companies' views and dialogues on FL-[Q3.1-1]

1 – Nokia Germany

We would be OK with Proposal 7 in FL summary.

For proposal FL-[Q3.1-1] point a), just a note that for the second sub-bullet, I read it as the intention is to support 'one bit maps to one sub-group, but the order of words is bit confusing for me:

- Support ~~O~~one bit in the DCI payload indicating one UE subgroup ~~is supported~~

2 – MediaTek Inc.

FL-[Q3.1-1]-Nokia-[R-1]-FL-[R-1]

Thanks Nokia/Jorma's feedback and sorry for missing Proposal 7 (there should be an additional tag [Q3.1-0] for it). On FL-[Q3.1-1], we will revise 2nd subbullet of a) as suggested:

- Support one bit in the DCI payload indicating one UE subgroup

3 – Qualcomm Technologies Int

For "b) If TRS/CSI-RS-based PEI or SSS-based PEI is selected for Rel-17 paging enhancement, o One PEI indicating one PO or one UE subgroup is supported", we think there exists design that can use a common sequence to indicate more than one UE sub-groups is paged. So the sub-bullet of b) is not exactly correct.

4 – Samsung Research America

For the results in last meeting, we didn't really discuss how to indicate UE subgrouping for different L1 signal/channel design, especially for RS based solution. We cannot agree on the b) and c). The detailed methods for indicating UE subgrouping should be clarified in b) based on contributions submitted to this meeting.

5 – HiSilicon Technologies Co. Ltd

[Huawei, HiSilicon]

We are OK for proposal 7.

For FL-[Q3.1-1], actually we think we can just take care of how many bits needs to be transmitted to support the desired sub-group number. and how many bits one PEI can carry. Based on this, we can make the comparison among candidates.

Regarding details on how to encoding the sub-groups/POs into the carried bits of PEI, we think the three candidates needs to be at least aligned to make fair comparison.

As a baseline, one bit per one sub-group should be taken as the baseline for comparison of three candidates. E.g. if 8 sub-groups needs to be supported for each PO, that means 8 bits need to be carried for a PO by PEI, let's compare the required the resource overhead of three candidates to indicate 8 bits for a PO.

6 – ZTE Corporation

[ZTE, Sanechips]

In addition to the listed bullets, it would be helpful to agree on how many sub-groups to be carried by PEI.

Regarding how to carry sub-group information by sequence based PEI, there can be different alternatives. However, if we consider CDM based method, the performance would be degraded; if a common group based PEI is considered, the false alarming rate will increased (as shown in the table in FL summary), which would decrease the PS gain. As a results, we think the "One PEI indicating one PO or one UE subgroup is supported" is a proper way to be considered.

7 – Intel Corporation (UK) Ltd

[Intel]

Feedback on Proposal 7:

Proposal 1 in Intel's tdoc is missed:

Proposal 1: A maximum of 4 sub-groups per PO is preferred. Considering feedback from RAN2, at most 8 sub-groups may be supported per PO.

So, Intel should be counted within the group of companies in row #3.

Especially since RAN2 has left the decision to RAN1, we prefer to seriously consider whether even 8 is necessary. Based on our analyses and from others, it should be clear that the power saving gains saturate very fast. Thus, we suggest to consider a maximum of 4 subgroups per PO as a working assumption and send an LS to RAN2 to inform them of the same.

Feedback on Proposal in FL-[Q3.1-1]:

Do not agree.

We strongly disagree with limiting the capacity of sequence-based PEI to 1 bit. The reasoning given (based on what was assumed for simulations reported by companies!!!) is fundamentally wrong. It is unfortunate to see some selected simulation assumptions being used to justify capability of a design principle when there

exists multiple results establishing feasibility of supporting much more than 1 bit capacity and discussions on various ways to support multi-bit indication capabilities in company tdocs and email discussions.

8 – CATT

In CATT contribution R1-2104532, our TRS-based PEI design with orthogonal cover could support up to 2^22 (2048x2048) subgroups or subgroups in combination. Please update the results based on RAN1#105-e contribution.

9 – Apple Italia S.R.L.

We are fine to support up to 8 sub-groups (Proposal 7) if PDCCH-based PEI is adopted. However, if the sequence-based PEI is adopted, it is not clear that we have to support 8 sub-groups or not. At least the design may not be very friendly for supporting a large number of sub-groups.

10 – Ericsson India Private Limited

P7 - We support.

For TRS/CSI-RS, what is the meaning of one PEI? Is it one detected sequence which yields one or more PEI indications?

[Q3.1-1]

Sub-bullet update suggested from FL looks OK.

Question - Does the FFS part apply to both a) and b) ? If so, what does it mean for a)?

11 – Spreadtrum Communications

FL-[Q3.1-1]-Spreadtrum-[R-1]

In our view, PDCCH-based PEI can be understood as a PDCCH or a bit in PDCCH PEI. So, we can avoid using PDCCH-based PEI in detailed description, so ”Subgroups in a PO are indicated by one PDCCH-based PEI” can be removed, since the next sentence has the clear meaning.

12 – China Mobile Com. Corporation

Support FL-[Q3.1-1]

13 – Sony Europe B.V.

FL-[Q3.1-1]-Sony-[R-1]

Item (c) is not very clear. We suggest the following modification:

If SSS-based PEI is selected for Rel-17 paging enhancement:

- Subgroups in a PO are indicated by time/frequency/code multiplexing of SSS-based PEI.
- One bit (information) represented by one SSS-sequence indicating one UE subgroup is supported.

14 – LG Electronics Inc.

FL-[Q3.1-1]-LG-[R-1]

support the proposal.

15 – LG Electronics Inc.

Sorry for spamming. please ignore my previous comment.

FL-[proposal 7]-LG-[R-1]

We support proposal 7.

FL-[Q3.1-1]-LG-[R-1]

We support the proposal and also fine with Nokia's modification.

For b), we suggest modification for the sub-bullet as bellow:

One ~~PEI~~ sequence indicating one ~~PO~~ UE group or one UE subgroup is supported.

16 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are OK with the proposal.

17 – vivo Communication Technology

We have different opnions to b) of the proposal. Based on Observation 2a agreed in RAN1 #104-bis-e for Behv-A, UE (sub)group indication capacity per sequence-based PEI can be 1 bit, however it should not be regarded as "One PEI indicating one PO or one UE subgroup". As we analysed in our contribution for several meetings, sub-grouping method introduced in Rel-16 NB-IoT can save the number of candidate sequences by defining a "common sequence" representing the case that no less than two sub-groups need to be paged as depicted in Table 1 in R1-2106011. And the additional false alarm rate caused by the common sequence is proven to be marginal. **The most important thing is that UE only needs to detect the following two sequences of PEI per PEI occasion and the two sequences can be identified as the two codepoints of 1 bit for UE (sub)group indication capacity per sequence-based PEI.**

- **Codepoint 1: The sub-group specific sequence, to indicate only the sub-group which the UE belongs to receive paging, and**

- **Codepoint 2: The common sequence, to indicate no less than two sub-groups to receive paging.**

So we suggest to modify it as follows:

FL-[Q3.1-1]

Proposal:

a) If PDCCH-based PEI is selected for Rel-17 paging enhancement,

o Subgroups in a PO are indicated by one PDCCH-based PEI

o One bit in the DCI payload indicating one UE subgroup is supported

b) If TRS/CSI-RS-based PEI or SSS-based PEI is selected for Rel-17 paging enhancement,

o One PEI indicating one PO ~~or one UE subgroup~~ is supported

o One PEI can indicate one or more subgroups is supported

c) FFS: Whether and how code-point based mapping is utilized for paging indication to subgroups in a PO

18 – DOCOMO Communications Lab.

We are OK with the proposal.

19 – PANASONIC R&D Center Germany

It is suggested to modify to "one or more UE subgroups" in the sub-bullets of both a) and b)..

3.2 PEI Comparisons with UE Sub-grouping Enhancement

The following feedback forms are based on **Section 3.2** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 9: Companies' views and dialogues on FL-[Q3.2-1]

1 – Nokia Germany

We are OK with proposal FL-[Q3.2-1]

2 – Qualcomm Technologies Int

We are fine with the proposal.

3 – Samsung Research America

The maximum UE subgroup size should be clarified for PEI only.

4 – ZTE Corporation

[ZTE, Sanechips]

We are supportive of the proposal.

5 – Intel Corporation (UK) Ltd

[Intel]

If we are to support as large as 8 sub-groups, we think the option of splitting the indication between PEI and paging DCI should be supported. So, at this stage, we cannot agree to the proposal.

We evaluated different assumptions that are reflective of indicating a varying numbers of subgroups via the PEI with the rest being indicated via the paging DCI, and also showed feasibility of sequence-based PEI by evaluation of the extreme case of indicating all sub-groups by PEI. However, we are being classified under "all associated subgroups to one PEI", aiming to imply support for "subgroup indication by PEI only".

Some parts from our contribution relevant to this Proposal are from Section 6 of our tdoc that probably got missed. it would be great if they are captured above accordingly – from Observation 12 till Proposal 4, including Table 3. Proposal 4 copied below for convenience:

Proposal 4: Both PEI and paging DCI may jointly indicate UE sub-grouping information, especially when number of sub-groups is large and PEI is sequence based.

6 – CATT

We can NOT agree on this proposal. Paging subgrouping indication could be supported by either PEI or paging DCI. There is no justification to be supported by PEI only.

7 – Apple Italia S.R.L.

We are fine with the proposal.

8 – Spreadtrum Communications

FL-[Q3.2-1]-Spreadtrum-[R-1]

We are basically fine with the proposal.

9 – China Mobile Com. Corporation

Support FL-[Q3.2-1]

10 – Nordic Semiconductor ASA

We support the proposal. We think it is well justified, because if sub-group wake-up is in PO there is no power saving from sub-grouping itself, because UE has to anyway synchronize to receive both PDCCH and PDSCH within PO. Maybe CATT could remind us what are the benefits of sub-grouping if they are in Paging DCI, i.e. how UE can save power.

11 – Sony Europe B.V.

FL-[Q3.2-1]-Sony-[R-1]

We are fine with this proposal.

12 – LG Electronics Inc.

FL-[Q3.2-1]-LG-[R-1]

We are supportive of the proposal.

13 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are fine with the proposal.

14 – DOCOMO Communications Lab.

We are fine with the proposal.

15 – vivo Communication Technology

We can agree with the proposal. To clarify our view on sub-grouping indication, we made some correction of summary table and upload to the draft folder. We (vivo) support sub-grouping indication carried by **sequence-based PEI**.

16 – PANASONIC R&D Center Germany

It is premature to agree on this.

4 Further Specification for PEI candidates based on PDCCH, TRS/CSI-RS and SSS

The following feedback forms are based on **Section 4** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 10: Companies' views and dialogues on FL-[Q4-1]

1 – Nokia Germany

For proposal FL-[Q4-1] we are not sure if we need to define a monitoring time window, it might be better to consider just monitoring time/occassion(s). In my understanding we don't have 'time window' for paging, albeit we have definition of PO (as a function of PDCCH monitoring occassions associated to one PO). Thus we would suggest to use for example "monitoring occassion time location".

Also for the FFS bullet, I would prefer to remove the "time window" or replace it with more generic term (e.g. monitoring occassion). In addition the time offset related to the monitoring occasion definition could be from PF, rather than from SSB. Using SSB as reference seems counterintuitive as we would need to then indicate/determine the specific SSB burst prior PF/PO.

2 – MediaTek Inc.

FL-[Q4-1]-Nokia-[R-1]-FL-[R-1][Q-1]

Thanks Nokia/Jorma's feedback. We use "time window" because there may require UE to monitor multiple MOs because of beam sweeping. Generically speaking, these are "monitoring time constraint(s)" with which we can revise bullet b) with more generic wording. Do you think the following revision is good for you:

...

b) **Monitoring time constraint(s)** including, **e.g.,** time gap between PEI and the target PO, **monitoring time granularity of PF, slot, or symbol**, and time offset to a SS burst before PEI.

3 – Qualcomm Technologies Int

We are fine with the proposal.

4 – Samsung Research America

We are not clear why need to support both. For a) how can UEs associated with different POs determine association PEI MO to monitor?

5 – HiSilicon Technologies Co. Ltd

Huawei, HiSilicon: We support the proposal. it would be better to also mention that the PEI is shortly after a SS burst considering the power saving gain basically comes from that.

Proposal:

UE determination of PEI monitoring occasion(s) (MO(s)) for a target PO is specified by both of the following:

a) Possible PEI MOs broadcasted by gNB via system information

b) A monitoring time window before the target PO **and after a SS burst**

o FFS: Description on the time window, e.g., including minimum time gap between PEI and the target PO and whether and how to specify time offset from a SS burst.

6 – ZTE Corporation

[ZTE, Sanechips]

We are supportive of the proposal. Regarding whether to limit the window after SSB, our understanding is that if the PEI carries information for multiple PO, the SSB before PO may be different for UEs detect different POs. Hence, we think we can further decide whether and how to specify time offset from a SS burst after the demination of SSB before PO is clear.

7 – Intel Corporation (UK) Ltd

[Intel]
Same view as Samsung - why two mechanisms are necessary needs further justification.

8 – CATT

We have concern on the proposal. PEI frequency resources information could be configured by system information. However, the time domain PEI monitoring occasion needs to be associated with each paging occasion within a DRX cycle. Since the paging occasion is derived based on configured parameters and UE ID, it is not possible to have PEI resource information by system information and window without any association with UE ID.

9 – Apple Italia S.R.L.

The two options are not entirely clear to us.

We think some broadcast information will always be needed, and it is just a matter of what is broadcast and how the UE determine the PEI MOs. But in any case, the UE would determine one PEI MO corresponding to one PO. In case of multi-beam operation, there is one PEI occasion in each beam. UE may choose to monitor only a single beam or multiple beams depending on the RF. The monitoring time window in option b) may imply that the UE needs to sweep within a time window even if the UE just monitors a single beam.

10 – Ericsson India Private Limited

OK with proposal.

11 – China Mobile Com. Corporation

Same question as Samsung and Intel, how both methods work together.

12 – Sony Europe B.V.

FL-[Q4-1]-Sony-[R-1]

We are fine with this proposal.

13 – LG Electronics Inc.

FL-[Q4-1]-LG-[R-1]

We are fine with the proposal in principle, but the meaning of "window" is confusing for us. Instead, for example, "bundle of PEI monitoring occasions" or "PEI Occasion" can replace the word "window".

14 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are fine with the proposal.

15 – vivo Communication Technology

For **FL-[Q4-1] Proposal,** besides system information, we think it is also possible for possible PEI MOs be configured without via system information. For example we can define a rule for UE associated with certain PO to find its associated PEI MOs. Such mechanism relies less on system information is much easier and robust. Hence, we suggest to open for this discussion:

FL-[Q4-1]

Proposal:

UE determination of PEI monitoring occasion(s) (MO(s)) for a target PO is specified by both of the following:

a) **FFS:** Possible PEI MOs broadcasted by gNB via system information **or not**

b) A monitoring time window before the target PO

o FFS: Description on the time window, e.g., including minimum time gap between PEI and the target PO and whether and how to specify time offset from a SS burst.

16 – PANASONIC R&D Center Germany

We are okay with the proposal.

Feedback Form 11: Companies' views and dialogues on FL-[Q4-2]

1 – Nokia Germany

For FL-[Q4-2], just for clarity it might be best in point a) refer to 'TRS availability information' as TRS information is more generic and could be understood also relate to the configuration:

a) TRS availability information for idle/inactive-mode UEs

Regarding point b), we are not really convinced that we should reserve bits for this in EPI. In both cases, further action from UE is required i.e. reading the SIB(s), thus power saving based on EPI in this context seems irrelevant. Also noting that network could map more POs to one PEI e.g. with 6 sub-groups each. Hence we would think point b) could be further discussed.

2 – MediaTek Inc.

FL-[Q4-2]-Nokia-[R-1]-FL-[R-1][Q-1]

Thanks Nokia/Jorma's feedback. On sub-bullet a), we will further revise TRS information to TRS availability information.

On subbullet b), proponents of including indication for SI update/ETWS think this type of indication will last for a long time. Separating the indication help UEs to avoid dummy wake-ups. To move forward, we can first put it as FFS, and proponents are welcome to continue the dialogue on clarifying the need and benefit of including additional indication for SI update/ETWS.

By the above, companies please check if the following revision can be good for you:

FL-[Q4-2]

If PDCCH-based PEI is selected for Rel-17 paging enhancement, the following additional indications are supported:

a) TRS **availability** information for idle/inactive-mode UEs

-

Up to [2] bits and indication detail should be designed in Agenda Item 8.7.1.2

b) **FFS whether and how to include indication for SI update and/or ETWS**

3 – Qualcomm Technologies Int

We do not support this proposal for the following reasons:

For a), it is not preferred to couple the TRS for idle/inactive feature with PEI feature.

For b), the benefit is unclear for additional design efforts and implementation complexity.

4 – Samsung Research America

We don't support this proposal.

For a), we don't agree to couple PEI with TRS availability indication. Both functionalities are based on on-demand transmission, the combination could increase gNB signaling overhead.

For b), we are not convinced to support it by the cost of large DCI size. we think the PSG is very limited.

5 – HiSilicon Technologies Co. Ltd

[Huawei,HiSilicon]

We support the update from Moderator. To resolve Qualcomm's concern, we can add "if assistance TRS occasions are configured" as a condition for bullet a).

6 – ZTE Corporation

[ZTE, Sanechips]

We are supportive of carrying TRS availability information and SI update indication and/or ETWS indication via PEI. However, we think the number of bits for TRS availability information should not limited to 2 as the payload size of PDCCH based PEI has not been determined. Regarding whether to carry SI update and ETWS indication, our understanding is that without that information in PEI, UE has to detect PO for the information update, which would defeat the power saving gain from PEI. Hence,we suggest to update the proposal as below

If PDCCH-based PEI is selected for Rel-17 paging enhancement, the following additional indications are supported:

a) TRS information for idle/inactive-mode UEs

· FFS number of bits

· Indication detail should be designed in Agenda Item 8.7.1.2

b) SI update indication and/or ETWS indication

· FFS number of bits and detailed content design

7 – Intel Corporation (UK) Ltd

[Intel]

Do not agree.

Same view as Samsung, Qualcomm on coupling two different features. The benefit and need for the rest (bullet b) can be discussed at a latter stage.

8 – CATT

We object this proposal. PEI could not indicate the ETWS information separately. ETWS information is a large size of broadcast information (larger than paging message). The PDSCH resource carrying ETWS would be scheduled by paging DCI.

9 – Apple Italia S.R.L.

We are generally fine with the updated proposal from the moderator. But we prefer to put ”X” bits instead of ”2”, with the value of X FFS. This depends on the discussion in AI 8.7.1.2.

10 – Ericsson India Private Limited

The two features (PEI and TRS availability indicator) can operate independently, i.e. including availability indicator in Paging DCI should be allowed in any case regardless. . While coupling these two (PEI and TRS availability in PEI) should be possible, but it should not be mandated, i.e. NW can configure whether PEI carries TRS availability indicator.

11 – China Mobile Com. Corporation

a) Support carrying TRS information.

b) Don’t support, the motivation is not strong.

12 – Nordic Semiconductor ASA

We are fine with updated FL proposal

13 – Sony Europe B.V.

FL-[Q4-2]-Sony-[R-1]

We do not support this proposal, we suggest to decide on this after decision on PEI design is finalized.

14 – Guangdong OPPO Mobile Telecom.

[OPPO]

Whether or not the additional indication should be supported need to FFS.

We suggest to postpone it until the DCI format is determined (if PDCCH-based PEI is selected).

15 – DOCOMO Communications Lab.

We are fine with updated FL proposal.

For a), We prefer to use put ”X” bits instead of ”2.

16 – vivo Communication Technology

For **FL-[Q4-2] Proposal,** whether TRS availability indication carried by PEI should be decided in AI 8.7.1.2.

17 – PANASONIC R&D Center Germany

1. Okay with a).
2. We have not discussed b) so a bit too early for that. But we are open to discuss if time allows.

Feedback Form 12: Companies' views and dialogues on FL-[Q4-3]

1 – Nokia Germany

We are OK with proposal FL-[Q4-3]

2 – Qualcomm Technologies Int

In ”Alt 3: Create a new DCI format with P-RNTI for Rel-17 paging enhancement”, the RTI should be FFS.

3 – HiSilicon Technologies Co. Ltd

[Huawei, HiSilicon]

Maybe we don't need to restrict the RNTIs for the time being. At least the above DCI formats can be utilized.

4 – ZTE Corporation

[ZTE, Sanechips]

The P-RNTI is fixed in spec (instead of configured by network), hence, regarding Alt3, we think clarification is needed as to “a new DCI format with P-RNTI”, does it imply to extend the value range of P-RNTI or make sure the new DCI format can co-exist with DCI format 1-0 scrambled by the unique P-RNTI? Before it is clear, we think it's better to leave RNTI in alt3 as FFS.

5 – Intel Corporation (UK) Ltd

[Intel]

Can be postponed to a latter point in time when we have better clarity on the rest of the open issues.

6 – CATT

We don't see the need to discuss the RNTI and DCI format before PEI candidate is finalized. First of all, Inactive UE needs to monitor both P-RNTI for paging and C-RNTI for short data transmission in Inactive mode (RAN2#101 agreements). Thus, the use of RNTI needs to be carefully discussed if DCI-based PEI is selected.

7 – Apple Italia S.R.L.

We are fine with the proposal.

8 – Ericsson India Private Limited

OK to leave RNTI as FFS.

9 – China Mobile Com. Corporation

OK in general, RNTI can be FFS.

10 – Sony Europe B.V.

FL-[Q4-3]-Sony-[R-1]

Agree with CATT. We suggest to decide on this after PEI design is finalized. We also think we should have a different RNTI for this PEI.

11 – LG Electronics Inc.

FL-[Q4-3]-LG-[R-1]

Fine with the proposal, but as pointed out several companies, RNTI can be discussed later.

12 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are OK with the proposal.

13 – vivo Communication Technology

For FL-[Q4-3] Proposal Alt 1, not sure why coexistence with connected-mode UE utilizing DCI format 2_6 should be ensured. Since the DRX cycle for IDLE and connected mode are totally different.

14 – DOCOMO Communications Lab.

We are OK with the proposal. RNTI should be FFS.

15 – PANASONIC R&D Center Germany

Lets firstly figure out how many bits we need for PEI, then decide PDCCH, TRS/CSI-RS, or SSS-based design and then go for this level of details.

Feedback Form 13: Companies' views and dialogues on FL-[Q4-4]

1 – Nokia Germany

For proposal FL-[Q4-4] it would be good to clarify here that there should not be any change required to the legacy/other cells when/if sequence based PEI is introduced in some cells. I.e. fully orthogonal operation should be enabled.

2 – MediaTek Inc.

FL-[Q4-4]-Nokia-[R-1]-FL-[R-1][Q-1]

Thanks Nokia/Jorma's feedback. Since the description already requires no impact to legacy UE, this will also imply no impact to legacy network operations. **To address network side of concern, is there any specific requirement on the sequence generation design for sequence-based PEI?**

3 – Qualcomm Technologies Int

For "If TRS/CSI-based PEI or SSS-based PEI is selected for Rel-17 paging enhancement, FFS sequence generation with P-RNTI and subgroups indication, subject to no impact to legacy serving-cell and neighbour-cell UEs.", it is not clear why P-RNTI should be used to generate the sequence. Suggest to remove this wording and replace it "other information if necessary".

4 – Samsung Research America

We share similar view as QC, it's not clear why P-RNTI is needed for sequence generation. In addition, we prefer more discussion on UE subgroup indication in this meeting.

5 – HiSilicon Technologies Co. Ltd

[Huawei, HiSilicon]

We don't want to accept any new sequence or pattern design to increase the UE and network complexity. Any PEI design needs reuse the legacy sequences and RS pattern of SSS or TRS. We should make this clear in the proposal.

6 – ZTE Corporation

Clarification is needed with regard to "sequence generation with P-RNTI". New sequence generation and pattern should be excluded for the SSS-like, CSI-RS/TRS-like PEI.

7 – Intel Corporation (UK) Ltd

[Intel]

Same question as Qualcomm and Samsung. Also, we think this can be postponed to a latter point in time when we have better clarity on the rest of the open issues.

8 – CATT

The question is not clear. Sequence-based PEI use existing RS sequence and pattern with additional scrambling or cover. The question itself is lack of understanding how sequence-based PEI works.

9 – Apple Italia S.R.L.

It would be good if we start to list the possible options so that we understand the schemes better. We can do this separately for TRS-based and SSS-based PEI.

10 – Ericsson India Private Limited

Suggest to update as "FFS details including e.g….."

We also do not follow linkage to P-RNTI.

11 – China Mobile Com. Corporation

Similar view as above questions, why the sequence generation tie to P-RNTI?

12 – Sony Europe B.V.

FL-[Q4-4]-Sony-[R-1]

Again, we suggest to decide on this after PEI design decisions. Also, the relevance of P-RNTI to this proposal is NOT clear at all. Why does an SSS / TRS-based PEI have any concept of RNTI?

13 – LG Electronics Inc.

FL-[Q4-4]-LG-[R-1]

Similar view with Huawei/HiSilicon and ZTE. We do not prefer to introduce new sequence or pattern for the PEI.

14 – Guangdong OPPO Mobile Telecom.

[OPPO]

We are OK with the proposal.

15 – DOCOMO Communications Lab.

As some companies mentioned, We don't prefer to introduce new sequence or pattern for the PEI.

16 – vivo Communication Technology

For **FL-[Q4-4] Proposal**, agree with Samsung's suggestion. We can have some input this meeting on sequence based subgrouping, as well as other design details. Many of the mechanisms can be reused from Rel-16 NB-IoT design, e.g., sub-grouping and indication. we suggest the following modification.

FL-[Q4-4]

Proposal:

If TRS/CSI-based PEI or SSS-based PEI is selected for Rel-17 paging enhancement, the following is considered,

- Subgrouping indication similar Rel-16 NB-IoT, i.e.,

- Each UE has one subgroup-specific codepoint to indicate only the sub-group which the UE belongs to receive paging, and
- Each UE has one common codepoint to indicate all the sub-groups to receive paging

- FFS other subgroups indication mechnism, subject to no impact to legacy serving-cell and neighbour-cell UEs.

If SSS-based PEI is supported, existing SSS sequence generation is as baseline.

- FFS whether multiple symbols SSS is supported.

If TRS/CSI-based PEI is supported, existing TRS/CSI-based sequence generation is as baseline.

- FFS configuration of the TRS/CSI used for PEI.

17 – PANASONIC R&D Center Germany

Lets firstly figure out how many bits we need for PEI, then decide PDCCH, TRS/CSI-RS, or SSS-based design and then go for this level of details.

5 Summary

The following feedback forms are based on **Section 5** of the draft summary in the following folder:

https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Inbox/drafts/8.7.1.1/Phase_1

*** Please go over the corresponding section before providing your feedback(s) ***

Feedback Form 14: Companies' views and dialogues on FL-[Q5-1]

1 – Nokia Germany

We would support PDCCH-based PEI for the physical layer design.

2 – Qualcomm Technologies Int

We support SSS-based PEI as first priority and can accept TRS-based PEI.

3 – Samsung Research America

For the second bullet, it should be TRS/CSI-RS based PEI, or we can say it CSI-RS based PEI as TRS is

a type of CSI-RS.

Our first priority is CSI-RS based PEI. Since there are many common design of SSS-based PEI and CSI-RS based PEI, such as UE behavior for detection, and MO configuration. We are fine to agree on RS based PEI first.

4 – HiSilicon Technologies Co. Ltd

We support PDCCH based PEI. Also, we have only 3 RAN1 meetings left for Rel-17, and we have to finish all the details of PEI and may coordinate with RAN2 in the remaining meetings. It really does not make sense and a burden to consider all the specification details of all three candidates. We need to have narrow down to focus our work on the selected candidate in this meeting.

5 – Intel Corporation (UK) Ltd

[Intel]
We think the discussion for proposal in FL-[Q5-1] may not help much at the present until we make more progress on the earlier questions. As of now, we prefer TRS-based PEI, but open to SSS- or other sequence (CSI-RS)-based PEI designs if justified.

6 – ZTE Corporation

We support PDCCH based PEI considering the overall performance including LLS, resource overhead, power saving gain, and light workload. Note the PDCCH based PEI can be also configured with a small CORESET with limited number of RBs and payload size. In this case, ML decoding instead of Polar code can be used to improve the performance and decrease the detection complexity. In this sense, PDCCH based PEI can provide the best flexibility and compatibility.

In addition, the Rel-17 WI should be finished at end of this year, we have spent most of our TU discussing about the metrics for the down-selection of PEI candidates. However, no consensus has made yet. At this moment, down-selection among the three candidates is important than triple the standardization workload by considering all the candidates in parallel.

7 – CATT

We support sequence-based PEI with preference in TRS/CSI-RS. TRS/CSI-RS based PEI has better detection performance, power saving gain, coexistence with PDSCH/PDCCH/TRS/CSI-RS, less overhead, and many codepoints (up to 2048*2048) for paging subgrouping indication than DCI-based PEI.

8 – Apple Italia S.R.L.

We support PDCCH-based PEI.

9 – Ericsson India Private Limited

We support PDCCH-based PEI.

10 – China Mobile Com. Corporation

We support PDCCH-based PEI.

11 – Sony Europe B.V. **FL-[Q5-1]-Sony-[R-1]** We agree with Intel. We also think the discussion for this proposal is too early at the present, We suggest to wait until we make more progress on the earlier questions. Having said that, SSS-based PEI is our priority.
12 – LG Electronics Inc. We support PDCCH-based PEI.
13 – Guangdong OPPO Mobile Telecom. [OPPO] We support PDCCH-based PEI for the physical layer design.
14 – DOCOMO Communications Lab. We support PDCCH-based PEI.