**3GPP TSG-RAN WG2 Meeting #116 electronic R2-21xxxx**

**Online, 1 - 12 November 2021, 2021**

**Agenda Item: 8.9.3**

**Source: Xiaomi Communications (email discussion rapporteur)**

**Title: Summary of [AT116-e][045][ePowSav] Paging Subgrouping (Xiaomi)**

**Document for: Discussion and Decision**

# Introduction

This contribution provides a summary of the following email discussion:

* [AT116-e][045][ePowSav] Paging Subgrouping (Xiaomi)

 Scope: a) based on [R2-2109647](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2109647.zip), taking into account agreements above, for remaining proposals, collect one round of comments, attempt agreement offline,

 b) determine what configuration info need to broadcasted by gNB.

 Intended outcome: Report

 Deadline: Wed W2

Deadline for companies’ inputs:

For initial comments collection, before Nov 8th, 0900 UTC, Monday

For proposal checking and companies can further comment by Nov 9th,, 0900 UTC

# Contact information

|  |  |
| --- | --- |
| Company | Name and email address |
| Xiaomi | Li Yanhua; liyanhua1@xiaomi.com |
| Qualcomm | Linhai He (linhaihe@qti.qualcomm.com) |
| Ericsson | Martin van der Zee (martin.van.der.zee@ericsson.com) |
| Yunsong Yang | Yunsong Yang (yyang1@futurewei.com) |
| Sequans | Noam Cayron (noam.cayron@sequans.com) |
| MediaTek | Li-Chuan TSENG (li-chuan.tseng@mediatek.com) |
| OPPO | Haitao Li (lihaitao@oppo.com) |
| vivo | Chenli (Chenli5g@vivo.com) |
| Huawei, HiSilicon | Jagdeep Singh (jagdeep.singh6@huawei.com) |
| CATT | Pierre Bertrand (pierrebertrand@catt.cn) |
| LGE | SangWon Kim, sangwon7.kim@lge.com |
| Sony | Anders Berggren (Anders.Berggren@sony.com) |
| Transsion | Lin Mo (Lin.mo@transsion.com) |
| Nokia | Chunli Wu (Chunli.wu@nokia-sbell.com) |
| CMCC | Xiaoxuan Tang (tangxiaoxuan@chinamobile.com) |
| Apple | Sethuraman Gurumoorthy (sethu@apple.com) |

# Discussion

## 3.1 General

In the current RAN2 #116e meeting, the following agreements were made [1].

|  |
| --- |
| => Assume that one subgroup indication refer to either CN assigned subgroups or UE-ID based subgroup (no overlapping)=> Both UE ID based and CN based subgrouping can be supported simultaneously in a cell, it is allowed to just support one of them. => FFS if the total number of CN-assigned subgroups is OAM configured. Max would be 8 as this is what RAN support.  |

Following agreements were made in the previous RAN1 #106-bis meetings:

|  |
| --- |
| **From RAN1 #106-bis-e:**AgreementFor NR Rel-17, paging indications to UE subgroups are carried only in PEI.Agreement For PEI, a new DCI format is supported to include at least paging indications to UE group(s)/subgroups of the associated PO(s)* One bit in the DCI payload indicating one UE subgroup of a PO or one UE group/PO
* The maximum number of total bits for paging indication field in PEI DCI format is x
	+ One PEI can be configured to indicate up to 4 PO(s) in a PF
		- FFS whether to supporting map PEI to 3 POs in a PF
	+ FFS: 1 PEI for POs across multiple PFs
	+ FFS: value of x
 |

And on the draft RRC parameters list for R17 power saving in RAN1 [5], a new parameter, subgroupsNumPerPO, was introduced to indicate the “*Number of subgroups supported per PO in the cell, for UE to read the subgroup indication from physical layer signaling*”:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WI code** | **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| **8.7.1.1 Paging Enh.** |
|  | Paging enhancement | 38.213 |   |  |   | subgroupsNumPerPO | new |   | Number of subgroups per Paging Occasion (PO) for UE to read subgroups indication from physical-layer singling | TBD with maximum of 8  |   | per cell | cell-specifc |   | Agreement:For UE subgroups indication in physical layer, maximum of 8 subgroups per PO is supported. |

And we also received the LS from SA2 with the following were captured in the cover sheet [3] (may be somewhat outdated, co-sourced by QC, MTK, Apple, Ericsson, HW):

|  |
| --- |
| Given the above, the following impacts to SA2 specification TS 23.501 are identified:1. UE may provide “UE paging probability” to aid AMF in decision for paging subgrouping.
2. AMF may assign a paging subgroup ID. If assigned it provides to RAN in N2 paging request.
3. Even if AMF does not assign, RAN needs to know UE supports paging subgrouping. Proposal: UE provides NR paging subgrouping information in registration request. AMF indicates NR paging subgrouping support to UE in Registration Accept and to NG-RAN in N2 paging request.
4. It is assumed that a UE that supports NR paging subgrouping support both 5GC assigned NR paging subgroup and NR paging subgroup by randomization, this simplifies the negotiation.
 |

## 3.2 RAN capability

This is mainly focusing on RAN capability for CN-assigned subgrouping and/or UE-ID based subgrouping. Since RAN1 decided the total number of L1 subgroups per PO (*subgroupsNumPerPO*), and we need to know how to split those L1 subgroups into the 2 methods.

### 3.2.1 Co-exist of CN-assigned subgrouping and UE-ID subgrouping

The network can broadcast its support for both CN assigned subgrouping and UE-ID based subgrouping. Since we have agreed the hard split between the 2 methods, we have to split the L1 subgroups for each separately. An example is there are two separate sets of subgroups at the same time, e.g., X (>=0) number of L1 subgroups for CN based subgroups and the rest are for UE-ID based subgrouping as show in the figure. Note X is less than *subgroupsNumPerPO.*



Figure 1: an example of Co-exist case

Q1: Do Companies agree that RAN indicates a parameter Nsg-CN or Nsg-UEID to indicate how many L1 subgroups are used for CN-assigned subgrouping?

|  |  |  |
| --- | --- | --- |
| Company  | Yes/No | Comments |
| Qualcomm | See comment | If the number of CN-assigned subgroups Nsg-CN is predefined in the specs, since RAN2 have agreed that there is no remapping of subgroup assignment in RAN, the minimum value for *subgroupsNumPerPO* should be Nsg-CN. Then the number of UE-ID based subgroups equals *subgroupsNumPerPO* - Nsg-CN. Therefore, in this case there is no need for gNB to advertise how many L1 subgroups are used for CN-assigned subgrouping.If the number of CN-assigned subgroups is not predefined (e.g. configured by OAM), then UE which has a CN-assigned subgroup ID does not need to know how many subgroups gNB allocates for CN-assigned subgrouping, i.e. the simplest solution is to have one-to-one mapping between CN-assigned subgroup ID and L1 subgroup ID. Then for UEs supporting UE-ID based subgrouping, they need to know how many subgroups are assigned for them (Nsg-UEID). Whether Nsg-CN can be used to derive that number may depend on another issue, i.e. whether CN-assigned and UE-ID based should be separate capabilities or not. If they are separate capabilities, then it is a bit odd to require UEs which are only capable of UE-ID based subgrouping to understand and process Nsg-CN.Rapp:Seems for the unpredefined case, we still need to indicated Nsg-UEID |
| Intel | Yes to implicit;No to explicit | We think it is better that the number of subgroups for UEID based subgrouping is explicitly signalled by the network since it is needed by the UE to work out the subgroups for the UEID based subgrouping. In this case, the network does not need to indicate explicitly a parameter Nsg-CN. The following implicit indications are possible: a) PEI configuration with L1 subgrouping bits without UEID based subgrouping configuration (I.e. indicate the number of subgroups for UEID based subgrouping) indicates RAN support of CN based subgrouping only. b)  PEI configuration with L1 subgrouping bits with UEID based subgrouping configuration and not all L1 subgrouping bits are used by UEID based subgrouping configuration. This means that CN based subgrouping is supported and the remaining L1 subgrouping bits are for CN based subgrouping. Moreover, if all L1 subgrouping bits are used by UEID based subgrouping configuration means that CN based subgrouping is not supported in the cell. Rapp:Seems want to indicated Nsg-UEID |
| Ericsson | See comment | In our view RAN2 should wait for RAN1 agreement on the available bits for subgrouping and the 1:N PEI to PO mapping options. In our view it should be configurable if one or both subgrouping methods are used in the cell, and what the 1:N PEI to PO mapping (N=1, 2, 3 or 4) is. We would not configure both methods simultaneous in the cell, because we do not see the need for it and it requires more bits in the PEI, i.e. we rather use the PEI bits to enable a 1:N mapping and reduce the number of PEI transmissions. Rapp: But we should allow to support both as agreed.We hope that RAN1 agrees that the PEI DCI can support up to 32 bits, which would enable 8 subgroups with a 1:4 PEI to PO mapping (POs in the same PF). If only up to 16 bits are available then only 1:2 PEI to PO mapping can be configured. But we think that the CN should also be able to signal the number of subgroups it uses, i.e. in case the CN only uses 4 subgroups than RAN can configure 4 subgroups and a 1:4 mapping with a 16 bit DCI. RAN should not "remap" CN-assigned subgroups to save bits in the DCI, because the RAN may group them together in a wrong way. We also think there is no need for this now that RAN1 has agreed on DCI based PEI, i.e. not support sequence based PEI. Rapp: Seems no subgroups for UE-ID based? |
| Futurewei | No | It is not very useful to advertise the total number of CN-assigned subgroups to individual UEs, whether they have a CN-assigned subgroup ID or not. All a UE care is which method(s) is/are supported in the cell, whether the UE has a CN-assigned subgroup ID or not, and if the UE has no CN-assigned subgroup ID and UEID-based subgrouping is supported by the cell and the UE, how many UEID-based subgroup IDs are supported and where these subgroup IDs begin (assuming the CN-assigned subgroup IDs, if any, always begin from 0). So, the PEI configuration should include the total L1 subgrouping bits per PO (i.e., *subgroupsNumPerPO* or Nsg) and the total number of UEID-based subgroups per PO (i.e., Nsg-UEID). If Nsg-UEID = 0, only CN-assigned subgrouping is supported in the cell. * For a UE having a CN-assigned subgroup ID, the UE uses the CN-assigned subgroup ID as is when monitoring PEI.
* For a UE having no CN-assigned subgroup ID, the UE monitors its paging in the legacy way.

If Nsg-UEID = Nsg, only UEID-based subgrouping is supported in the cell.* For a UE capable of UEID-based subgrouping, the UE uses a subgroup ID equal to the hash output when monitoring PEI.
* For a UE incapable of UEID-based subgrouping, the UE monitors its paging in the legacy way.

If 0 < Nsg-UEID < Nsg, both CN-assigned and UEID-based subgrouping are supported in the cell.* For a UE having a CN-assigned subgroup ID, the UE uses the CN-assigned subgroup ID as is when monitoring PEI.
* For a UE having no CN-assigned subgroup ID and being capable of UEID-based subgrouping, the UE uses a subgroup ID equal to the sum of (Nsg - Nsg-UEID) and the hash output when monitoring PEI.

For a UE having no CN-assigned subgroup ID and being incapable of UEID-based subgrouping, the UE monitors its paging in the legacy way.Rapp:Seems want to indicated Nsg-UEID |
| Sequans | See comments | It is too early to decide, it depends on both design decisions from RAN1 and RAN2, as highlighted by comments from QC and Ericsson. If the number is not specified, it still remains to be seen whether CN grouping and UE-ID grouping are independent capabilities or not. |
| Samsung | See comments | We can wait for RAN1 to complete its design |
| MediaTek | No | Agree with the procedures described by Futurewei. In this way the number of CN-assigned subgroups is implicitly indicated.We understand that some details of PEI are still under discussion in RAN1. But subgrouping is a RAN2 issue and we think RAN2 can make decision here.Rapp:Seems want to indicated Nsg-UEID |
| ZTE | See comments | We understand it depends on how we implement the co-existence of UE ID based subgrouping and CN assigned subgrouping, in other word, how to separate the UE ID subgroups from CN assigned subgroups. In our understanding, the it may not need the Nsg-cn to be broadcast to UE if the following conditions are met:1: As Qualcomm mentioned, one-one map can be fulfilled (i.e No remap mechanism is applied). Which means anyway UE having a CN assigned subgroup ID can find the right Bit in the subgroup bitmap based on the assigned subgroup ID.And 2: In the bit-map, CN assigned subgroups shall be put after the UE ID based subgroups (i.e UE without any assigned subgroup ID do not need to calculate the actual position in the bitmap by using Nsg-cn) |
| OPPO | See comments | Share the same view as QC. |
| vivo | No | If the total number of CN-assigned subgroups is fixed and specified, or OAM configured, RAN needs not to include a parameter of Nsg-CN to indicate how many L1 subgroups are used for CN-assigned subgrouping. It simplifies the interworking between RAN and CN regarding the CN-assigned subgroup configuration.From UE perspective, since RAN2 have agreed that there is no remapping of subgroup assignment in RAN, and “At least for UEID-based subgroup method the total number, Nsg, of supported subgroups by the network is decided by RAN and broadcasted in System Information.” UE can deduce the PEI mapping based on PEI configuration which is under RAN1 discussion. Therefore, it’s unnecessary to indicate a parameter Nsg-CN by RAN. The detailed PEI mapping design depends on the RAN1 conclusion. |
| Huawei, HiSilicon | See comments | We generally agree with Intel and Futurewei, the number of CN-assigned subgroups can be implicitly indicated. As per our understanding the main intention is that UE needs to clearly understand the number of supported subgroups for each subgrouping method. |
| CATT | Yes with comments | RAN2 could indeed add this new parameter, Nsg-CN, in SIB, where 1 < Nsg-CN ≤ *subgroupsNumPerPO* (or 0 < Nsg-CN ≤ *subgroupsNumPerPO*-1) to be used as an offset in UEID-based formula.Or it could be Nsg-UEID, no strong view, but for sure it is not needed to broadcast both.It may also depend on Q2, i.e. if the total number of CN assigned subgroups the CN can assign is fixed and specified, maybe broadcasting Nsg-CN is not needed? |
| LGE | See comments | For UE ID based subgroup, UE needs to know Nsg-UEID to derive its subgroup ID, and it is already agreed.For CN assigned subgroup, UE doesn’t needs to know Nsg-CN, so 1bit indication is preferred to advertise the CN-assigned subgroup to UEs. |
| Sony | No | No reason, the number is not relevant. The UE needs to know which subgroup to monitor. |
| Transsion | See comments | We understanding that if the total number of CN-assigned subgroups is fixed and specified, the sum of number of UE-ID based subgroups and the number of CN assigned subgroups should not exceed but doesn’t have to be equal to the number of subgroups per PO supported, therefore it’s necessary to RAN broadcast the total number of UE\_ID based subgroup for UE to derive its subgroup ID. |
| Xiaomi | - | Not have a strong view to indicate Nsg-CN or Nsg-UEID. Agree with CATT, that not both of them need to be broadcasted. We can accept to broadcast Nsg-UEID.Agree that if the number of CN assigned subgroup is fixed, we do not need to broadcast either Nsg-CN or Nsg-UEID.  But if not (configured by OAM), one of them need to indicate to UE since UE is not aware of the value of OAM. |
| Nokia | See comments  | Based on the agreement from the online session that there could be a mix of CN-assignment based and UE-ID based subgrouping, either the number of CN-assignment or the number of UE-ID based subgrouping needs to be signaled on top of the total number for subgrouping. |
| CMCC | No | We agree that the total number of UE-ID based subgroups should be broadcasted for UEs knowing their subgrouping. It doesn’t matter this is derived from Nsg-CN and pre-defined/fixed total number or Nsg-UEID. But we prefer Nsg-UEID for its simplicity. As for CN-assigned subgrouping, CN-assigned subgroup ID should be explicitly indicated to UE.  |
| Apple | See Comments | Not sure if we need both, but we are acceptable to broadcast Nsg-UEID. |

Summary:

Q1/Q3/Q4 can be discussed together.

Companies mentioned that if the number of CN-assigned subgroups Nsg-CN is predefined in the specs, then no need for gNB to advertise how many L1 subgroups are used for CN-assigned subgrouping. Then the number of UE-ID based subgroups equals *subgroupsNumPerPO* - Nsg-CN. However, if the number of CN-assigned subgroups Nsg-CN is not predefined in the specs, then for UEs supporting UE-ID based subgrouping, they need to know how many subgroups are assigned for them (Nsg-UEID). The rest can be potentially for UE which has a CN-assigned subgroup ID (Whether remapping will be FFS.) UE which has a CN-assigned subgroup ID does not need to know exactly how many subgroups gNB allocates for CN-assigned subgrouping, i.e. the simplest solution is to have one-to-one mapping between CN-assigned subgroup ID and L1 subgroup ID.

Rapporteur thinks since majority people choose that the number of CN-assigned subgroups Nsg-CN is not predefined in Q2, either the number of CN-assignment or the number of UE-ID based subgrouping needs to be signaled on top of the total number for subgrouping.

* For broadcast Nsg-UEID (11):

QC, Intel, Futurewei, MTK, oppo, HW, CATT, LGE, Transsion, Nokia, CMCC

A possible way to indicate RAN capability (Intel/ Futurewei):

**Coexist**: 0 < Nsg-UEID < *subgroupsNumPerPO*

**UE-ID only**: Nsg-UEID = *subgroupsNumPerPO*

**CN assigned only**: Nsg-UEID = *0 or not exist*

* For broadcast Nsg-cn:

CATT, xiaomi, Nokia

* No strong view or wait for more RAN1’ input:

E///, Sequans, Samsung, vivo, sony

Since most companies are fine for broadcast the number of UE-ID based subgroupings to indicated RAN’s capability, Rapporteur thinks we can take this as a starting point. And this is also in line with what we have agreed “At least for UEID-based subgroup method the total number, Nsg, of supported subgroups by the network is decided by RAN and broadcasted in System Information.”

And the signaling details can be discussed further.

**Proposal 1 (For agreement): RAN introduces a new parameter Nsg-UEID to indicate its support for CN assigned subgrouping and/or UE-ID based subgrouping. FFS for the signaling details.**

For the co-exist case, we are not sure the total number of CN assigned subgroups the CN can assign and whether it can be bigger than the Nsg-CN L1 subgroups the RAN can support (More RAN1’s input is needed for the DCI size design). But before that we can consider to resolve the “FFS if the total number of CN-assigned subgroups is OAM configured” in this meeting first. And we will further consider if some N to 1 mapping from CN assigned subgroups to Nsg-CN L1 subgroups or remapping solutions will be needed in the next meeting.

* Option 1: The total number of CN-assigned subgroups is fixed and specified
* Option 2: No need to specify, e.g., by OAM
* Option 3: The total number of CN-assigned subgroups is decided by CN and informed to RAN (I still list it here)

Q2: Which option do companies prefer described above for the total number of CN-assigned subgroups?

|  |  |  |
| --- | --- | --- |
| Company  | Option1/2/3 | Comments |
| Qualcomm | Option 1 | Option 1 is the simplest. We can support Option 2 if it is supported by majority. |
| Intel | Option 2 |  |
| Ericsson | Option 3 (preferred) or 2 | We think that companies agree that more than 8 subgroups is not going to give much benefit. But using less than 8 subgroups (e.g 4) would still be effective and it would save bits in the PEI, i.e. reduce the PEI size (improve the power saving gains assuming that the DCI format size is configurable). Given that the number of subgroups in RAN is configurable, then the number of subgroups in the CN should obviously also not be fixed.  |
| Futurewei | Option 3 (preferred) or 2 | We prefer this number not being fixed by specification. Either option 2 or 3 can be used for configuring such number. From interoperability PoV, option 3 may be preferred. |
| Sequans | Option 3 (preferred) or 2 | Agree with Ericsson |
| Samsung | Option 2 or option 3 |  |
| MediaTek | Option 3 (preferred) or 2 |  |
| ZTE | Option 2 or option 3 |  |
| OPPO | Option1 or Option 2 | We prefer Option 1 since it is the simplest. We can also accept Option 2 if it is supported by the majority. |
| vivo | Option 1 (preferred) or 2 | Option 1 is the simplest solution. Option 2 can be supported as well to simplify the NW implementation.Considering the RAN2#113bis-e agreement that “If the network chooses to not provide specific subgrouping information, there will be configuration option where subgrouping can be supported by randomization (by UE-ID)”, CN-assigned subgrouping has higher priority. RAN can decide whether to configure UE-ID based subgrouping and determine the number of subgroups in RAN based on the status of CN- assigned subgrouping. |
| Huawei, HiSilicon | Option 2 or option 3 | For option 3, we are not sure the total number of CN-assigned subgroups (decided in CN) is the same in a certain registration area, that is, the CN informs the same number of CN-assigned subgroups to all RAN in a certain registration area? |
| CATT | Option 1 | It would be the simplest, but we are OK to follow the majority.  |
| LGE | Option 1 | Option 1 is the simplest. We can support Option 2 if it is supported by majority. |
| Sony | Option 2 |  |
| Transsion  | Option 1 or Option 2 | Agree with Qualcomm. |
| Xiaomi | Option2 | Fixed is not flexible for the CN implementation.And we also want to ask is the OAM controls CN and gNB? If OAM only control CN, CN needs to tell the gNB the maximum number of CN assigned subgroupings. |
| Nokia | See comments | All the options work. With option 1, maximum number of 8 should be assumed to not waste L1 bits. If not fixed, whether to choose option 2 or 3 is more for other WGs to decide as it would not impact air interface. |
| CMCC | Option 3 (preferred) or 2 |  |
| Apple | Option 1 | Simplest case |

Summary:

All the companies can accept the option2. 5 companies preferred option1 but can accept option2. 6 companies preferred option3 but can accept option2. Considering the majority view, we can take option2.

**Proposal 2(For agreement): No need to specify** t**he total number of CN assigned subgroups, e.g., by OAM**

### 3.2.2 CN-assigned subgrouping only

The second question is how gNB informs the UE that it supports CN-assigned subgrouping only. A candidate solution would be network to configure the total Lay1 subgroups for CN based subgroups or 0 Lay1 subgroup for UE-ID based grouping.

Q3: Do Companies agree that RAN indicates a parameter Nsg-CN with a value equal to *subgroupsNumPerPO*  or 0 Lay1 subgroup for UE-ID based grouping or a one-bit indication for all the L1 subgroups are used for CN-assigned subgrouping ? (or some other options, you can add)

|  |  |  |
| --- | --- | --- |
| Company  | Yes/No | Comments |
| Qualcomm | See comment | We think the answer to this question again depends on how the number of CN-assigned subgrouping is assigned (e.g. predefined, configured, signaled, etc). If the proposal in Q1 is agreed, then the answer is yes. Otherwise, gNB can signal a one-bit indication for whether CN-assigned subgrouping is supported or not. |
| Intel | See our comments to Q1  | Rapp:Sees want Nsg-UEID = 0 |
| Ericsson | See our comments to Q1 |  |
| Futurewei | No | We think RAN should advertise Nsg-UEID instead. And, when Nsg-UEID = 0, all the L1 subgroups are used for CN-assigned subgrouping. Please see our response to Q1. Rapp:Nsg-UEID = 0 |
| Sequans | See comments to Q1 |  |
| Samsung | No | Based on number of UE ID based subgroups and PEI bits, UE can know whether CN assigned subgrouping is supported or not. Alternate would be to have a 1 bit indication. |
| MediaTek | See our comments to Q1 | Rapp:Sees want Nsg-UEID = 0 |
| ZTE | See comments to Q1 | It depends whether RAN need to indicate a parameter Nsg-CN. And we confirm RAN can configure all subgroups for CN assigned subgrouping  |
| OPPO | See comments to Q1 | We don’t think it is a valid assumption that RAN advertises the Nsg-CN. |
| vivo | No | See our comments to Q1 |
| Huawei, HiSilicon | See our comments to Q1 |  |
| CATT | Yes | See our answer to Q1. |
| LGE |  | RAN doesn’t need to advertise the Nsg-CN., but an explicit indication is needed to advertise the support for CN-assigned subgrouping, i.e. 1bit. |
| Sony | No | We don’t see the rational for doing this advertisement. |
| Transsion | See our comments to Q1  |  |
| Nokia | See comments to Q1 | Either signal the CN-assignment bits or UE-ID bits is fine on top of the total L1 bits. |
| CMCC | See comments to Q1 |  |
| Apple | See comments to Q1 |  |

### 3.2.3 UE-ID based subgrouping only

It is also possible for RAN to not spare any L1 subgroup used for CN assigned subgrouping which means all the RAN configured L1 subgroups per PO will be used by UE-ID assigned subgrouping by default.

A candidate solution would be network to configure Nsg-CN to 0 or the absence of Nsg-CN can indicate implicitly that the total Lay1 subgroups are for UE-ID based grouping.

* Option 1: Explicitly, by configuring Nsg-CN =0
* Option 2: Implicitly way, by absence of Nsg-CN

Q4: Which option do companies prefer described above for RAN indicating only support UE-ID based subgrouping?

|  |  |  |
| --- | --- | --- |
| Company  | Option1/2 | Comments |
| Qualcomm | See comment | For UE which has a CN-assigned subgroup ID, designs discussed in Q1~3 will allow them to determine whether CN-assigned subgrouping is supported by the cell or not. This also includes UEs which support both types of subgrouping, as we have agreed that CN-based subgrouping always has higher priority than UE-ID based subgrouping. Rapp: The last sentence is based on the condition the network supports both.For UE which can only support UE-ID based subgrouping, they do not need to know if only UE-ID based subgrouping is supported. They only need to know how many such subgroups are configured for them to use. Rapp:For UE which can support CN-assigned based subgrouping, they still need to know if only UE-ID based subgrouping is supported. Right?Therefore, we are not sure if this issue needs to be discussed.  |
| Intel | See our comments to Q1  |  |
| Ericsson | See our comments to Q1 |  |
| Futurewei | No | We think RAN should advertise Nsg-UEID instead. And, when Nsg-UEID = Nsg, all the L1 subgroups are used for UEID-based subgrouping. Please see our response to Q1. Rapp:By giving Nsg-UEID to the total number of supported Lay1 subgroups. |
| Sequans | See comments to Q1 |  |
| Samsung | No | In RAN2#115 following was agreed* At least for UEID-based subgroup method the total number, Nsg, of supported subgroups by the network is decided by RAN and broadcasted in System Information

This is sufficient. If network supports UEID-based subgrouping, it will broadcast number of UE ID based subgroups, otherwise not.Rapp:By giving Nsg-UEID to the total number of supported Lay1 subgroups. |
| MediaTek | See our comments to Q1 |  |
| ZTE | No | It has been agreed that the Nsg is broadcast to UE, to our understanding, if RAN does not want to allocate any subgroup to UE ID based subgouping, then Nsg shall be set to 0. |
| OPPO | See comments to Q1 | Nsg-UEID anyway needs to be broadcasted as mentioned by Samsung. Then wondering why we discuss this issue. |
| vivo | See our comments to Q1 |  |
| Huawei, HiSilicon | See our comments to Q1 |  |
| CATT | Either way | Stage 3 detail. |
| LGE | See our comments to Q1/3 |  |
| Sony | None | Not sure the relevance if this indication, and to whom would the network explicitly or implicitly inform about this subgrouping. |
| Transsion | See our comments to Q1  |  |
| Nokia | See comments to Q1/Q3 | Either signal the CN-assignment bits or UE-ID bits is fine on top of the total L1 bits. |
| CMCC | See comments to Q1 |  |
| Apple | Option 1 | Straight forward way in our opinion. Option 2 also would work. |

### 3.2.4 Not support any of them

Q5: Do companies agree that RAN indicates not support any of them by not giving the supported L1 subgroups for subgrouping (e.g., no PEI subgrouping configuration)?

|  |  |  |
| --- | --- | --- |
| Company  | Yes/No | Comments |
| Qualcomm | Yes | gNB support for subgrouping is optional. |
| Intel | See comments | Subgrouping support is an integral part of the PEI and vice versa. Hence this will mean that no PEI configuration is provided in the cell (i.e. not just no subgrouping configuration in the PEI configuration)Rapp:I am not sure whether we can give PEI configuration with *subgroupsNumPerPO* =0? So I used not give the supported subgroups.Of cause, “No PEI configuration” is a way to achieve that.So I add an “e.g.,” to “no PEI subgrouping configuration”.I think what your way is already covered. |
| Ericsson | Yes | In addition to the comments provided by QC and Intel above:* CN subgrouping, UE-ID subgrouping and PEI (without subgrouping) are optional for gNB to support/configure
* If subgrouping is configured, PEI shall also be configured
* gNB may configure CN-subgrouping without UE-ID (and vice versa) or both
 |
| Futurewei | Yes | As an optional feature, no configuration, no support. |
| Sequans | Yes |  |
| Samsung | See comments | Same view as intel |
| MediaTek | See comments | Same view as intel |
| ZTE | Yes |  |
| OPPO | Yes |  |
| vivo | Yes | This feature is optional, via no subgrouping configuration |
| Huawei, HiSilicon | See comments | Based on RAN1 agreement: One bit in the DCI payload indicating one UE subgroup of a PO or one UE group/PO. Thus, it is possible that PEI is supported, but for associated POs, there is only one UE subgroup (or can be regarded as no subgrouping is used in PO). In this case, there is still PEI subgrouping configuration but actually without L1 subgrouping. So we think:RAN indicates not support any of them by not giving the supported L1 subgroups for subgrouping or mapping to one subgroup in a PO (e.g., no PEI subgrouping configuration) |
| CATT | Yes | Setting *subgroupsNumPerPO* = 0 or absence of *subgroupsNumPerPO* indicates the cell does not support any subgrouping. |
| LGE | See comments | Same view as intel |
| Sony | See comment | Does the question mean whether network indicates no support in System information? |
| Transsion | Yes |  |
| Xiaomi | Yes |  |
| Nokia | Yes |  |
| CMCC | Yes |  |
| Apple | Yes |  |

## 3.3 issues related to other WG

This session relates to issues related to other WG.

We only capture the results of UE capability. UE assistance information is currently discussed in a separate email (CMCC) and the proponent company will treat RAN paging in another email (Ericsson, 046).

Note other issues discussed in [4] (e.g., negotiations between CN and gNBs) are currently dropped here since people show not much interest.

### 3.3.1 UE capability

Q6 is about the UE capability.

20 companies provide inputs for this question in [3].

* 12/19 companies support (option 1) that introduce common UE capability for UE-ID based subgrouping and network-assigned subgrouping in CN and RAN. With key argument is that option 1 is a simple scheme and from UE perspective there is no too much difference.
* 8/19 companies support option 2:
	+ 5 companies support (option 2a) that RAN only needs to care about UE’s capability of supporting the UE ID based subgrouping while UE’s capability of supporting the CN-assigned subgrouping is handled in NAS.
	+ 3 companies support (option 2b) that both capabilities are reported to CN by NAS signalling and CN forwards both to RAN in paging message. Futurewei brings a point that we need to transfer UE’s AS capability when escalating CN-initiated paging to support 2b.

**Proposal: No consensus on whether subgrouping capability is common or separate.**

* Option 1: introduce common UE capability (i.e., only one UE capability reported to RAN or CN by NAS);
* Option 2: introduce separate UE capabilities;
* Option 2a: UE’s capability of supporting the UE ID based subgrouping is reported to RAN by AS UE capability signalling while UE’s capability of supporting the CN-assigned subgrouping is reported to CN by NAS signalling).
* Option2b: both capabilities are reported to CN by NAS signalling and CN forwards both to RAN in paging message

And a question is asked to people: can companies accept what is captured in [3]? If not, we will further discuss in RAN2.

Q6: Can companies accept what is captured in [3]? If not, we will further discuss in RAN2.

|  |  |  |
| --- | --- | --- |
| Company  | Yes/No | Comments |
| Qualcomm | No | First, SA2 did not state in their LS (S2-2107856/R2-2111234) that UE capability for those two types of subgroups must be common. Even if the text provided by the rapporteur is some agreement made by SA2, it is only an assumption they prefer, from SA2’s perspective. From UE’s perspective, support for CN-assigned subgrouping is a core network capability and should be reported to CN via NAS signaling. UE-ID based subgrouping, which does not involve CN at all, should be a RAN paging capability and be reported to RAN by RRC signaling in UE Radio Paging Information. From implementation point of view, because CN-assigned subgrouping involves updates to both CN and RAN, one can expect that UE-ID based subgrouping likely will be deployed earlier than CN-based subgrouping. In that case, having separate capabilities for different types of subgrouping can help reduce implementation complexity and effort. |
| Intel | No (but see comments) | While we think option 1 (i.e. “*introduce common UE capability*” and in SA2 LS [3] via NAS) is sufficient from UE implementation point of view, we need a bit in the UE AS capability at least for inter-operability testing perspective. Further, the UE ID based subgrouping is reported to RAN by AS UE capability signalling is the normal way (i.e. consistent) in which UE provides UE RAN capability as this information is required by gNB for paging. Hence we think UEID based subgrouping as a UE AS capability bit is better (i.e. we support option 2 “*introduce separate UE capabilities*”).  We understand that CN needs to know whether the UE supports CN based subgrouping.  Hence we suggest first agreeing that UE supports CN based subgrouping is provided via NAS.  |
| Ericsson | See comments | In our view the RAN may configure UE-ID, CN-assigned, or both. From this perspective, we think that the UE may support UE-ID based only. Because we will not provide IOT test opportunity for CN-based subgrouping in case we only want to deploy UE-ID based RAN subgrouping. It can be discussed further if a UE that supports CN-assigned, shall also support UE-ID based subgrouping.  |
| Futurewei | No | We supported option 2b in the original discussion, because when the CN escalates or floods the paging for a UE, some gNBs supporting only the UEID-based subgrouping may not have the UE’s capability regarding the UE’s support of UEID-based subgrouping and need to know it from the CN. |
| Sequans | Yes? | It seems to us that the question is asking whether one of the three options in [4] is acceptable, in which case the answer is yes. If the question is about the LS we are not sure what it is expected of us to agree or not to, it is statements by SA2. Rapp:The purpose of the question is to ask people whether they can accept what is captured in the SA2’s LS on the common capability. If people can, then RAN do not need to discuss this.If not, RAN2 can further discuss.  |
| Samsung |  | We support option 1 |
| MediaTek | Yes | From UE implementation perspective, we support Option 1, but we may consider further input from SA2. Also notice that even for UEID-based subgrouping, CN needs to be aware of UE capability, so that CN can inform RAN after UE reselects to another cell. |
| ZTE |  | No strong view, we slightly prefer Option 1 which can avoid a lot of discussion for signaling design, but we can follow the majority.  |
| OPPO | No | We think UE ID based subgrouping should be an AS capability while network-assigned subgrouping should be a NAS capability, we prefer to introduce separate UE capabilities, which would be more flexible for UE implementation. |
| vivo | Yes | In SA2 LS [3] “*Based on the reported UE capabilities, the AMF can determine the assistance information for NR Paging Subgroup according to the NR UE characteristics, i.e. local configuration, subscription information and/or statistical information. If the AMF has determined assistance information for Paging Subgroup, the AMF shall deliver the information to the UE during Registration and the NG-RAN in the NGAP Paging Message or* *RRC Inactive Assistance Information for support of paging a NR UE in CM\_IDLE or CM\_CONNECTED with RRC Inactive state.*”In our understanding of above info in SA2 LS, it’s preferred that only one UE capability reported to CN by NAS, i.e. Option 1. |
| Huawei, HiSilicon | No | We supported option 2a. We share the same view with QC, separate UE capabilities is more flexible for deployment. If separate UE capabilities is supported, CN-assigned subgrouping can be NAS capability and UE ID based subgrouping should be AS capability. |
| CATT | Yes | Rapporteur meant [4] instead of [3], i.e. the previous summary for this offline. But what is captured there is still open. As for the descriptions of the two options, we agree, but we definitely prefer option 1 (common signaling) because it is simpler, way sufficient, and aligned with SA2 agreements which are already captured in their CRs [3].  |
| Sony | 1 or 2b. See comment | Agree with MediaTek. Also don’t see how RAN itself can apply UE-ID based subgrouping without involvement from CN in Idle mode case, since RAN has no information of any UE what so ever when the UE is in Idle mode. Then in case of RRC-Inactive, the gNB is responsible for RAN based paging and need to have relevant information to apply subgrouping. |
| Transsion |  | We support option 1. |
| Xiaomi | No | We prefer option2a.  |
| Nokia | Yes | In the SA2 agreed CR (from Qualcomm, MediaTek., Apple, Ericsson, Huawei, HiSilicon), option 1 with common capability has been captured “4. It is assumed that a UE that supports NR paging subgrouping support both 5GC assigned NR paging subgroup and NR paging subgroup by randomization, this simplifies the negotiation”. We can follow this assumption since no issue is identified from RAN2 point of view. |
| CMCC | 1 or 2b. | We sightly prefer Op.1 for its simplicity.  |
| Apple | No | Agree with Qualcomm |

Summary:

9 companies can accept the common capability as captured in [3] which is simpler but 7 companies still stick to separate UE capabilities which is better for UE implementation complexity and IOT test. And some people think UEID based subgrouping as a UE AS capability bit is better and do not need to send to CN by NAS (2a).

Rapporteur suggests to bring this to online discussion.

* Option 1(9): introduce common UE capability (i.e., only one UE capability reported to RAN or CN by NAS);
* Option 2: introduce separate UE capabilities (7);
* Option 2a: UE’s capability of supporting the UE ID based subgrouping is reported to RAN by AS UE capability signalling while UE’s capability of supporting the CN-assigned subgrouping is reported to CN by NAS signalling).
* Option2b: both capabilities are reported to CN by NAS signalling and CN forwards both to RAN in paging message

**Proposal 6: (For discussion) No consensus on whether subgrouping capability is common or separate.**

### 3.3.2 LS to CT1/SA2

Rapporteur thinks at least the progress or decisions on the following topics made by RAN2 should be informed to CT1/SA2.

* The total number of CN-assigned subgroups CN can assign in Q2;
* UE capability in Q6.

Q7: Can companies agree that a LS should be sent to CT1/SA2 to capture the progress of RAN2?

|  |  |  |
| --- | --- | --- |
| Company  | Yes/No | Comments |
| Qualcomm | Yes |  |
| Intel | Yes. LS should also include RAN3 | Agree with the rapporteur, LS needs to be sent to CT1, ~~/~~SA2 and RAN3 for the above topics   |
| Futurewei | Yes |  |
| Sequans | Maybe | Depends on the actual progress, but yes in principle |
| Samsung | May be |  |
| MediaTek | Yes | If we do make some progress, we should inform SA2/CT1 and RAN3. |
| ZTE | May be |  |
| OPPO | Maybe |  |
| vivo | May be |  |
| Huawei, HiSilicon | Yes | Agree with MTK. |
| CATT | Maybe | Depending on the progress |
| LGE | Maybe | Depending on the progress |
| Sony | Maybe |  |
| Transsion | May be |  |
| Xiaomi | YEs | Agree with MTK. |
| Nokia | Yes | Should inform SA2/CT1/RAN3 on RAN2 progress. |
| CMCC | Yes |  |
| Apple | Yes | If we make good progress, we can inform SA2/CT1 and RAN3 |

Summary:

Companies agree that a LS can be send to SA2/CT1/RAN3 to inform the progress.

**Proposal 7: a LS can be send to SA2/CT1/RAN3 to inform the progress.**

## 3.4 Other

Q8: Any other relevant issue to discuss (Only limits to paging subgrouping)?

|  |  |
| --- | --- |
| Company | Issue description  |
|  |  |
|  |  |

Summary:

No inputs.

# Conclusions

Based on companies’ inputs to this email discussion, the following proposals are listed for agreement:

**Proposal 2(For agreement): No need to specify** t**he total number of CN assigned subgroups, e.g., by OAM.**

**Proposal 1 (For agreement): RAN introduces a new parameter Nsg-UEID to indicate its support for CN assigned subgrouping and/or UE-ID based subgrouping. FFS for the signalling details.**

**Proposal 5(For agreement): RAN indicates not support neither CN-assigned subgrouping nor UE-ID subgrouping by not giving the supported L1 subgroups.**

* **The signalling details can be FFS .**
* **E.g., no PEI subgrouping configuration, *Setting subgroupsNumPerPO* = 0 or *absence of subgroupsNumPerPO*.**

**Proposal 6: (For discussion) No consensus on whether subgrouping capability is common or separate.**

* **Option 1: introduce common UE capability (i.e., only one UE capability reported to RAN or CN by NAS);**
* **Option 2: introduce separate UE capabilities;**
* **Option 2a: UE’s capability of supporting the UE ID based subgrouping is reported to RAN by AS UE capability signalling while UE’s capability of supporting the CN-assigned subgrouping is reported to CN by NAS signalling).**
* **Option2b: both capabilities are reported to CN by NAS signalling and CN forwards both to RAN in paging message**

**Proposal 7(For agreement): A LS can be send to SA2/CT1/RAN3 to inform the progress.**

The LS is drafted in [6] and will be provided later.

# References

1. RAN2 #116-e Meeting minutes
2. R2-2108917, LS on UE Power Saving, MTK
3. [R2-2111234](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_116-e/Docs/R2-2111234.zip) LS Reply on UE Power Saving (S2-2107856)
4. [R2-2109647](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2109647.zip) Summary of [Post115-e][089][ePowSav] Paging Subgrouping, xiaomi
5. [R2-2111246](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2111246.zip) LS on Re-17 LTE and NR higher-layers parameter list (R1-2110575; contact: Ericsson)
6. R2-2xxxxx Draft LS on UE Power Saving