**3GPP TSG-RAN WG2 Meeting #109bis R2-200xxxx**

**Online, April 2020**

**Agenda Item: 6.11.1**

**Source: MediaTek Inc. (Rapporteur)**

**Title: Summary of [Post109e#43][PowSav] UE Assistance and RRC open issues and TDocs**

**Document for: Discussion and decision**

1 Introduction

This document discusses the various open issues on UE assistance and with the Rel-16 version of the RRC specification for power savings. The aim of this discussion is to provide recommendations to resolve them.

2 Known open issues

The open issues discussed in this section are from those listed in [1]. Please note that those issues raised in email discussion Post109e#44 are not listed here.

### Issue#1: Range of reported UAI

We have the following open issue from R2#109e:

*The reported values of UE assistance on reduced bandwidth, cells and MIMO layers for power savings can range up to at least the corresponding value in the current active configuration. FFS if it can be up to UE capability.*

The issue was debated over email discussions 108#39 and AT109e#505 [2][3], with 10 companies indicating that they would prefer a reporting range up to the UE’s capability while 3 companies indicated that they would prefer to limit the reporting range to the current active configuration.

To have a more robust and free-form technical discussion, companies are recommended to provide their input to the table below. In the column on the left, companies can describe scenarios that need to be addressed on this open issue. Companies are encouraged to then provide solutions/arguments in the column on the right to address the corresponding scenario raised.

|  |  |
| --- | --- |
| **Scenario to be addressed** | **Discussion on the scenario (indicate your company with your comments)** |
| [CATT] Scenario #1: Blind SCell setup by NW upon new DRB.  A UE has on-going traffic with small data rate and is configured accordingly with e.g. a small bandwidth on a single Serving Cell on FR1. Then the UE requests a new DRB setup to serve a new application. NR is expected to provide a significant improvement in the user experience in terms of throughput and latency. As a result, a typical network implementation of early NR deployments will, upon setting-up a new DRB, activate all configured SCells to serve the associated new application with maximum performance. However, in most cases only a subset of all SCells would be needed and this will consume unnecessary large power, especially from the RF side, considering FR2 SCells involving power-hungry multi-beam antenna systems. | [CATT] In Scenario #1, if the UE cannot indicate its bandwidth and SCell needs associated with the new application, which would necessarily be larger than the current ones, the NW will behave as described in the left column, i.e. activate right away arbitrarily the highest performance, although overkill, bandwidth and SCell configuration. Reporting early the desired absolute configuration upon new DRB setup prevents the NW to allocate a maximum configuration first and then the UE to report a preferred reduced configuration afterwards. This allows saving all UE power spent unnecessarily in the meantime in tracking and measuring FR2 SCells (and associated beams) it does not need. |
| [CATT] Scenario #2: An opposite network implementation to scenario #1 could wait for getting the full picture of the buffer status in DL and/or UL before making a decision to activate appropriate SCells. This incurs some unavoidable delay before making such decision. During this delay, UE still needs to consume power, e.g. PDCCH monitoring, measurements and so on while not taking profit of the appropriate SCells setup for the requesting application e.g. file download or upload. | [CATT] Same as for scenario #1, if the UE cannot indicate its bandwidth and SCell needs associated with the new application, which would necessarily be larger than the current ones, the NW will behave as described in the left column incurring unnecessarily delay in setting up the appropriate configuration, and thus power consumption. |
| [CATT] Scenario #3: A UE is configured with both FR1 and FR2 SCells for a given application. The UE gets into a power limited mode (e.g. low battery) and would therefore prefer to abandon FR2 power-hungry SCells in favor of an augmented configuration in FR1 SCells. | [CATT] This scenario can be addressed only if the UE can report a preferred configuration in FR1 which is “augmented” compared with current configuration and a reduced configuration on FR2 SCells.  [QCM] We agree with CATT that this scenario can happen but can’t be addressed if UE is only allowed to request up to its current configuration. |
| [QCM] Scenario #4: Suppose UE has been running on battery and operating in low-power mode. After it is plugged in an outlet, it wants to switch out of low power mode and adjust its radio resource configuration for higher throughput. | [QCM] In this scenario, there is no easy way for network to learn that UE has changed its power source and wants to increase its bandwidth etc. If UE is restricted to request only up to its current configuration, currently there is no other way for UE to signal this change in its power saving preference.  On network side, if a network implementation can’t handle UE requests beyong its current configuration, it can simply not accept such requests.  [Intel] We also support this scenario #4. However, we want to add a clarification on the network part. In our understanding, if the network implementation cannot handle UE’s request (beyong current configuration), network should at least be able to understand the value (as it is one of the possible configurations defined in specification) and if possible, netwok may still try to provide a larger configuration (even if it not as high as the one previously provided).  [Apple] Agree that based on the available UE power budget, UE should be allowed to request for a configuration to achieve a higher performance (e.g. Throughput). At the same time, this is just a request from the UE and not binding on the NW. If the NW has resources to allocate to the UE at this instance, it can allocate to the UE. If not the NW can ignore the UE request to upgrade beyong the current active configuration, while taking note of the UE request for any future configuration to that UE.  [MTK] Agree with the comments from Intel. |
| [Huawei] Scenario #5: A UE has requirement of power saving, e.g. prefers to work with 50M BW or 2 DL MIMO layers. UE cannot report its preference when the current configuration is lower than 50M BW or 2 DL MIMO layers. Only when the NW reconfigures the BW to 100M or DL MIMO layers to 4 layers, in which the UE finds that the new configuration exceeds its preference, the UE can send the UE assistance info indicating reduced the configuration, to request the NW to adjust the BW or DL MIMO layers back. | [Huawei] In this scenario, the NW cannot know UE preference earlier, the NW may configure sCC, BW and MIMO layers which is deviating from UE preference. Only after the unexpected configuration was done, the UE can report UE assistance info to the NW, then the NW may need to re-configure the UE back to the original configuration. It seems a totally unnecessary produce and costs signaling, and this can be avoid if the NW can acquire the UE preference earlier. So in our understanding, the UE can report its preference to NW once it has, even though the preferred value may be higher than the current configuration, it can be taken into account by the NW for further re-configuration.  [MTK] Agree that this scenario needs to be supported. The intention with UAI is to provide assistance to the NW, and Huawei has raised exactly this with this scenario – a means to assist the NW prior to a reconfiguration. |
| [Intel] Scenario #6: when UE knows that expecting large amount of data requires to be transmitted and power consumption is a critical factor (e.g. when running low on battery). | [Intel] In this scenario #6, from power consumption point of view, it can be more beneficial at a given moment to have larger configuration than the one currently in use as UE can save power while increasing the active aggregated BW instead of using smaller one for a longer period of time. Moreover, if UE had previously sent its preference of using an smaller configuration, there is no way for a UE to indicate that its previous preference is not valid any more, therefore the need for a UE to be able to indicate its new preference that might be a larger value than the one configured with (and maybe previously indicated as a preference by the UE).  [MTK] Agree that this scenario is useful. It is always more power efficient to use a wide band when there is a large amount of data to be sent. This will allow the UE to go to sleep earlier, thereby maximizing power savings. |
| [Samsung]  When UE needs to save its power, it may request to increase FR1 BW while to reduce FR2 BW, in order to avoid sudden degradation of the UE peak data rate.  Increasing FR1 BW means to excess current active configuration (for FR1). |  |
| [Apple] Scenario#7: UE can know the new APP coming earlier than NW performing AS configuration . Based on such knowledge, UE can indicate NW to activate/configure more SCell for data transmission. | [Apple] It can help to reduce the transmission time by increasing the larger frequency resource, and UE power can be saved due to the transmission time reduction   In legacy, NW scheduler performs SCell activation/deactivation based on radio quality, data amount and the evaluation timer for activation/deactivation ping-pong avoidance. The NW evaluation on all these factors will lead to no SCell activation or delay in SCell activation. |
| [Apple] Scenario#8: It can be used to indicate the UE preference of NR SCG addition, especially for EN-DC case. | [Apple] Sometimes NW doesnot configure inter-RAT measurement and not enable EN-DC configuration even if UE is in good NR coverage and data amount is not small. UE working on the narrow bandwidth resource for long time is not good for UE power compared to the UE working on large bandwidth resource for short time. Therefore, UE preference larger than current configuration can provide the helpful indication to NW for making NR SCG addition/removal decision. |
| [vivo] Scenario#9: UE is in low power status, but expects a large value of data transmission for some critical information (e.g. map data) which can be forecasted by the UE. After the transmission, the UE will return back to the narrow bandwidth/smaller numberf of CC. | [vivo] There may be no large bandwidth configuration or multiple CCs configuration from network for this UE at current stage. It is better for the UE to report some fancy preference to the network to seek for long-time power saving target.  From the network side, it is up to network to whether response the UE requests. But at least, network can consider such requirement from UE side.  Besides, we think there is no restriction to restrict the UE reporting range. We should keep the flexibility for the UE to request any value of maximum aggregated bandwidth, number of carriers and MIMO layers up to UE capability. Anyway, it is up to network to configure. |

**Rapporteur’s summary:**

*The following scenarios have been raised by 8 companies on this topic:*

1. *UE has been running on battery and operating in low-power mode (e.g. FR1 cells only). After it is plugged in an outlet, it wants to switch out of low power mode and adjust its radio resource configuration for higher throughput (e.g. FR1 and FR2 cells)*
2. *A UE has on-going traffic with small data rate (e.g. lower than 50M BW or 2 DL MIMO layers), and a new application triggers the need for a higher data rate requirement (e.g. 50M BW or 2 DL MIMO layers). As no UAI is reported by the UE, the NW reconfigures the UE beyond its preference (e.g. 100M BW or 4 DL MIMO layers). Thereafter the UE would send a UAI indicating the reduced configuration requirement requesting an additional reconfiguration by the NW. Until this reconfiguration takes place, the UE would consume more power than is necessary.*
3. *When expecting large amounts of data to be transmitted, it can be more beneficial at a given moment to have larger configuration than the one currently in use, as UE can save power while increasing the active aggregated BW instead of using smaller one for a longer period of time.*
4. *When UE needs to save its power, it may request an increase to FR1 BW while reducing FR2 BW, in order to avoid sudden degradation of the UE peak data rate*
5. *UE of new applications earlier than NW can perform a reconfiguration. Based on this knowledge, UE can indicate NW to activate/configure more SCell for data transmission reducing the transmission time reduction*

*From the earlier discussions (108#39 and AT109e#505 [2][3]) 10 out of 13 companies supported reporting UAI beyond the current configuration. The arguments raised above indicate that there are several scenarios in which the ability for the UE to report UAI beyond the current configuration is useful from a power consumption perspective. As no counter arguments have been raised, the following is proposed:*

**Proposal 1: UE can indicate any preferred value within its capability for maximum aggregated bandwidth, number of carriers, MIMO layers and minimum scheduling offset. (8/8)**

### Issue#2: Reporting UAI for a frequency range for which no cells are configured

*A UE can report a preferred aggregated bandwidth for a frequency range on the configured serving cell. FFS if it is allowed even if it is not configured with serving cells on that frequency range*

Similar to Issue#1, this issue was debated over email discussions 108#39 and AT109e#505 [2][3], with 10 companies indicating that they would prefer a reporting range up to the UE’s capability while 3 companies indicated that they would prefer to limit the reporting range to the current active configuration.

To have a more robust and free-form technical discussion, companies are recommended to provide their input to the table below similar to Issue#1 above.

|  |  |
| --- | --- |
| **Scenario to be addressed** | **Discussion on the scenario (indicate your company with your comments)** |
| [CATT] Scenario #1: same as for issue #1 | [CATT] If the UE is not configured with FR2 SCell (not needed for current on-going traffic) it cannot indicate a preferred FR2 SCell configuration, and the NW will behave as described in the left column, i.e. activate right away arbitrarily the highest performance, although overkill, FR2 SCell configuration. Reporting early the desired absolute configuration upon new DRB setup prevents the NW to allocate a maximum configuration first and then the UE to report a preferred reduced configuration afterwards. This allows saving all UE power spent unnecessarily in the meantime in tracking and measuring FR2 SCells (and associated beams) it does not need |
| [CATT] Scenario #2: same as for issue #1 | [CATT] Same as for scenario #1, if the UE cannot indicate its FR2 bandwidth and SCell needs associated with the new application, the NW will behave as described in the left column incurring unnecessarily delay in setting up the appropriate configuration, and thus power consumption |
| [QCM] Scenario #3: same as Scenario #4 that we described in Issue #1 | [QCM] Please see our comment on Scenario #4 in Issue #1. |
| [Intel] Scenario #6 as described in issue #1 | [Intel] Comment in scenario #6 of issue #1 would also be applicable. |
| [Samsung]  Currently, FR2 cell only has been configured, but UE may want to leave from FR2, but to be served by FR1. |  |
| [Apple] Scenario #7: same as Scenario #5 that we described in Issue #1 | [Apple] Same comments on scenario#7 in Issue#1. |
| [Apple] Scenario #8: same as Scenario #6 that we described in Issue #1 | [Apple] Same comments on scenario#8 in Issue#1. |
| [vivo] same as scenario #9 in issue #1 | [vivo] Same as scenario#9 in issue#1. |

**Rapporteur’s summary:**

*The same arguments for Issue#1 and raised for Issue#2 and in the same vein, the following in proposed:*

**Proposal 2: UE can indicate a preferred maximum aggregated bandwidth for a frequency range not configured with serving cells. (7/7)**

### Issue#3: Intepretation of fields when not reported

*All fields in the minSchedulingOffsetPreference and DRX-Preference IEs in the UE assistance information message are optional fields. FFS what it means when the UE omits the values.*

With regards to the interpretation of omitted IEs (e.g. drx-preference, maxBW-preference etc.) within a UAI report, the current implementation for power savings is aligned with the agreements from the main session in R2#108 on UAI reporting (see approved CR R2-1916632).

The open issue is the NW’s interpretation of the UAI report, when fields within an IE are omitted from the report (preferredDRX-ShortCycle is omitted from the drx-preference IE, or preferredK0/2 is omitted from the minSchedulingOffsetPreference IE). In [2], one company pointed out that it is dependent on whether this is the first instance that a UAI is sent or one that follows an earlier report. Accordingly the discussion below is split to consider how the NW interprets a UAI in each of these scenarios.

**Interpretation when fields within an IE (e.g. preferredDRX-ShortCycle in a drx-Preference IE, or preferredK0/2 in a minSchedulingOffsetPreference IE) are omitted from a UAI report**

***Scenario A: The UE has not provided a preference for the field since UAI was configured***

*How does the NW intepret the UAI received, when it does not include the field?*

*Option 1. UE does not have a preference for this field  
Option 2. Other (please specify)*

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| --- | --- | --- |
| **Company** | **Preference** | **Comments (if any)** |
| Qualcomm | Option 1 |  |
| CATT | Option 1 |  |
| Huawei | Option 1 | In our understanding, the NW’s interpretation of the UAI report is independent on whether this UAI is reported earlier or not. If the fields within an IE (e.g. preferredDRX-ShortCycle, or preferredK0/2) are omitted, it can be interpreted as “no preference” for this parameters.  However, if the UAI IE (e.g. drx-Preference IE, or minSchedulingOffsetPreference IE) is omitted, it means UE does not want to change its preference, which is the same logic applied to delay budget IE and overheating IE. For a special case, the UAI IE has not been reported before and is omitted, since the NW has not stored any UE preference and can still consider that no preference is requested by UE. |
| Intel | Option 1 |  |
| LG | Option 1 | Regardless of the previously reported prefernce , we prefer to align with overheating behaviouir, e.g, if preferredDRX-ShortCycle-r16 in DRX-Preference-R16 IE is omitted, it is interpreted as no preference for this parameter, and if DRX-Preference-R16 IE is omitted, it is interpreted as no change its preference. |
| Samsung | - | We would like to have a consistency with existing UE assistance principle.  Note that we have to distinguish 2 cases and that this requires grouping of the power saving information  1) Entire power saving assistance absent: no change compared to previous  2) Power saving assistance provided, but some subfield is absent: no preference for concerned subfield (and any previous preference is cleared)  >We think above is conform general UE assistance principles. We can provide further details on ASN.1 for the grouping |
| Ericsson | Option 1+ | If the UE has not provided a preference after UAI was configured (either for the complete IE or for a single parameter inside the IE) this means that the UE does not have a preference (for all the parameters of the IE when the IE is omitted or for the parameter(s) that are omitted in the IE). When the UE indicates “no preference” this means in most cases that the UE is fine with the current configuration, except for release assistance where it means that the UE does not prefer to be released and does not have a preference which state to transfer to. Furthermore when a complete IE is omitted this implies that the UE does not have any preference for the UAI features the UE has indicated to support, i.e. for the UAI features that it does not support and the IE is omitted, the NW should assume “don’t know”.  PS: after configuration the UE shall not send the UAI message just to indicate that it does not have a preference to avoid unnecessary signalling, except for release preference, where the UE may indicate a preferred RRC state it would to go when the connection is released. In our view the UE should not sent a release preference to stay in connected, i.e. this is what the NW by default would assume. |
| ZTE | Option 1 |  |
| Apple | Option 1 |  |
| OPPO | Option 1 |  |
| vivo | Option 1 | In our understanding, the NW’s interpretation of the UAI report is independent on whether this UAI is reported earlier or not. Regardless whether there is reported preference before, we should have the same UE behavious.  Similar as in overheating scenario, if the fields within an IE (e.g. preferredDRX-ShortCycle, or preferredK0/2) are omitted, we prefer that it can be interpreted as “no preference” for this parameters. |
| MediaTek | Option 1 | With regards to the two cases raised by Samsung: the behaviour in case 1 is already agreed (i.e. aligned with agreed delta signaling principles – see explanation in description text under Issue 3).  This question only addresses case 2, i.e. in case some subfields are absent. |
| Sony | Option 1 |  |

***Scenario B: The UE has previously provided a preference for the field in a UAI***

*How does the NW intepret the UAI received, when it does not include the field?*

*Option 1. UE does not have a preference for this field  
Option 2. UE does not want to change its preference from the previously reported preference  
Option 3. Other (please specify)*

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| --- | --- | --- |
| **Company** | **Preference** | **Comments (if any)** |
| Qualcomm | Option 2 |  |
| CATT | Option 1 | It is aligned with the behavior in Scenario A (i.e. when the UE has not provided a preference for the field since UAI was configured.) |
| Huawei | Option 1 | In our understanding, the NW’s interpretation of the UAI report is independent on whether this UAI is reported earlier or not. If the fields within an IE (e.g. preferredDRX-ShortCycle, or preferredK0/2) are omitted, it can be interpreted as “no preference” for this parameters.  However, if the UAI IE (e.g. drx-Preference IE, or minSchedulingOffsetPreference IE) is omitted, it means UE does not want to change its preference, which is the same logic applied to delay budget IE and overheating IE. For a special case, the UAI IE has not been reported before and is omitted, since the NW has not stored any UE preference and can still consider that no preference is requested by UE. |
| Intel | Option 2 | We want to highlight that this option 2 is aligned with RAN2 agreement on how NR UE assistance should work i.e., following delta operation of the previously reported UAI information. |
| LG | Option 1 | Regardless of the previously reported prefernce , we prefer to align with overheating behaviouir, e.g, if preferredDRX-ShortCycle-r16 in DRX-Preference-R16 IE is omitted, it is interpreted as no preference for this parameter, and if DRX-Preference-R16 IE is omitted, it is interpreted as no change its preference. |
| Samsung | - | See our opinion on the scenario A |
| Ericsson | Option 1 and 2 | In case of option 1, the UE would have to send unchanged preferences every time when it wants a change for one (or more) parameters. This would apply for all the UAI features that the UE supports, and the UE has signaled a preference for before. For legacy UAI we understood there was a baseline agreement that UE shall only signall changes, i.e. delta-signalling, and not repeat previous preferences. Therefore option 2 would be the way forward.  But we think that there may be a need for the UE to cancel previously signaled preference (i.e. delete stored preferences in NW). This basically means that we support both option 1 and 2. We think it is not efficient, or necessary that the signals an old preference again, just to keep the preference stored in the NW. To support both option 1 and 2, a means to cancel previously signaled preferences is needed, e.g. introduce special value in signaled value range. |
| ZTE | Option 1 | For overheating assistance information, UE can indicate to network that it is no longer experiencing an overheating condition by sending UEAssistanceInformation message without reducedMaxCCs, reducedMaxBW-FR1, reducedMaxBW-FR2, reducedMaxMIMO-LayersFR1 and reducedMaxMIMO-LayersFR2 in OverheatingAssistance IE. Similarly, we would like to interpret the absence of a field as one way to indicate no preference. |
| Apple | Option 2 | The previous reported preference should still considered to be valid. Otherwise it is a overburden to keep repeating the preference that was already reported. |
| OPPO | Option 2 |  |
| Vivo | Option 1 | Same as scenario A. |
| MediaTek | Option 1 | Slight preference for option 1 to allow an indication that the previously expressed preference is no longer valid, and the UE has no power constraints. |
| Sony | Option 2 | If not included, no change is requested. |

**Rapporteur’s summary:**

*Scenario A: The UE has not provided a preference for the field since UAI was configured*

*12 out of 13 companies agree that when fields within an IE (e.g. preferredDRX-ShortCycle in a drx-Preference IE, or preferredK0/2 in a minSchedulingOffsetPreference IE) are omitted from a UAI report, it is to be interpreted as the UE having no preference for the field if the field h.*

*Scenario B: The UE has previously provided a preference for the field in a UAI*

*6 companies prefer option 1 (interpret as no preference), while 5 companies prefer option 2 (no change from previously reported preference). One company indicates that both options are needed (i.e. in addition to no change from previously reported preference, the UE should also be able to indicate no preference). There is no clear majority on how to interpret the field in this scenario, so the following is proposed:*

**Proposal 3: If a field is not reported in a UAI, for which a preference has not been earlier indicated (since UAI was configured), it is interpreted as the UE not having a preference for the field (12/13)**

**Proposal 4: If a field is not reported in a UAI, for which a preference has been earlier indicated (since UAI was configured), R2 to decide if it is interpreted as a) the UE does not have a preference for the field (6/13), or b) UE does not want to change its preference from the previously reported preference (5/13)**

### Issue#4: Release Preference IE structure

As per the current implementation of release preference reporting in RRC, once the UE is configured with UAI for release preference, the UE reports a *releasePreference* **only** when it prefers to leave RRC connected mode. Thereafter, it can report *releasePreference* again in case of a change of its preference (i.e. back to connected).

During email discussion 108#39, two options for the release preference IE structure had most support and are listed out below:

*Option 1: Preferred state is always reported, and indicates idle, inactive, connected and out of connected, i.e.*

preferredRRC-State-r16 ENUMERATED {idle, inactive, connected, out of connected}

*Option 2: Release indication and preferred RRC state are separately indicated, i.e.*

releaseIndication-r16 ENUMERATED {connected, out-of-connected} OPTIONAL,

preferredRRC-State-r16 ENUMERATED {idle, inactive} OPTIONAL

Option 1 is aligned with the current implementation described above. Option 2 raises a new open issue on the interpretation of a *releasePreference* IE that only includes *preferredRRC-State*. Companies are asked to provide their preference between the two options above. If Option 2 is preferred, please also include your interpretation of a *releasePreference* IE that only includes *preferredRRC-State*.

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| **Company** | **Option 1/2** | **Comments (if any)** |
| Qualcomm | Option 2 | Option 1 only allows UE to indicate its preference for Idle/Inactive state when it requests connection release. UE has no way to indicates its state preference when its connection release is initiated by network.  This limitation of Option 1 can be avoided if preferred RRC state and connection can be indicated independently (i.e. Option 2). More specifically,   * If both ReleaseIndication and PreferredRRC-state are present, it means UE is requesting a connection release and a preferred RRC state after the release; * If only ReleaseIndication is present, UE is not asking for a connection release at the moment and the indicated preference is only for later when network releases UE’s connection; * If only ReleaseIndication is present, it means UE is requesting a connection release without any preference for its RRC state after the release. |
| CATT | Option 1 | It’s simple and clear. There is no agreement that UE can indicate its preference on RRC non-connected state only without a connection release request. |
| Huawei | Option 1 | Clear and fewer bits. |
| Intel | Option 1 | We do not see strong need for a UE to indicate at the same time its preference to be moved “out of connected” and to be moved into “idle or inactive” (as per option 2), however we are ok going with the majority view. Further points to consider, if UE indicate its preference based on option 1, our understanding is that some UEs or under certain circunstances UE prefers moving “out of connected” (without any preference on whether this is idle or inactive), vs other ones that have an explicit preference and could indicate this via “idle” or “inactive” preference. For option 2, both parameters indicate UE preferences related to UE’s RRC state transmission, therefore additional discussion may be needed to understand what it means when one of those parameters is omitted from UE’s preference (as the scenario is different than the one described in issue #3). For example, in t1 UE indicates its releaseIndication = out-of-connected, and preferredRRC-State = idle, and in t2 UE only indicates its releaseIndication = connected; how would network understand that UE wants to be kept in connected while the previous/stored preferredRRC-State = idle.  On summary, we think that option 1 provide similar UE’s flexibility as option 2 while avoiding potential contradictory cases or additional cases that needs clarification in the specification (i.e. when UE previously indicate its preferred RRC-State = idle or inactive, and in a future indicate its releaseIndication = connected). |
| LG | Option 1 | Option 1 is clear and simple from readability and signaling point of view. |
| Samsung | Other | According to general UE assistance principle, we prefer to have the following option:  releasePreference-r16 ENUMERATED {idle, inactive, out-of-connected}  The absence of the field releasePreference means that UE does not want to be released (i.e. to remain in connected mode) |
| Ericsson | Option 0 | We think the RAN2 agreements and IE structure are flawed:   1. After the UE has indicated that it prefers to leave connected mode, the UE will release the UE unless there is pending DL data. Thus there is practically no opportunity for the UE to “cancel” a previous release preference, i.e. the UE would typically be released. In case there is pending DL data and the UE is not released, the UE may consider the release preference “cancelled”, i.e. cancellation in that sense is already supported. 2. Similar as QC indicated above, we think it is useful that the UE can indicate a preferred RRC state it would like to transition to after configuration. This to facilitate the case when the NW releases the UE first, so the NW can take the UE preference into account.   We propose the following ASN.1 (we also think there is no need for UE to signal a change in preferred RRC state):  releaseIndication-r16 BOOLEAN OPTIONAL,  preferredRRC-State-r16 ENUMERATED {idle, inactive} OPTIONAL |
| ZTE | Option 1 |  |
| OPPO | Option 1 | Both options are clear and could be used to indicate all the possible cases. Option 2 needs one more bit than option1. |
| vivo | Option 1 | It seems that all preference can be covered by option 1. |
| MediaTek | Option 1 | Agree with others that option 1 is clear. |
| Sony | Option 1 |  |

**Rapporteur’s summary:**

*9 out of 12 companies prefer option 1. 2 companies prefer the option to report preferred RRC state separately from a request to leave connected state, as an input to NW triggered release. 1 company wants to revert the agreement from the last meeting on reporting a preference to move back to connected. Given that this topic was discussed over email in and past, and the majority view, the following is suggested*

**Proposal 5: Preferred RRC state is always reported in the release preference, and can indicate idle, inactive, connected and out of connected**

### Issue#5: NR SCG release preference

*UE implicitly can indicate a preference for NR SCG release by indicating zero number of carriers or zero aggregated maximum bandwidth in both FR1 and FR2.*

The agreement above is currently captured in TS 37.340 [4]. A suggestion was made at R2-109e to also capture the text above as a Note in the RRC specification as a clarification to the reader. Example text is provided below:

***NOTE: If the UE is in (NG)EN-DC, it can indicate a preference for NR SCG release by indicating zero maximum number of secondary component carriers, or zero maximum aggregated bandwidth in both FR1 and FR2.***

*Do companies support the inclusion of a Note as above into the RRC specification?*

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (or text modification suggestions, if any)** |
| Qualcomm | Yes | We think this note is both necessary and useful to have, especially for developers who may read only 38.331 for their work (developers typically do not read stage-2 specs, or at least not as carefully as they would read 38.331). As simple and a bit redundant as it may seem, it can help developers who are not aware of this agreement know how UE can request SCG release, without potential misinterpretation or second guessing.  Ps. A number of notes in 331 are added for the same reason (e.g. Note 1 on RRC reconfiguration with sync). So there is precedence for adding such a note. |
| CATT | Yes | Agree with Qualcomm. |
| Huawei | No strong view | Using zero maximum number of sCC, or zero maximum aggregated BW in both FR1 and FR2 is an implicit way and has few spec impacts, but it is OK to us to add a NOTE if companies think it is clearer. |
| Intel | Yes | We share Qualcomm’s view |
| LG | Yes | From the network implementation perspective, we think that the adding note is useful to interpret zero maximum number of secondary component carriers, or zero maximum aggregated. |
| Samsung | Yes |  |
| Ericsson | “No” | We agree with the proposal, but think a stronger clarification is needed. We think we should specify when the UE may send 0 CCs/BW for both FR1 and FR2, i.e. prevent UE signalling incorrect preferences, i.e. not just a NOTE for guidance. For example this could be clarified in the semantics description. |
| ZTE | No | We do not think this note is needed in RRC spec. Having it in stage 2 spec is sufficient. |
| Apple | Yes | This is a simple and effective mechanism to signal NR SCG release. |
| OPPO | Yes | A note is needed to interprete how to understand if zero maximum number of secondary CC, or zero maximum aggregated bandwidth in both FR1 or FR2 is reported. |
| vivo | Yes but! | First, we agree with Qualcomm that something is needed to be captured in stage-3 specification, e.g. add a note in RRC specification.  Regarding the wording of the note, the suggested text is not enough from stage-3 perspective.  It is not clear in which IE (MCG-UAI or SCG-UAI) to indidcate the zero max number of secondary component carriers. We should first conclude whether there is SCG specific UAI as in issue #7. After that, we can further discuss whether this zero max number of secondary commonent carriers should be indicated in SCG.  a. If it is indicated in MCG-UAI, according to the legacy conclusion in LTE, it should be interpreted as UE prefers to release all Scell/Pscell.  b. If it is indicated in SCG-UAI, it may be interpreted as UE prefers to release all Scell on SCG. |
| MediaTek | Yes | Agree with the point raised by QC |
|  |  |  |

**Rapporteur’s summary:**

*10 out of 12 companies prefer to capture something related to ‘the implicit SCG release’ in the RRC specification, and 1 company indicated that it has no strong view on this. Most companies prefer doing so with a Note. One company pointed out that the precise wording can be decided after having the discussion on SCG specific UAI. Therefore the following is suggested.*

**Proposal 6: A Note is included in the RRC specification clarifying how the UE can indicate a preference for NR SCG release. (9/12)**

### Issue#6: Whether flags *ps-TransmitPeriodicL1-RSRP/CSI* are defined per cell group or per CSI report configuration

An open issue from the last meeting was whether the *ps-TransmitPeriodicL1-RSRP* and *ps-TransmitPeriodicCSI* flags were to be defined per cell group or per CSI report configuration. The updated parameter list from R1 [5] does not provide a recommendation. It is therefore recommended that we conclude on this open issue in R2.

*Which option do companies support regarding the definition of the ps-TransmitPeriodicL1-RSRP/CSI flags?*

*Option 1: Defined per cell group (no change to the RRC CR)  
 Option 2: Defined per CSI configuration*

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1/2** | **Comments (if any)** |
| Qualcomm | Option 2 | Our view is that we need only a single flag configured per CSI-reportConfig and that can help avoid unnecessary CSI reports when UE has no data. The reason behind our preference is that  - The need for CSI report (L1-RSRP in particular) is different between active traffic and no traffic. When there is active traffic, narrow beams with high gains are used to maximize throughput. So frequent CSI reporting is needed to maintain not-so reliable narrow beams. On the other hand, when there is no traffic, UE only needs to maintain its PDCCH beam, which typically is more robust and requires less frequent beam management. So CSI reporting can be much less frequent.  - To support different CSI reporting frequencies based on traffic, we can either introduce sparse reporting when UE has no data (unfortunately it was not agreed in the last meeting), or configure CSI reporting per CSI, e.g. set CSI reporting flag to TRUE for low frequent CSIs intended for PDCCH beams but set CSI reporting flag to FALSE for high frequent CSIs intended for PDSCH beams. Obviously, we can’t achieve such behavior if CSI reporting flag is configured per UE. |
| CATT | Option 1 | Option 1 is simple. Option 2 can be achieved via network implementation, e.g. the network can configure frequent CSIs as SPS CSI reporting and infrequent CSIs as periodic CSI reporting to reduce UE power consumption. |
| Huawei | Option 1 | *ps-TransmitPeriodicL1-RSRP/CSI flags* is about L1-RSRP/CSI report when the *drx-onDurationTimer* does not start, so it focuses on the “sleep” state of UE without active traffic. Thus, per-CG configuration is simple and sufficient. |
| Intel | Option 1 | Note that this open item is also discussed in Q5 of ongoing email discussion #41. As explained there, we are ok current agreement unless RAN1 agrees otherwise |
| LG | Option 1 | According to the RAN1 agreement, only Option 1 is possible. |
| Samsung | Option 1 |  |
| Ericsson | Option 1 | These are RRC parameters introduced by RAN1, and RAN1 agreed. RAN1 agreed per cell group, i.e. we should not re-discuss and change in RAN2. We have sent an LS to RAN1 how to use these two flags. Why do we selectively re-discuss this particular aspect in RAN2? |
| ZTE | Option 1 |  |
| OPPO | Option 1 | Option 1 is simple. Option 2 will lead to more signal overhead. |
| vivo | N/A | In our understanding, there is no clear conclusion in RAN1. The discussion may also happen in this RAN1 meeting. Giving that this issue is still being discussed in RAN1. Can we leave it open by now? There is still chance to conclude it in May meeting. If there is no further input from RAN1, we can follow option 1 as mentioned by other companies. |
| MediaTek | Option 1 |  |
|  |  |  |

**Rapporteur’s summary:**

*9 out of 11 companies prefer to leave the existing RRC spec as it is. 1 company wants to leave this to R1 to discuss further. No change is proposed on this topic, and this open issue from the last meeting can be considered resolved from RAN2’s perspective.*

**Observation 1: From R2’s perspective, flags *ps-TransmitPeriodicL1-RSRP/CSI* are defined per cell group. (9/11)**

3 Known open issues related to SCG specific UAI

In this section we discuss the open issues related to the agreements on SCG specific UAI.

*In MR-DC with NR SN, support SCG specific UAI for power saving, which includes drx-Preference, maxBW-Preference, maxCC-Preference, maxMIMO-LayerPreference, and minSchedulingOffsetPreference.*

*UE transmits SCG specific UAI for power saving in a transparent container to the MN and the MN then forwards the received container to the NR SN. FFS if UAI can also be reported for power saving directly via SRB3 if configured. FFS on the signalling details.*

### Issue#7: Reporting SCG specific UAI for power saving via SRB3

*Do companies support the reporting of SCG specific UAI for power saving via SRB3?*

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
| Qualcomm | Yes | If SRB3 is configured and supported by UE. |
| CATT | Yes | The MN does not need to be aware of SCG specific UAI for power saving. Hence, if SRB3 is configured, the UE can report SCG specific UAI for power saving via SRB3 directly. |
| Huawei | Yes | If SRB3 is configured and supported by UE. The similar mechanism for SN FailureInformation and SN MeasurementReport can be re-used for SCG specific UAI. |
| Intel | Yes | We are ok with allowing this mechanism although we may need to reconsider if additional complexity is identified. |
| LG | Yes |  |
| Samsung | - | Preferable to have a consistency with overheating assistance, i.e. can follow the approach introduced for EN-DC overheating |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Apple | Yes | Same reason as CATT |
| OPPO | No | In our opinion, reporting via SRB3 could reduce reporting delay. As UAI for power saving is not so urgent in most cases, there is no need to support reporting SCG specific UAI for power saving via SRB3 |
| vivo | Yes | It is similar to other cases. |
| MediaTek | No | Agree with Oppo. We do not see any need to do so. |
|  |  |  |

**Rapporteur’s summary:**

*9 out of 12 companies prefer to be able to report SCG specific UAI for power saving via SRB3. The topic is broken down further in Issues#8 and #9 where corresponding proposals are provided.*

### Issue#8: SCG specific UAI for power saving in (NG)EN-DC

*How does the network configure the UE to report SCG specific UAI for power savings in case of (NG)EN-DC?*

*Option 1: Include the NR UAI configuration in RRCConnectionReconfiguration on the LTE leg, (i.e. otherConfig is included in nr-SecondaryCellGroupConfig)  
Option 2: Include the NR UAI configuration in RRCReconfiguration on the NR leg using SRB3  
Option 3: Other (please specify)*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preference(s)** | **Comments (if any)** |
| Qualcomm | Option 1 | Option 2 can also be used if SBR3 is configured |
| CATT | Option 1&Option2 | If SRB3 is configured, the network can include the NR UAI configuration in *RRCReconfiguration* via SRB3 directly.  If SRB3 is not configured, the NR SN generate *RRCReconfiguration* message which includes the NR UAI configuration. Then the LTE MN transfers the received RRC message for SCG configuration transparently to the UE via RRCConnectionReconfiguration message (i.e. *otherConfig* is contained in *mrdc-SecondaryCellGroup* in *RRCConnectionReconfiguration* message.) Actually, in option 1, the NR UAI configuration is also included in *RRCReconfiguration* but transferred on the LTE leg. |
| Huawei | Option 1 & 2 | The similar mechanism for SN FailureInformation and SN MeasurementReport can be re-used for SCG specific UAI. |
| Intel | Option 1 & 2 |  |
| LG | Option 1 & 2 |  |
| Samsung | Option 1 | It is assumed that MN is responsible |
| Ericsson | Option 1 & 2 | Solution depends on whether SRB3 is supported/configured or not |
| ZTE | Option 1 & 2 |  |
| Apple | Option 1 & Option 2 | Option 2 if SRB3 is configured, Option 1 otherwise |
| OPPO | Option1 | If reporting SCG specific UAI for power saving via SRB3 is not supported, the NR UAI configuration should not be reconfigured *on the NR leg using SRB3* either. |
| vivo | Opton 1 & 2 | We agree with CATT. It is also similar to other cases. |
| MediaTek | Option 1 |  |
|  |  |  |

**Rapporteur’s summary:**

*In case of (NG)EN-DC, all companies agree that it is possible to configure SCG specific UAI via SRB1 on the LTE leg. 8 out of 12 companies also suggest that it should be possible to configure SCG specific UAI on the NR leg via SRB3 if configured.*

**Proposal 7: In (NG)EN-DC, SCG specific UAI for power saving can be configured by the network via SRB1 (using *nr-SecondaryCellGroupConfig*) or SRB3 (using *RRCReconfiguration*).**

*How does the UE report the SCG specific UAI for power savings in case of (NG)EN-DC?*

*Option 1: Include the NR UEAssistanceInformation in ULInformationTransferMRDC on the LTE leg  
Option 2: Transmit UEAssistanceInformation on the NR leg using SRB3  
Option 3: Other (please specify)*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preference(s)** | **Comments (if any)** |
| Qualcomm | Option 1 | Option 2 can also be used too if SBR3 is configured |
| CATT | Option 1&Option 2 | If SRB3 is configured, the UE can transmit *UEAssistanceInformation* via SRB3 directly.  If SRB3 is not configured, the UE transmits the *UEAssistanceInformation* message via the E-UTRA MCG embedded in E-UTRA RRC message *ULInformationTransferMRDC*. The MCG forwards the received info transparently to the SCG. |
| Huawei | Option 1 & 2 | The similar mechanism for SN FailureInformation and SN MeasurementReport can be re-used for SCG specific UAI. |
| Intel | Option 1 & 2 |  |
| LG | Option 1 & 2 |  |
| Samsung | - | Preferable to have a consistency with overheating assistance, i.e. can follow the approach introduced for EN-DC overheating |
| Ericsson | Option 1 & 2 |  |
| ZTE | Option 1 & 2 |  |
| Apple | Option 1 & Option 2 | Option 2 if SRB3 is configured, Option 1 otherwise |
| OPPO | Option1 | See our reply to issue#7. BTW, we wonder what is the difference between this issue and issue#7. |
| vivo | Option 1 & 2 | We agree with CATT. It is also similar to other cases. |
| MediaTek | Option 1 |  |
|  |  |  |

**Rapporteur’s summary:**

*In case of (NG)EN-DC, 11 out of 12 companies agree that it is possible to transmit SCG specific UAI via SRB1 on the LTE leg. 9 out of 12 companies also suggest that it should be transmitted on the NR leg via SRB3, if configured.*

**Proposal 8: In (NG)EN-DC, SCG specific UAI for power saving is transmitted in *ULInformationTransferMRDC* on the LTE leg. (11/12)**

**Proposal 9: In (NG)EN-DC, SCG specific UAI for power saving is transmitted on the NR leg via SRB3, if SRB3 is configured. (9/12)**

### Issue#9: SCG specific UAI alongside NR-DC

As our agreement was for MR-DC with NR SN, the implication is that SCG specific UAI for power saving is supported in NR-DC as well. However, the UAI report in NR-DC (for all cases, including power saving) is across both cell groups, i.e. it is for NR cells across both the MCG and the SCG. We therefore need to discuss the configuration, reporting and interpretation of the UAI in NR-DC.

*Do companies support the reporting of SCG specific UAI for power saving for NR-DC?*

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
| Qualcomm | Yes |  |
| CATT | Yes | Some UE assistance info, e.g. *maxBW-Preference, maxCC-Preference, maxMIMO-LayerPreference*, can be CG specific or across both cell groups. However, some UE assistance info (i.e. *drx-Preference* and *minSchedulingOffsetPreference*) is CG specific reporting. For example: DRX configuration is CG specific configuration. The MCG and the SCG may serve totally different traffic types. Then the preferred DRX configurations are different the MCG and the SCG. If the UE only reports preferred DRX configurations across both cell groups, inappropriate DRX configurations may be configured by the network. E.g. short DRX configurations are suitable for traffics on the SCG. If the UE reports preferred short DRX configurations across both cell groups, inappropriate short DRX configurations may be configured by the MCG. If the UE doesn’t report preferred short DRX configurations, short DRX configurations may not be configured by the SCG. Considering all UE assistance info can be CG specific, we propose the UE to report CG specific UAI (not across both cell groups) for power saving for NR-DC. |
| Huawei | Yes |  |
| Intel | Yes |  |
| LG | Yes |  |
| Samsung | Yes |  |
| Ericsson | No | We do not see a strong motivation to indicate different preferences for MCG and SCG in NR. The UE may have different preferences for MCG in LTE and SCG in NR, because the RATs have different characteristics w.r.t. power consumption. However in case of NR-DC we talk about the same RAT with the same characteristics, i.e. the UE can indicate “aggregated” preferences that apply to both cell groups. |
| ZTE | No | For NR-DC case, we share the same understanding with Ericsson that UE can indicate “aggregated” preference rather than different preference for MCG and SCG. For example, when UE indicating the maximum aggregated uplink bandwidth, it includes uplink carrier(s) of both the NR MCG and the SCG in NR-DC.  For some CG specific assistance info, e.g. drx-Preference and minSchedulingOffsetPreference, UE can simply indicate one preference which is applicable for both CGs. We cannot see much gain in indicating different preference for MCG and SCG. |
| Apple | Yes |  |
| OPPO | Yes |  |
| vivo | Yes |  |
| MediaTek | No | Agree with Ericsson and ZTE |
|  |  |  |

If the answer to the above question is yes, then the following questions need to be addressed.

*In NR-DC, what does the UE report on the MCG, when UAI for power saving is configured on the MCG as well as on the SCG?*

*Option 1: The UAI includes assistance information across MCG and SCG  
Option 2: The UAI includes assistance information specific to MCG only  
Option 3: Other (please specify)*

*[Rapporteur’s clarification] – The intention of the question is to understand the contents of the UEAssistanceInformation message that is sent on the MCG, and not the contents of the transparent UAI contained in the ULInformationTransferMRDC sent on the MCG.*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preference(s)** | **Comments (if any)** |
| Qualcomm | Option 3 | The UAI includes assistance information specific to either MCG or SCG.  In our view, in many scenarios power saving is a procedure more specific to a MAC entity than UE. Therefore, UE should have the flexibility to indicate its preference specific to a cell group. |
| CATT | Option 3 | The UAI reporting is CG specific. The MCG doesn’t need to be aware of UAI for the SCG. Thus:  - For UAI for MCG, the UE reports it to the MCG directly.  - For UAI for SCG, the UE reports it to the SCG via SRB3 directly if SRB3 is configured while the UE reports it to the MCG via SRB1 (i.e. the *UEAssistanceInformation* message is embedded in NR RRC message *ULInformationTransferMRDC*) which is forwarded to the SCG via the MCG transparently if SRB3 is not configured. |
| Huawei | Option 3 | It is more complex for the NW if the UAI reported is across MCG and SCG, since the coordination between MN and SN is needed. CG specific UAI is clearer and preferred. Agree with CATT above. |
| Intel | Option 3 | The UAI could include assistance information specific to MCG and/or SCG depending on the required scenario, understanding that it is up to UE implementation to decide which/when to report UAI. We want to also clarify that in our understanding, the SCG specific UAI sent via MCG (to the SCG) would go as a transparent container. |
| LG | Option 2 | The UAI is reported independently to each CG applying the UAI, i.e., MCG specific UAI is reported to the MCG directly, and SCG specific UAI is reported to the SCG via SRB 3 or embedded message. |
| Samsung | Option 1 |  |
| Apple | Option 3 | UAI for SCG depends on if SRB3 is configured. Same reasoning as CATT |
| OPPO |  | We think UAI for MCG and SCG should be reported respectively. So if UE reports a UAI to MCG, it should simultaneously indicate whether the UAI is for MCG or for SCG. |
| vivo |  | We agree to have CG specific assistance information. It is not clear for us how to interprete UAI across MCG and SCG. |

*In NR-DC, what does the UE report on the MCG, when UAI for power saving is configured on the MCG only?*

*Option 1: The UAI includes assistance information across MCG and SCG  
Option 2: The UAI includes assistance information specific to MCG only  
Option 3: Other (please specify)*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preference(s)** | **Comments (if any)** |
| Qualcomm | Option 2 |  |
| CATT | Option 2 | As mentioned above, UAI is CG specific. If UAI for power saving is configured on the MCG only, it means the network wants to know the UE preference configurations on the MCG only. |
| Huawei | Option 2 |  |
| Intel | Option 2 | It is not clear why a UE configured only with UAI for MCG could report UAI for SCG. We assume that a UE has to also be configured by the network separately to be able to report UAI for SCG. |
| LG | Option 2 |  |
| Samsung | Option 2 | Not clear how the option 1 works when UAI is configured on MCG only |
| Apple | Option 2 |  |
| OPPO | Option 2 |  |
| vivo | Option 2 | According to the answer to above question, it should be Option2. |

*How does the network configure the UE to report SCG specific UAI for power savings in case of NR-DC?*

*Option 1: Include the NR UAI configuration in RRCReconfiguration on SRB1, (i.e. otherConfig is included in mrdc-SecondaryCellGroup)  
Option 2: Include the NR UAI configuration in RRCReconfiguration on SRB3  
Option 3: Other (please specify)*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preference(s)** | **Comments (if any)** |
| Qualcomm | Option 1 |  |
| CATT | Option 1&Option 2 | If SRB3 is configured, the network can send *RRCReconfiguration* message which includes *otherConfig* via SRB3 directly.  If SRB3 is not configured, similar to the case of (NG)EN-DC, the NR UAI configuration is included in *RRCReconfiguration* generated by the SCG. Then the message is contained as *mrdc-SecondaryCellGroup* in *RRCReconfiguration* of the MCG and sent via SRB1, i.e. *otherConfig* is included in *mrdc-SecondaryCellGroup*. |
| Huawei | Option 1 & 2 | The similar mechanism for SN FailureInformation and SN MeasurementReport can be re-used for SCG specific UAI. |
| Intel | Option 1 & 2 |  |
| LG | Option 1 |  |
| Samsung | Option 1 | It is assumed that MN is responsible |
| Apple | Option 1 and Option 2 | Option 2 if SRB3 is configured. Option 1 otherwise |
| OPPO | Option 1 |  |
| vivo | Option 1 &2 | Similar as above issues. |

*How does the UE report the SCG specific UAI for power savings in case of NR-DC?*

*Option 1: Include the NR UEAssistanceInformation in ULInformationTransferMRDC on SRB1  
Option 2: Transmit UEAssistanceInformation on the NR leg using SRB3  
Option 3: Other (please specify)*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preference(s)** | **Comments (if any)** |
| Qualcomm | Option 1 |  |
| CATT | Option 1&Option 2 | It is similar to the case of (NG)EN-DC.  If SRB3 is configured, the UE can transmit *UEAssistanceInformation* via SRB3 directly.  If SRB3 is not configured, the UE transmits the *UEAssistanceInformation* message via the NR MCG embedded in NR RRC message *ULInformationTransferMRDC*. The MCG forwards the received info transparently to the SCG. |
| Huawei | Option 1 & 2 | The similar mechanism for SN FailureInformation and SN MeasurementReport can be re-used for SCG specific UAI. |
| Intel | Option 1 & 2 |  |
| LG | Option 1 & 2 |  |
| Samsung | Option 1 | It is assumed that MN is responsible |
| Apple | Option 1 and Option 2 | Option 2 if SRB3 is configured. Option 1 otherwise |
| OPPO | Option 1 |  |
| vivo | Option 1 &2 |  |

**Rapporteur’s summary:**

*In case of NR-DC, 9 out of 12 companies agree that it is possible to report SCG specific UAI for power saving for NR-DC, while 3 companies do not see a motivation for doing so. The following is proposed based on the majority view:*

**Proposal 10: In NR-DC, SCG specific UAI for power saving can be configured by the network. (9/12)**

*Of the 9 companies that support SCG specific UAI in NR-DC, 8 companies prefer that the reported UE assistance information for power saving is CG specific.*

**Proposal 11: The reported UAI for power saving is specific to a cell group. (8/9)**

All 9 companies support configuring the SCG specific UAI via SRB1, while 5 companies also indicate support to configure the SCG specific UAI via SRB3.

**Proposal 12: In NR-DC, SCG specific UAI for power saving can be configured by the network via SRB1 (using *mrdc-SecondaryCellGroup*) or SRB3 (using *RRCReconfiguration*).**

All 9 companies support reporting the SCG specific UAI via SRB1, while 6 companies also indicate the SCG specific UAI is transmitted via SRB3 if configured.

**Proposal 13: In NR-DC, SCG specific UAI for power saving is transmitted in *ULInformationTransferMRDC* on SRB1. (9/9)**

**Proposal 14: In NR-DC, SCG specific UAI for power saving is transmitted on the SCG via SRB3, if SRB3 is configured. (6/9)**

4 Other open issues

Please use the table below to list out other issues that companies would like to raise for further discussion

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Issue ID** | **Description** | | **Discussion** | **Rapporteur’s suggestion** |
| M#1 | The intention of per-BWP DL MIMO layers configuration is that UE adaptation of the number of Rx antennas provides power saving gains. For example, if per-BWP DL MIMO layers are re-configured to 2 layers from 4 layers, the power consumption is reduced if UE switches to 2 Rx antennas from 4 Rx antennas. Thus, there is an underlying relationship between maximum DL MIMO layers and Rx antennas. UE should be allowed to turn on the same number of Rx antenna(s) in a DL BWP as the maximum number of DL MIMO layers indicated per BWP, and this is expected to be captured in the spec to provide an instruction for UE implementation.  So the following NOTE is preferred to be added in the field description for *maxMIMO-Layers*.  NOTE: When the maximum MIMO layers configured for a DL BWP is N, the UE may use N antenna connector(s) for the reception of PDSCH on the DL BWP. | | [QCM] For any given DL MIMO configuration, It has always been up to UE implementation how many Rx antenna to use. There is no need to add such a note to define coupling between them.  [CATT] We have the same understanding as Qualcomm.  [Huawei] Support to add this NOTE to make it clear that this UE implementation is allowed.  [LG] We have same understanding with Qualcomm. The relationship between DL MIMO configuration and Rx antenna does not need to be defined.  [MTK] Agree with QC that there is no need for such a note  [Intel] We also share QC’s view (i.e. no need for adding that note)  [ERI] We share the same understanding as the companies above, i.e. in our view there is not need for such a NOTE. In our understanding the number of antenna’s used by the UE should be left to the UE implementation. Furthermore we if the NOTE provides good guidance, i.e. in some cases the UE may benefit from using more antenna’s then the number of max MIMO layer that is configured (e.g. at cell edge). | No action:  All responding companies have indicated that there is no need for such a note, as the number of RX antennas to use is left to UE implementation. |
| M#2 | [Intel] Assuming that UE can only provide its preference of a reduced value from the one currently configured (as discussed in the first issues of this document). We wonder if companies would want to re-consider allowing for those cases that UE can also indicate to the network when its previously provided preference is not valid (e.g. for the cases when UE may preferred having a larger configuration than the one previously indicated in UAI and is currently in used). | | [MTK] Option 1 for Issue#3 can solve this  [QCM] What Intel proposes could be a compromise. But we’d disagree with MTK that Option 1 for Issue #3 (i.e. “no preference” would solve it, because network would not know whether UE wants to be “reconfig up” or “reconfig down” by its “no preference” indication.  [Intel] In our understanding, this new topic is dependent on the outcome of the issue #1 (and not as related to issue #3). We share the view explained by QC that this aims to be a possible compromise that was also raised during the 109 e-meeting discussion for a UE to indicate that it would prefere a re-configuration to a large value within its possible range.  [ERI] We agree that the UE should be able to indicate to the NW that a previously signaled preference is no longer valid (except for the preference to be released ☺). The solution for this has to be considered together with the solution when UE does omits a preference, and whether “delta-signalling” applies. But please do not make it unnecessary complicated, and do not try to invent something new every time, but built on what we already have. That in the end is good for UE and NW. | Postpone:  This may only need to be discussed following the discussion on Issue#1. |
| M#3 | [Intel] It is pointed internally that the following statements on the field description of *maxMIMO-Layers* are not aligned to RAN1 agreements and understanding:  “*this value overrides the maxMIMO-Layers configuration in IE PDSCH-ServingCellConfig”*  *“The value of maxMIMO-Layers for a DL BWP shall be smaller than or equal to the value of maxMIMO-Layers configured in IE PDSCH-ServingCellConfig (if present)*.”  The motivation for our comment is the following:  1. RAN1 related agreements (copied below for reference) do not state that this new *maxMIMO-Layers* overrides the oneconfigured in IE *PDSCH-ServingCellConfig*.  2. The *maxMIMO-Layers* configured in IE *PDSCH-ServingCellConfig* shall be unchanged since it is still used in other PHY operations e.g. to determine rate matching procedures (LBRM) and therefore, the new maximum MIMO layer configuration provided for a DL BWP should have no impact on this field. Therefore, the field description it might better state what MIMO layer configuration for a DL BWP should be used for (instead of indicating that the DL BWP config overrides per CC config.).  2. The *maxMIMO-Layers* configured in IE *PDSCH-ServingCellConfig* shall be configured to have this feature work. Therefore, the sentence with “if present” should be removed.  On summary, we propose the following change:   |  | | --- | | ***maxMIMO-Layers***  Indicates the maximum MIMO layer configuration for a DL BWP. If present, UE may assume that the number of MIMO layers for PDSCH is less than or equal MIMO layer configuration for a DL BWP. ~~If present, UE may assume that this value overrides the~~ *~~maxMIMO-Layers~~* ~~configuration in IE~~ *~~PDSCH-ServingCellConfig~~* ~~when the UE operates in this BWP. If absent, the UE uses the~~ *~~maxMIMO-Layers~~* ~~configuration in IE~~ *~~PDSCH-ServingCellConfig~~* ~~when the UE operates in this BWP.~~ The value of *maxMIMO-Layers* for a DL BWP shall be smaller than or equal to the value of *maxMIMO-Layers* configured in IE *PDSCH-ServingCellConfig* ~~(if present)~~. |   For further reference, see below RAN1 related agreements taken in different meetings. Note that it is also highlighted an explicit note that also explains that LBRM is not dependent on this new per BWP configuration:   * *Support per-DL-BWP configuration of maximum number of DL MIMO layers*    + *Signalling details up to RAN2* * *The configured per-BWP DL max MIMO layer value is expected to be less than or equal to the per-cell configured DL Max MIMO layer value (if configured).* * *DL-SCH TBSLBRM is invariant across all the DL BWPs, when DL max MIMO layer adaptation is per BWP*   + *FFS details* * *No spec change for TS38.212 is needed for determining DL-SCH TBSLBRM when downlink max MIMO layer adaptation is configured.*    + *Note: DL-SCH TBSLBRM is not dependent on the per-BWP configured maximum number of DL MIMO layers value.* * *When maximum number of DL MIMO layers per BWP is configured for all configured DL BWPs for a serving cell,*   + *At least one BWP is configured with per-BWP configured maximum number of DL MIMO layers value equal to the per-cell configured maximum number of DL MIMO layers value (if configured).* | | [MTK] – Intel raise a valid point that for LBRM, R1 have agreed to use the cell-specific value rather than the BWP specific value (which is not aligned with our agreement from R2-107). We are ok to remove the sentence ‘If present…’ on overriding the MIMO configuration from the serving cell configuration, but the sentence ‘If absent…’ is still needed.  [QCM] We agree the issue raised by Intel is valid. We are fine with the text change suggested by MTK.  [Intel] We can be ok with the point raised by MTK (i.e. keeping the sentence that address the “if absent” scenario), although we assumed that this is default behavior (as follow legacy operation) and might not be as critical to add. If this change were preferable, the suggested change would look as follow:  ***maxMIMO-Layers***  Indicates the maximum MIMO layer configuration for a DL BWP. If present, UE may assume that the number of MIMO layers for PDSCH is less than or equal MIMO layer configuration for a DL BWP. ~~If present, UE may assume that this value overrides the~~ *~~maxMIMO-Layers~~* ~~configuration in IE~~ *~~PDSCH-ServingCellConfig~~* ~~when the UE operates in this BWP.~~ If absent, the UE uses the *maxMIMO-Layers* configuration in IE *PDSCH-ServingCellConfig* when the UE operates in this BWP. The value of *maxMIMO-Layers* for a DL BWP shall be smaller than or equal to the value of *maxMIMO-Layers* configured in IE *PDSCH-ServingCellConfig* ~~(if present)~~.  [ERI] We agree with the proposed change by Intel above, except we are confused about the sentence:  *If present, UE may assume that the number of MIMO layers for PDSCH is less than or equal to MIMO layer configuration for a DL BWP.*  We are not sure what this sentence is trying to say, or whether it is needed. | The following change is suggested:  ***maxMIMO-Layers***  Indicates the maximum number of MIMO layers to be used for PDSCH in this ~~MIMO layer configuration for a~~ DL BWP. ~~If present, this value overrides the~~ *~~maxMIMO-Layers~~* ~~configuration in IE~~ *~~PDSCH-ServingCellConfig~~* ~~when the UE operates in this BWP.~~ If absent, the UE uses the *maxMIMO-Layers* configuration in IE *PDSCH-ServingCellConfig* when the UE operates in this BWP. The value of *maxMIMO-Layers* for a DL BWP shall be smaller than or equal to the value of *maxMIMO-Layers* configured in IE *PDSCH-ServingCellConfig* ~~(if present)~~. |
| E#1 | Cancellation of a preference to release the connection does not work and should therefore be removed | | [MTK] This is not an open issue, but one that has been resolved after extensive discussion.  [ERI] Whether this is an open issue or not, is a secondary aspect in our view. In case a feature does not work and may cause uncessary signalling it should be removed in our view. | No action |
| Sony#1 | Based on [Post109e#42][PowSav] UE capabilities , we should wait for RAN1 input when it comes to RAN1 features overlapping, e.g. DRX adaptation, but it would be good to anyway discuss those paramters in the upcoming RAN2 meeting preparing for those to be added. | |  | This can be discussed as part of the UE capabilities discussion. |
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**Proposal 15: The field description of maxMIMO-Layers is updated to indicate that the field does not overrides the value provided in *PDSCH-ServingCellConfig*.**

5 Summary of issues raised in submitted TDocs

This section summarises documents [6] to [13] that were submitted on UE assistance/RRC issues.

## 5.1 Further discussion on Issue#1 and Issue#2

The summary of the discussion on Issues#1 and #2 is copied below:

**Rapporteur’s summary:**

*The following scenarios have been raised by 8 companies on this topic:*

1. *UE has been running on battery and operating in low-power mode (e.g. FR1 cells only). After it is plugged in an outlet, it wants to switch out of low power mode and adjust its radio resource configuration for higher throughput (e.g. FR1 and FR2 cells)*
2. *A UE has on-going traffic with small data rate (e.g. lower than 50M BW or 2 DL MIMO layers), and a new application triggers the need for a higher data rate requirement (e.g. 50M BW or 2 DL MIMO layers). As no UAI is reported by the UE, the NW reconfigures the UE beyond its preference (e.g. 100M BW or 4 DL MIMO layers). Thereafter the UE would send a UAI indicating the reduced configuration requirement requesting an additional reconfiguration by the NW. Until this reconfiguration takes place, the UE would consume more power than is necessary.*
3. *When expecting large amounts of data to be transmitted, it can be more beneficial at a given moment to have larger configuration than the one currently in use, as UE can save power while increasing the active aggregated BW instead of using smaller one for a longer period of time.*
4. *When UE needs to save its power, it may request an increase to FR1 BW while reducing FR2 BW, in order to avoid sudden degradation of the UE peak data rate*
5. *UE of new applications earlier than NW can perform a reconfiguration. Based on this knowledge, UE can indicate NW to activate/configure more SCell for data transmission reducing the transmission time reduction*

*From the earlier discussions (108#39 and AT109e#505 [2][3]) 10 out of 13 companies supported reporting UAI beyond the current configuration. The arguments raised above indicate that there are several scenarios in which the ability for the UE to report UAI beyond the current configuration is useful from a power consumption perspective. As no counter arguments have been raised, the following is proposed:*

[10] raises the counter arguments listed below against P1. I’ve also included responses to these arguments received over the reflector in the table below. Similar to the discussion on Issues#1 and #2, companies are encouraged to provide further input to the table below.

|  |  |
| --- | --- |
| **Scenario to be addressed** | **Discussion on the scenario (indicate your company with your comments)** |
| *Scenario#10: UE determination of future resource requirements are unreliable or erroneous* | [CATT] We can answer this in two-fold:  1) As described in some of the scenarios listed in the email discussion, one key point for the UE to provide an accurate prediction is to minimize the power consumed in unnecessary beams monitoring over multiple cells and large bandwidths, since this is also (on top of the Tx) where the RF power is burnt. So we think UE has an interest in predicting some accurate value rather than over-estimate it.  2) It can be questioned why this issue of erroneous prediction is an issue only for UE’s estimation of larger needs, as the same issue likely applies when UE makes erroneous estimation of reduced needs. But we understand the key point is the potential system capacity impact of allocating “large” resources, when following an erroneous UE’s reported preference. Which is the Point 2 below. |
| *Scenario#11: Incorrect resource allocation can negatively impact system capacity for the NW* | [CATT] We are not sure of why system capacity is challenged here. We are discussing NW RRC-configuring a UE with SCells/BWPs in FR1 and/or FR2 based on a reported preference. This is not MAC scheduling and at this point no PDCSH/PUSCH resource is given to the UE. We assume MAC scheduler will still schedule the UE according to the exact BSR needs and also considering other UEs in the cell. Since, in our understanding, the system capacity is primarily driven by the ability of the MAC scheduler to schedule UEs appropriately, we are not so sure of the severe impact of an inaccurate reported preference value by a UE at RRC level.  As a 2nd point, we got from operators the feedback that UE power consumption is the primary concern of early 5G networks deployments, not system capacity (especially when FR2 cells are involved). |
| *Scenario#12: Existing mechanisms (such as BSR or other power saving features) are sufficient to address this issue* | [ERI] We agree that nothing new is needed, except that the UE can indicate that a previous reduced CC/BW/MIMO is no longer valid.  [CATT] Even in that case, it is still unclear to us how does NW predicts the need in terms of CC/BW/MIMO and FR1/FR2 partitioning based on BSR only, and so far, it is our understanding that the approach is to overprovision by default rather than to allocate based on real UE’s needs. |
| *Scenario#13: UE determination of future resource requirements does not necessarily reduce the UE power consumption.* | [ERI] It is not clear nor obvious, that in case the NW configures the UE with future/expected resource requirements, that this reduces the UE power consumption, i.e. on the contrary. Perhaps such configuration improves latency (and UE experience). We have not seen any (quantitative) evaluation of the expected UE power savings.  [CATT] We acknowledge we have no simulation results to show quantitative performance benefit, but we just relay operators’ feedback/concerns from the field experience on this issue. We also share your view (on reflector) that initial Rel-15 NW deployments were not necessarily designed for UE power saving in first place and NW vendors are willing to improve this in next releases. But this is also why we believe those NW vendors that would be willing to rely on more UE information should be allowed to. |
| *Scenario#14: UE trigger for future resource requirements needs further discussion and should be specified if agreed.* | [ERI] When it is not clear nor specified how the UE determines the future resource requirements, it is not clear if the NW can rely on it and configure what the UE prefers.  [CATT] [Also addressing your further response on the reflector regarding “bad UE implementations/mis-use of the feature”]. We see it more as a general issue of the accuracy of UE’s reports, not only associated with the discussion of reporting “more” or “less” than currently configured. In our understanding the issue of assessing reports accuracy from different UE implementations has been there since 3G (you mentioned fast dormancy example) and is part of RRM stack in the base stations. So, in the case we are discussing, we think this evaluation of UE’s prediction of their future needs would be done, by comparing the “allocated” vs “scheduled” and so should not impact the RRM complexity so much. |
| *Scenario#15: UE trigger for future resource requirements may create additional signalling when NW does not support it.* | [ERI] The NW can ignore UE preference signalling, but in case the NW does not implement “*future resource requirements*” it would create unncesarry signalling in the NW, and the UE would send signalling that is not used and waste power tool.  [CATT] If NW does not want to implement such UAI it can just not configure it. If NW does not want to implement UE’s preference when it is larger than current configuration, option 3 below may be a compromise. |

[10] acknowledges the need to address Scenario#4 (the case where UE is plugged in to an outlet), and therefore suggests the following compromise (similar to that proposed in M#2 in section 4):

*The UE may signal that previously signalled preference(s) to reduce resources are no longer valid.*

[7] proposes alternative behaviour to address Issue#1 as below. The suggestion to resolve Issue#1 here is to leave it to NW configuration, i.e. NW can control whether the UE reports UAI up to the current configuration or up to the UE capability.

*NW can control in a dynamic manner for each RRC Connection if the UE is allowed to trigger such upgrade request using UAI up to the UE capability.*

As a result of the discussion thus far, the following options exist. Companies are requested to provide their preferred option(s) from the list below:

**Q1: What is your preferred option on the reporting of maximum aggregated bandwidth, number of carriers, MIMO layers and minimum scheduling offset?**

1. **UE can indicate any preferred value within its capability**
2. **UE can indicate that previously signalled preference(s) to reduce resources are no longer valid**
3. **NW can configure if the UE can indicate values limited by a) the current configuration or b) the UE’s capability**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option(s)** | **Comments (if any)** |
| Intel | 1, 2, 3 | We hope that option 2 will be allowed as part of the issue #3 discussed here. In addition, we understand it would be helpful for a UE to be able to report its preferred value within its capability (option 1) as explained on the different scenarios described. On other hand, understanding network concerns or different views, we are also opened to enable option 3 aiming for a possible compromise. |
| LG | 1 | We think it would be good to give the flexibility for a UE. |
| Ericsson | 2 |  |
| CATT | 1, 3 | Compromise 3 would be OK for us. Option 2 is a separate and more general issue that also applies to other UAI features. |
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## 5.2 Further discussion on Issue#3

Scenario B of Issue#3, i.e. interpretation of a field when a value has been previously reported, is inconclusive and is raised in a few documents [9] [10]. The summary is copied below

**Rapporteur’s summary:**

*Scenario B: The UE has previously provided a preference for the field in a UAI*

*6 companies prefer option 1 (interpret as no preference), while 5 companies prefer option 2 (no change from previously reported preference). One company indicates that both options are needed (i.e. in addition to no change from previously reported preference, the UE should also be able to indicate no preference). There is no clear majority on how to interpret the field in this scenario.*

*Proposal 4: If a field is not reported in a UAI, for which a preference has been earlier indicated (since UAI was configured), R2 to decide if it is interpreted as*

*a) the UE does not have a preference for the field (6/13), or*

*b) UE does not want to change its preference from the previously reported preference (5/13)*

This proposal has been discussed further over email with a compromise suggested that allows indication of both options a) and b) above, i.e. to be able to indicate no preference as well as to be able to indicate no change from previous preference. The options were well summarized by Intel and are copied below for reference:

* *Compromise (1): option (a) and (b) based on Ericsson’s proposal in email discussion #43 keeping the agreed ASN.1*
* *Compromise (2): option (b) following LTE UAI approach. Note that this approach does not allow delta operation keeping the agreed ASN.1*
* *Compromise (3): Samsung’s proposal 1 in* [*R2-2003229*](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003229.zip) *[9] with the proposed ASN.1 change where the parent structure is powerSavingAssistance-r16 for the partial-delta operation.*
* *Compromise (4): Samsung’s proposal1 in* [*R2-2003229*](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003229.zip) *[9] but keeping the agreed ASN.1 where the parent structure is each of the new features defined where UE provides its PWS preferences for the partial-delta operation (e.g. drx-Preference-r16 or MinSchedulingOffsetPreference-r16).*

*Note that compromise (3) and (4) focus on the same partial-delta principle/functionality explained by Samsung where the parent structure that is replaced would be different for each one.*

* *If further clarification were helpful, please find below a table showing exemplary scenarios. Assuming T1<T2, for all 4 compromises, at T1 and T2 times, the table shows what the UE’s preferences are upon transmission/reception of the given UAI message (marked with A below). In addition, assuming that UE would want to keep its preferences sent at T1, different UAI messages (mark with B, C, D, E, F below) are used in T2’ (instead of using UAI msg A).  As before it is assumed that T1<T2’ and the table shows what the UE’s preferences are upon transmission/reception of the given UAI message for a given compromise option.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Time*** | ***Compromise options*** | ***Message or  UE's preference*** | ***delayBudgetReport*** | ***preferredDRX-LongCycle-r16 (defined w/in drx-Preference-r16)*** | ***preferredDRX-InactivityTimer-r16 defined (w/in drx-Preference-r16)*** | ***preferredK0-SCS-30kHz-r16 (defined w/in MinSchedulingOffsetPreference-r16)*** |
| *T1* | *1, 2, 3, 4* | *UAI msg (A)* | *msMinus320* | *NA (no value reported ever)* | *ms100* | *s12* |
| *UE's preference* | *msMinus320* | *NA (no value reported ever)* | *ms100* | *s12* |
| *T2* | *1,2,3,4* | *UAI msg (B)* | *NA (no value reported)* | *ms1024* | *NA (no value reported)* | *NA (no value reported)* |
| *1 (Note-1)* | *UE's preference* | *msMinus320* | *ms1024* | *ms100* | *s12* |
| *2 (Note-2)* | *UE's preference* | *NA  (no value reported again)* | *ms1024* | *NA  (no value reported again)* | *NA  (no value reported again)* |
| *3 (Note-3)* | *UE's preference* | *msMinus320* | *ms1024* | *NA  (no value reported again)* | *NA  (no value reported again)* |
| *4 (Note-4)* | *UE's preference* | *msMinus320* | *ms1024* | *NA  (no value reported again)* | *s12* |
| *T2'* | *1 (Note-1)* | *UAI msg (C)* | *NA (no value reported)* | *ms1024* | *previous-value-not-valid (new value to be defined)* | *NA (no value reported)* |
| *UE's preference* | *msMinus320* | *ms1024* | *NA (previous-value-not-valid)* | *s12* |
| *2 (Note-2)* | *UAI msg (D)* | *msMinus320* | *ms1024* | *ms100* | *s12* |
| *UE's preference* | *msMinus320* | *ms1024* | *ms100* | *s12* |
| *3 (Note-3)* | *UAI msg (E)* | *NA (no value reported)* | *ms1024* | *ms100* | *s12* |
| *UE's preference* | *msMinus320* | *ms1024* | *ms100* | *s12* |
| *4 (Note-4)* | *UAI msg (F)* | *NA (no value reported)* | *ms1024* | *ms100* | *NA (no value reported)* |
| *UE's preference* | *msMinus320* | *ms1024* | *ms100* | *s12* |

*Note-1: For compromise 1, a previously reported values are kept unless it is explicitly indicated to discard it via “previous-value-not-valid (new value to be defined)”*

*Note-2: For compromise 2, previously reported values are discarded unless they are reported again (as in LTE UAI)*

*Note-3: For compromise 3, in T2, values previously provided in different parent structure are only kept (e.g. for delayBudgetReport) as powerSavingAssistance parent structure is fully replaced (as shown in T2). Therefore as the parent structure of powerSavingAssistance is fully replaced (when reported as T2), this means that previous preferences provided on T1 for preferredDRX-InactivityTimer-r16 and MinSchedulingOffsetPreference-r16 are discarded unless the UE sends them again (in addition to the new parameter that changes, i.e. preferredDRX-LongCycle-r16), as it is shown in T2’.*

*Note-4: For compromise 4, the parent structure would be drx-Preference-r16, therefore in T2, upon sending a preferred value for preferredDRX-LongCycle-r16, the previously one provided in preferredDRX-InactivityTimer-r16 is discarded but the one in preferredK0-SCS-30kHz-r16 is kept (as drx-Preference-r16 and MinSchedulingOffsetPreference-r16 are different parent structures). In addition,  as the parent structure of drx-Preference-r16 is fully replaced (when reported as T2), this means that previous preferences provided on T1 for preferredDRX-InactivityTimer-r16 is discarded unless the UE send it again (in addition to the new parameter that changes, i.e. preferredDRX-LongCycle-r16), as it is shown in T2’.*

**Discussion:**

It would be good to focus the discussion on the four options suggested above, to converge on the expected behaviour.

* Option 1 and option 4 can be seen as corollaries.
  + In option 1, the absence of a field is interpreted as ‘no change’, while ‘no preference’ is explicitly indicated
  + In option 4, the absence of a field is interpreted as ‘no preference’, while ‘no change’ is explicitly indicated
* Option 2 is not aligned with the delta signaling principles that was agreed in the main session (see approved CR R2-1916632).
* Option 3 proposes to bring all power saving parameters under one umbrella IE (powerSavingAssistance), and requires the UE to report all fields (e.g. DRX, max BW and so on) within the new powerSavingAssistance IE. This raises further questions, as we have agreed quite early on, that these fields are individually configured and have their own prohibit timer values. For example, UE is configured with two different prohibit timers for DRX and max BW reporting. If the prohibit timer is running for max BW reporting, what does the UE report in the UAI?
  + Would it be DRX feedback only (in which case NW would assume that the UE has no preference for max BW), or
  + Would it be DRX and max BW feedback (in which case individual prohibit timers serve no purpose)?

**Q2: What is your preferred option(s) from the four options outlined above? Please provide additional comments on expected behaviour, especially if Option 2 or Option 3 is preferred.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option(s)** | **Comments (if any)** |
| Intel | Compromise 3 or 1 | As explained on reflector, our key priority is to agree on a solution that enables scenario (A) when its previously provided UAI preference is still valid, as well as, scenario (B) when its previously provided UAI preference is not valid any more.  As we explained in our previous comments, we tried to capture on compromise (4) our understanding from CATT’s comment sent over reflector which looks to be different to us than the explanation provided by MediaTek for option 4. Even though we have sympathy for compromise 4, we understand that it has the drawnback that UE cannot indicate when a previous preference provided within a parent structure is not valid (scenario (B)) e.g. if UE reported preferredDRX-LongCycle-r16 within the drx-Preference-r16, how could UE indicate that this preference is not valid (without indicating the preference of other sub-field)?  We acknowledge the concerns raised by MediaTek for option 3, however in our understanding, the proposed change of ASN.1 should not impact the procedural modeling already agreed for each UAI PWS preference features (which are configured/supported independently, and the behavior of the different prohibit timers is independent too). Therefore, when a UE repeats the value of its previous preference, this should not trigget its prohibit timer to (re)start (which should be easily to address on the procedural text).  In addition, we would also be ok enabling compromise 1 even if a new value needs to be defined for each field to indicate that previous value is not valid (i.e. “*previous-value-not-valid*”). |
| LG | Option 2 | As metioned in Issue#3, we prefer to align with overheating behaviouir, i.e, if parameters in parent IE are omitted, it is interpreted as no preference for this parameter. |
| Ericsson | Option 1 or compromise 3 | PS1: we wonder if we are mixing functionality and coding in this discussion, i.e. “previous preference no longer valid” seems a functional discussion to us, while it is mixed with the discussion what it means when an OP parameter is omitted. The same applies to the  PS2: Option 3 is not what SS is proposing, right? I thought that SS proposal 1 *[R2-2003229](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003229.zip)* proposes that previous preferences remain valid when a feature is omitted, but preferences have to transmitted again within a feature. I think Himke also indicated this in some email.  PS3: we agree that repeating previous preferences to keep the preference stored in the NW works, but it is not bit efficient, e.g. for DRX we have many parameters to potentially repeat. Companies indicated a preference for a release structure which saved 1 bit. In this case we talk about a lot of bits.  PS4: We could be fine with the proposal by SS/Himke that on a feature level preferences remain stored when omitted, but not for the parameters within feature. However we want to ask what is the motivation for this “hybrid” proposal, i.e. the NW has to store on a feature level, but for individual parameter within a feature can rely on the UE to repeat them? |
| CATT | Option 4 | We agree with the rapporteur that option 3 contradicts an earlier RAN2 agreement, which we should avoid.  Similarly, option 1 contradicts an earlier RAN2 agreement “*Explicit signalling for ‘no preference’ is not supported for any of the power saving parameters (cDRX, number of SCells, aggregated BW or number of MIMO layers)*” which we should also avoid.  And option 4 is aligned with the current UAI reporting for overheating. |
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## 5.3 Question related to Issue#5

Following our agreement on the implicit indication of a preference to release the SCG for power savings, [8] points out that the RAN3 TS 38.423 does not have a release cause of ‘power savings’ for message *S-NODE RELEASE REQUIRED*, in case the NW would like to release the SCG. It is therefore proposed that an LS be sent to R3 to check whether any changes need to be made to their specifications to take our agreements into account.

*RAN2 sends an LS to RAN3 to confirm whether a new “Cause” related to power saving purpose is needed for SgNB Release Required.*

**Q3: Should R2 send an LS to R3 to inform them of our agreement on the indication of SCG release preference from the UE?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
| Intel | - | We are ok to send an LS to RAN3, however we think that RAN2 should inform them about the new PWS feature (including a short description and/or reference to related TS sections) letting them to discuss whether one of the existing cause values can be reused (e.g. “User Inacitvity” or a new cause one is needed. |
| LG | Yes |  |
| Ericsson | Yes | We are ok with an LS, but we should not tell RAN3 what to do, but that does not seem to be the proposal, e.g. it should be left to RAN3 if a new cause value is needed. |
| CATT | No | We are not sure of the benefit of adding a new cause? Or, put it differently, what is the drawback if the ‘unspecified’ cause value is used? Based on the current specification, the MN cannot reject the SN release request (i.e. there is no unsuccessful operation in TS 38.423). Then it is enough to reuse the ‘unspecified’ cause value to the implicit SCG release, unless some additional MN actions or behaviors are needed if the MN receives SN release request with the new cause. |
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## 5.4 New features and optimisations

The following proposals can be classified as new features or optimisations and it is therefore the rapporteur’s suggestion to not discuss these proposals further.

[6] proposes to introduce new UAI feedback on the Minimum Time Gap i.e. the time gap between the DCP and the start of DRX-onDuration timer as below:

*The UE may signal UE assistance information including a preferred value of Minimum Time Gap in addition to signaling its Minimum Time Gap capability.*

It is pointed out in this document that the minimum time gap is already signaled by the UE as part of capability signaling. As this proposal is for a new feature (rather than an open issue), and furthermore as it is related to an aspect that was discussed and defined by RAN1 (PS-offset), it is the rapporteur’s suggestion to not discuss this proposal in RAN2. If companies have any comments on this topic, they can provide their feedback below:

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| **Company** | **Comments (if any)** |
| Intel | Our understanding is that if this new “*UE assistance information including a preferred value of Minimum Time Gap*” should be triggered/requested by RAN1. Moreover the WID explicitly captured that RAN1 could provide input of RAN1-specific UAI preferences (i.e. “*NOTE: additional UE assistance information for RAN1-specific power saving techniques to indicate what setting of parameters related to this Work Item will lead to power savings for the UE can be included if agreed in RAN1*”) |
| LG | The introduction of the preferred value of Minimum Time gap is RAN1 scope. We should not discuss the optimization at this late stage of Rel-16. |
| Ericsson | Agree with the comments above, that this is a RAN1 topic, and should not be discussed in RAN2. |
| CATT | We agree with the rapporteur and Intel. |
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[7] proposes the following optimization to the prohibit timer mechanism, with the addition of a counter to further limit the number of UAI triggered by the UE. If companies have any comments on this topic, they can provide their feedback below:

*Using a budgeted count and timer based approach, NW can streamline and rationalize the number of such upgrade requests (up to UE capability) from UE.*

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| **Company** | **Comments (if any)** |
| Intel | We do not essential this level of optimization. |
| LG | We think the current prohibit timer is sufficient to restrict UAI triggering. We should not discuss the optimization at this late stage of Rel-16. |
| Ericsson | We assumed that the mixed counter/timer proposal was to forward the UAI for increased CC/BW/MIMO, i.e. not sure if this was a generic proposal. We are fine to introduce a counter in addition to a timer for UAI release signalling |
| CATT | We agree with the rapporteur. This is an optimization that we don’t need to discuss at this late stage. |
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[11] proposes to revert the agreement from the last meeting on the signaling of ‘connected’ preference, as below.

*The “connected” preference is removed from the ReleasePreference structure.*

It argues that rather than an explicit signaling of ‘connected’ preference, this can be implicitly indicated by further exchange of data between the NW and the UE. If companies have any comments on this topic or would like to support such behaviour, they can provide their feedback below:

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| **Company** | **Comments (if any)** |
| Intel | We preferred post-pone this discussion until we know the outcome of issue#3. The motivation being in our understanding a UE needs the means to indicate when its previous preference to move into idle, or inactive or out-of connected is not valid anymore. At the time, this was enabled via the value connected, however we would be open to revisit this agreement if the solution for issue #3 were to allow the UE to provide this kind of information (e.g. this might be possible with option 1, 2 and 3, but not with 4). |
| LG | We prefer the explicit value to request “connected”. |
| Ericsson | There is no need nor use to explicity signal “connected”, i.e. it only leads to additional signalling which whould be avoided: The UE woud typically immediately be released after having sent a release preference, unless there is DL data pending in the gNB. In case the UE would not be releaed immediately, and the UE would like to cancel, then the prohibit timer would typically prevent the UE from sending a cancellation. Furthermore after more UL/DL data the UE can assume that NW inactivity timer is reset and the UE remains in connection. Thus UE would not be able to “cancel” and there is no need to “cancel”. Agreeing to “connected” signalling goes against the agreement on having a prohibit timer to avoid uncessary signalling.  @Intel: In our view the “connected” discussion is not, and should not, be connected with the general discussion about what is means when a preferred parameter is omitted. The release assistance, i.e. the preference to be released, is different from the general preference signalling, because the UE is typically released after such preference. Furthermore a preference to be release also does not survive Idle/Inactive – Connected cycle. |
| CATT | We don’t see the reason for removing this agreement. And this is unrelated with issue#3 since, per proposal 5, preferredRRC-State is not an optional field.  @Ericsson: you suggest that after the prohibit timer has expired, if the UE was not released by the NW, it implicitly cancels the previous UE’s preference (hence no need to send “connected” if the UE would change its mind)? But then, in the case where the UE wouldn’t change its mind, it would then need to send again its preference to be released? |
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6 Conclusion

The following conclusions are candidates for easy agreement:

**Proposal 3: If a field is not reported in a UAI, for which a preference has not been earlier indicated (since UAI was configured), it is interpreted as the UE not having a preference for the field (12/13)**

**Proposal 6: A Note is included in the RRC specification clarifying how the UE can indicate a preference for NR SCG release. (9/12)**

**Proposal 7: In (NG)EN-DC, SCG specific UAI for power saving can be configured by the network via SRB1 (using *nr-SecondaryCellGroupConfig*) or SRB3 (using *RRCReconfiguration*).**

**Proposal 8: In (NG)EN-DC, SCG specific UAI for power saving is transmitted in *ULInformationTransferMRDC* on the LTE leg. (11/12)**

**Proposal 9: In (NG)EN-DC, SCG specific UAI for power saving is transmitted on the NR leg via SRB3, if SRB3 is configured. (9/12)**

**Proposal 15: The field description of maxMIMO-Layers is updated to indicate that the field does not overrides the value provided in *PDSCH-ServingCellConfig*.**

The following proposals may raise further discussion:

**Proposal 1: UE can indicate any preferred value within its capability for maximum aggregated bandwidth, number of carriers, MIMO layers and minimum scheduling offset. (8/8)**

**Proposal 2: UE can indicate a preferred maximum aggregated bandwidth for a frequency range not configured with serving cells. (7/7)**

**Proposal 4: If a field is not reported in a UAI, for which a preference has been earlier indicated (since UAI was configured), R2 to decide if it is interpreted as**

**a) the UE does not have a preference for the field (6/13)**

**b) UE does not want to change its preference from the previously reported preference (5/13)**

**Proposal 5: Preferred RRC state is always reported in the release preference, and can indicate idle, inactive, connected and out of connected (9/12)**

**Proposal 10: In NR-DC, SCG specific UAI for power saving can be configured by the network. (9/12)**

The following proposals are conditional on acceptance of P10:

**Proposal 11: The reported UAI for power saving is specific to a cell group. (8/9)**

**Proposal 12: In NR-DC, SCG specific UAI for power saving can be configured by the network via SRB1 (using *mrdc-SecondaryCellGroup*) or SRB3 (using *RRCReconfiguration*).**

**Proposal 13: In NR-DC, SCG specific UAI for power saving is transmitted in *ULInformationTransferMRDC* on SRB1. (9/9)**

**Proposal 14: In NR-DC, SCG specific UAI for power saving is transmitted on the SCG via SRB3, if SRB3 is configured. (6/9)**

7 References

1. R2-2002383 - RAN2#109e agreements and remaining Issues for Power Saving (CATT)
2. R2-2001914 - [AT109e][505][Pow] Email discussion on open issues on UE assistance (Qualcomm)
3. R2-2001912 - Email discussion summary on running 38.331 CR for Power Saving (Mediatek)
4. R2-2002387 - CR for supporting UE Power Saving in TS 37.340 (Oppo)
5. R1-2001478 - Updated consolidated parameter list for Rel-16 NR (Qualcomm)
6. R2-2002670 - Power Saving UE assistance information (Sony)

1. [R2-2002798](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_109bis-e/Docs/R2-2002798.zip) - Value Range for UE Assistance Information (Apple)
2. R2-2002838 - Remaining issues on implicit SCG release (OPPO)
3. R2-2003229 - Adopting general UE assistance reporting framework to UE power saving (Samsung Telecommunications)
4. R2-2003288 - Open issues UE capability, DCP, UE assistance and RRM relaxation (Ericsson)
5. R2-2003289 - UE assistance for connection release (Ericsson, ZTE, Deutsche Telekom)
6. R2-2003472 - Discussion on clarification for max MIMO layer and antenna port (Huawei, HiSilicon)
7. R2-2003473 - TP for clarification for max MIMO layer and antenna port (Huawei, HiSilicon)