**3GPP TSG-RAN WG2 #109bis-e R2-200xxx**

E-meeting: 20th – 30th, April, 2020

Agenda Item: 6.7.2.2

Source: CMCC

Title: [AT109bis-e][026][IIOT] Scheduling Enhancements, Part 1

Document for: Discussion and Decision

# 1 Introduction

This document is for the following offline discussion, particularly for topics in 6.7.2.2:

* [AT109bis-e][026][IIOT] Scheduling Enhancements (CMCC)

Status: Not yet Started, will be started after on-line session April 21

Scope: Treat topics in 6.7.2.2, open issues and corrections, in particular parts of [R2-2003497](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_109bis-e%5CDocs%5CR2-2003497.zip) that are not treated on-line.

Part 1: Determine which issues that need resolution, find agreeable proposals. Deadline: April 24 0700 UTC. Result to be merged into CRs in other email discussions (e.g. RRC, possibly MAC).

The summary document [13] of contributions submitted to Agenda Item 6.7.2.2 related to Scheduling Enhancements for IIOT WI sections are copied in the Annex for reference.

And this contribution aims to address the left issues in [13].

# 2 Discussion

## 2.1 Potential easy agreements

The following agreements are proposed as potential easy agreements based on the summary in [13].

Proposal 1: Not to introduce restrictions of how many SPS configurations are supported, e.g. per cell/ per UE (SPS/CG).

**Question 1: Do you agree with Proposal 1 ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **YES/NO** | **Comment / alternative proposal** |
| Nokia | YES |  |

Proposal 2: No need to capture limitation of maximum CG/SPS configurations per MAC entity in TS 38.300.

**Question 2: Do you agree with Proposal 2 ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **YES/NO** | **Comment / alternative proposal** |
| Nokia | YES |  |

Proposal 3: Support up to 32 SPS configurations per MAC entity.

**Question 3: Do you agree with Proposal 3 ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **YES/NO** | **Comment / alternative proposal** |
| Nokia | YES |  |

**Proposal 4: Support CG periodicities of multiple of 2/7 symbols in IIoT.**

**Question 4: Do you agree with Proposal 4 ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **YES/NO** | **Comment / alternative proposal** |
| Nokia | YES | Considering this has no impact to RAN1, we see no reason not to support it. It can be a UE capability which is separate from the slot level periodicities. |

**Proposal 6. SPS-Config and SPS-ConfigList in BWP-DownlinkDedicated cannot be configured simultaneously at a given time.**

**Question 5: Do you agree with Proposal 5 ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **YES/NO** | **Comment / alternative proposal** |
| Nokia | YES | We may run into some issues if we do otherwise, e.g. ambiguity in activation/release commands. |

**Proposal 7. ConfiguredGrantConfig and ConfiguredGrantConfigList in BWP-UplinkDedicated cannot be configured simultaneously at a given time.**

**Question 6: Do you agree with Proposal 7?**

|  |  |  |
| --- | --- | --- |
| **Company** | **YES/NO** | **Comment / alternative proposal** |
| Nokia | YES | We may run into some issues if we do otherwise, e.g. ambiguity in activation/release commands, CG confirmation MAC CE etc. |

## 2.2 Proposal may require more discussion

**Proposal 5: Progress further the issue of the step of determining the closest N needs to be added.by email discussion or on line discussion.**

**Question 7: Do you agree with Proposal 5?**

|  |  |  |
| --- | --- | --- |
| **Company** | **YES/NO** | **Comment / alternative proposal** |
| Nokia |  | Yes, we need to progress as there is a pending FFS in the specifications. Should we discuss a Text Proposal for this? We had our own proposal for a simple TP in [9], but we also think there was a good proposal in [6], i.e. clarify for Type 1 CG formula that:“where N >= 0 and N is the smallest value corresponding to the closest available CG occasion after configured grant Type 1 configuration.” |

## 2.3 Possible postpone Issues

### ***2.2.1 Issue #7 Configure grant type 1 resources calculation during BWP switch***

R2-2003586 [11] raised an issue that in rel-16, not similar with R-15, the occasion of configured grant type 1 is no longer solid in one SFN cycle due to the enhanced periodic can have a non-integer multiple time relationship with 10240ms. Thus UE need to deduct the occasion sequentially from the first occasion. Thus the understanding of ‘suspend’ and ‘initialize/reinitialize’ shall be clarified in Rel-16. Thus it proposed:

**Proposal 8: RAN 2 is kindly asked to clarify the ‘suspending’ and ‘(re)-initializing’ configured gran type 1 resources for the case of BWP switch:**

**The understanding of suspending:**

* **Option 1: UE still keep calculating the occasion of the suspended configured grant type 1 even when the related UL BWP is deactivated**
* **Option 2: UE stop calculating the occasion of the suspended configured grant type 1 when the related UL BWP is deactivated.**

**Correspondingly, the understanding of ‘initialize/reinitialize’**

* **Option 1: UE continue to use the occasion of the suspended configured grant type 1 when the related UL BWP is activated**
* **Option 2: UE recalculate the occasion of the configured grant type 1 based on the r*eferenceSFNnumber , timeDomainOffset, and S* and the SFN number when the switch on is occurred.**

**Question 8: Do you this issue need to be addressed in Rel-16? If yes, do you agree the proposal?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **YES/NO- Addressed in Rel-16** | **YES/NO- Do you agree the proposal** | **Comment / alternative proposal** |
| Nokia | Yes |  | We are not sure we understand the options really. In any case, we think UE needs to continue to calculate the occasions even when not operating in a BWP. Otherwise, there might be misalignment between the occasion it will use when it switches back to the BWP and the one it should be using.  |

**Proposal 9: When an UL BWP is deactivated, UE still need to calculate the resources sequentially for each configured grant type 1. When an UL BWP is activated, UE continue to use the occasion of the suspended configured grant type 1 resources when the related UL BWP is activated.**

**Question 9: Do you this issue need to be addressed in Rel-16? If yes, do you agree the proposal?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **YES/NO- Addressed in Rel-16** | **YES/NO- Do you agree the proposal** | **Comment / alternative proposal** |
| Nokia | Yes | Yes | It seems this is a proposal related to P8 as well. This is how we think it should work, so we support the proposal. |

### ***2.2.2 Issue #7 Measurement gaps***

R2-2002657[1] proposes UE to transmit during the measurement gaps, since UE cannot transmit/receive during the measurement gap and it impacts the latency performance. However, there were other proposals before this meeting that even if allowing UE to send during measurement gap, it does not solve the issue for DL traffic and one simpler solution is to allow UE to be equipped with two radios. Therefore, we expect this topic to be contentious and unlikely to converge at e-Meeting.

**Proposal 10: The TSN transmission should be allowed when TSN transmission collides with measurement gap, and Network can configure UE which types of TSN traffic can be transmitted during measurement gaps.**

**Question 10: Do you this issue need to be addressed in Rel-16? If yes, do you agree the proposal?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **YES/NO- Addressed in Rel-16** | **YES/NO- Do you agree the proposal** | **Comment / alternative proposal** |
| Nokia | No | No | This has been discussed and we agreed this should not be treated in Rel-16. |

### ***2.2.3 Issue #8 Burst arrival time***

R2-2002708 [3] proposes a clarification of the burst arrival time defined in SA2 TS 23.501. It raised an issue that the aggregation process results in the 5G network identifying TSCAI information (e.g. Burst Arrival time) and QoS flow characteristics that are representative of the aggregated set of TSN flows. The gNB uses this information to allocate periodic resource in support of the corresponding TSN streams. Currently, the burst arrival time is defined as the beginning of the burst. Since it is more beneficial for RAN to get the knowledge of a burst arrival time that refers to the end of the burst, it is proposed that RAN2 send SA2 an LS stating “It is beneficial for RAN to obtain from TSCAI a burst arrival time that refers to the end of the burst rather than the beginning of the burst” [4].

**Proposal 11: It is beneficial for RAN to obtain from TSCAI a burst arrival time that refers to the end of the burst rather than the beginning of the burst. And RAN2 can send SA2 an LS stating “It is beneficial for RAN to obtain from TSCAI a burst arrival time that refers to the end of the burst rather than the beginning of the burst”.**

**Question 11: Do you this issue need to be addressed in Rel-16? If yes, do you agree the proposal?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **YES/NO- Addressed in Rel-16** | **YES/NO- Do you agree the proposal** | **Comment / alternative proposal** |
| Nokia | No | No | We do not have a strong view, but we think determining the end of the burst may not be trivial at this stage. This could be left for implementation in Rel-16 and addressed in Rel-17 where SA2 is already working on defining additional parameters such as burst spread. |

# **3 Conclusion**

TBD

# 4 References

1. R2-2001627 Impact of CG/SPS with periodicities non dividing HF length Sequans CommunicationsR2-2002657 Handling of collision between TSN transmission and measurement gap Spreadtrum Communications discussion
2. R2-2002707 SPS CG remaining issues Ericsson discussion NR\_IIOT-Core
3. R2-2002708 TSC AI clarifications: meaning of arrival time Ericsson discussion NR\_IIOT-Core R2-2000790
4. R2-2002709 Draft LS: TSC AI clarifications for arrival time Ericsson LS out NR\_IIOT-Core R2-2000791 To:SA2
5. R2-2002663 Discussion about open issues for CG and SPS Huawei, HiSilicon discussion Rel-16 NR\_IIOT-Core
6. R2-2002753 Remaining issues for multiple SPS and CG configurations CATT discussion NR\_IIOT-Core
7. R2-2002946 Configuration of Configured Grant and Semi-Persistent Scheduling Samsung discussion Rel-16 NR\_IIOT-Core
8. R2-2003168 Periodicities of multiple of 2 or 7 symbols for CG Nokia, Nokia Shanghai Bell, Ericsson, NTT Docomo discussion Rel-16 NR\_IIOT
9. R2-2003169 Determining the ‘closest N’ for CG Type-1 initialization Nokia, Nokia Shanghai Bell draftCR Rel-16 38.321 16.0.0 NR\_IIOT
10. R2-2003504 RRC Open Issues for Scheduling Enhancements CMCC discussion Rel-16 NR\_IIOT-Core
11. R2-2003586 Remaining issues on configured grant type 1 resources calculation ZTE, Sanechips discussion Rel-16 NR\_IIOT-Core
12. R2-2003322 Remaining issues in IIoT UE capability Intel Corporation discussion Rel-16 NR\_IIOT-Core

1. [R2-2003497](file:///D%3A%5C%5CDocuments%5C%5C3GPP%5C%5Ctsg_ran%5C%5CWG2%5C%5CTSGR2_109bis-e%5C%5CDocs%5C%5CR2-2003497.zip%22%20%5Co%20%22D%3ADocuments3GPPtsg_ranWG2TSGR2_109bis-eDocsR2-2003497.zip) Summary of AI 6.7.2.2 IIoT Scheduling Enhancements CMCC (Summary Rapporteur) discussion Rel-16 NR\_IIOT-Core Late

# 5 Annex

## 5.1 Remaining Issue

### ***5.1.1 Issue #1: 38.300 FFS whether there are other restrictions of how many SPS configurations are supported, e.g. per cell / per UE***

|  |  |  |
| --- | --- | --- |
| ***Company/Tdoc*** | ***Yes/No*** | ***Related proposal*** |
| Ericsson [2] | No | The same number of 32 seems appropriate. The definition should be per MAC entity, not per UE, as MAC entity/module is responsible for scheduling. By this definition the maximum supported number can also be flexibly used among BWPs and cells.  |
| Huawei [5] | No | As for the restriction of the number of SPS configurations in other levels, e.g. per cell or per UE level, we don’t see any necessities there. No need to introduce per cell or per UE level’s restriction of the maximum number of supported SPS configurations. |
| CATT [6] | No | Not to introduce restrictions of how many SPS configurations are supported, e.g. per cell/ per UE (SPS/CG). |
| CMCC[10] | No | It is proposed to not to specify additional the maximum number of SPS configurations per UE. |

**4 companies expressed an opinion on this issue and none supported that it is necessary to introduce per cell or per UE level’s restriction of the maximum number of supported SPS configurations.**

Proposal 1: Not to introduce restrictions of how many SPS configurations are supported, e.g. per cell/ per UE (SPS/CG).

### ***5.1.2 Issue #2: 38.300: Editor’s note: The limitation of maximum of 32 CGs per MAC entity needs to be captured in TS 38.300***

|  |  |  |
| --- | --- | --- |
| ***Company/Tdoc*** | ***Yes/No*** | ***Related proposal*** |
| Ericsson [2] | No | No need to capture limitation of maximum CG/SPS configurations per MAC entity in TS 38.300. |

**Only one company expressed an opinion on this issue and there is no impact on current spec. or running CR.**

Proposal 2: No need to capture limitation of maximum CG/SPS configurations per MAC entity in TS 38.300.

### ***5.1.3 Issue #3: Whether a limitation on maximum number per MAC entity should be defined? If needed, what is the number?***

|  |  |  |
| --- | --- | --- |
| ***Company/Tdoc*** | ***Yes/No*** | ***Related proposal*** |
| Ericsson [2] | Yes | Support up to 32 SPS configurations per MAC entity. |
| Huawei [5] | Yes | Introduce a restriction that maximum 32 SPS configurations per MAC entity can be configured for a UE. |
| Samsung [7] | Yes | Max 32 SPS configurations per MAC entity are supported. |

**3 companies expressed an opinion on this issue and all supported that Max 32 SPS configurations per MAC entity.**

Proposal 3: Support up to 32 SPS configurations per MAC entity.

### ***5.1.4 Issue #4: FFS whether to support allowing CG periodicities of multiple of 2/7 symbols as a separate capability with a cross-slot boundary capability as a pre-requisite.***

|  |  |  |
| --- | --- | --- |
| ***Company/Tdoc*** | ***Yes/No*** | ***Related proposal*** |
| Huawei [5] | No | * It should be noted that such issue has not been discussed explicitly in either RAN1 or RAN2. We doubt this as suitable to support this feature and further introduce a cross-slot boundary capability without any formal input from RAN1 at this late stage.
* We prefer hence not to support CG periodicities of multiple of 2/7 symbols in this release.
 |
| CATT [6] | Yes | * it has been agreed that PUSCH repetition type B, i.e. cross slot boundary scheduling, is supported in RAN1. Hence, technically, there is no obstacle to support CG periodicities of multiple of 2/7 symbols.
* Furthermore, this feature allows configuring CG periods of e.g. 1.5 slots (N=3 with 7-symb granularity) which provides more flexibility in aligning CG and the traffic pattern, i.e. the CG occasion can be tailored to traffic.
* It also solves the mismatch issue between CG and traffic pattern issue when time elapses.
* Support CG periodicities of multiple of 2/7 symbols in IIoT.
 |
| Nokia, Ericsson, NTT Docomo [8] | Yes | * RAN1 specifications allow a UE to transmit a PUSCH that overlaps with the slot boundary if it supports and it is configured with “PUSCH repetition Type B” as part of the CG configuration. Otherwise, it does not transmit those PUSCHs that overlap with the slot boundary.
* Support CG periodicities of multiple of 2/7 symbols as a separate UE capability.

• PUSCHs that overlap with the slot boundary are handled according to RAN1 specifications (i.e. no RAN1 impact) |
| Intel [12] | No | Support of CG periodicities of multiple of 2/7 symbols is not defined in Rel-16. |
| CMCC[10] | Yes | It is proposed to support CG periodicities of multiple of 2/7 symbols as a separate capability with a cross-slot boundary capability. |

7 companies expressed opinions on this issue.

* 5 companies (CATT, Nokia, Ericsson, NTT Docomo and CMCC) prefer to support CG periodicities of multiple of 2/7 symbols as a separate UE capability.
* 2 companies (Huawei, Intel) prefer not to support of CG periodicities of multiple of 2/7 symbols as a separate UE capability.

Proposal 4: Support CG periodicities of multiple of 2/7 symbols in IIoT.

### ***5.1.5 Issue #5: 38.321 Editor’s Note: The step of determining the closest N needs to be added.***

|  |  |  |
| --- | --- | --- |
| ***Company/Tdoc*** | ***Yes/No*** | ***Related proposal*** |
| Huawei [5] | No | Add a note to clarify that the UE can determine the value of N for the first available CG occasion, the step of determination is up to UE implementation. |
| CATT [6] | Yes | The step of determining the closest N for CG type 1 is captured in MAC running CR. |
| Samsung [7] | Yes | The intention of the “lowest N” is that some CG occasions before the reception of the RRC reconfiguration may not be actually used. So, only CG occasions after the reception of the RRC reconfiguration can be used. |
| Nokia [9] | Yes | Description of how the UE determines the closest CG occasion when CG Type 1 is initialized needs to be added into TS38.321. |
| ZTE [11] | No | It is up to UE implementation to determine the closest value of N from the first N which is calculated based on the received referenceSFNnumber, timeDomainOffset and S. |

5 companies expressed an opinion on this issue.

* 3 companies (CATT, Nokia, and Samsung) prefer to descript the step of determining the closest N for CG type 1 is captured in MAC running CR.
* 2 companies (Huawei, ZTE) prefer that the step of determination is up to UE implementation.

The number of Companies from two camps are too close, hence it is proposed.

Proposal 5: Progress further the issue of the step of determining the closest N needs to be added.by email discussion or on line discussion.

### ***5.1.6 Issue #6 regarding the configuration design of SPS/CG***

R2-2002946 [7] raised the issue about the configuration design of SPS. The issue it that if a single SPS per BWP is configured, both SPS-Config and SPS-ConfigList in BWP-DownlinkDedicated are possible for multiple SPS configurations per UE. Similarly, if a single CG per BWP is configured, both ConfiguredGrantConfig and ConfiguredGrantConfigList in BWP-UplinkDedicated are possible for multiple CG configurations per UE. Hence, the determination of whether to allow the both ways of configuration and leave up to NW implementation is needed. And it proposed that both configurations are possible, but only one configuration should be used at a given time. And it proposed that

**Proposal 6. SPS-Config and SPS-ConfigList in BWP-DownlinkDedicated cannot be configured simultaneously at a given time.**

**Proposal 7. ConfiguredGrantConfig and ConfiguredGrantConfigList in BWP-UplinkDedicated cannot be configured simultaneously at a given time.**

## 5.2 Other open issues with little/no discussion before

### ***5.2.1 Issue #7 Configure grant type 1 resources calculation during BWP switch***

R2-2003586 [11] raised an issue that in rel-16, not similar with R-15, the occasion of configured grant type 1 is no longer solid in one SFN cycle due to the enhanced periodic can have a non-integer multiple time relationship with 10240ms. Thus UE need to deduct the occasion sequentially from the first occasion. Thus the understanding of ‘suspend’ and ‘initialize/reinitialize’ shall be clarified in Rel-16. Thus it proposed that RAN 2 is kindly asked to clarify the ‘suspending’ and ‘(re)-initializing’ configured gran type 1 resources for the case of BWP switch:

The understanding of suspending:

* Option 1: UE still keep calculating the occasion of the suspended configured grant type 1 even when the related UL BWP is deactivated
* Option 2: UE stop calculating the occasion of the suspended configured grant type 1 when the related UL BWP is deactivated.

Correspondingly, the understanding of ‘initialize/reinitialize’

* Option 1: UE continue to use the occasion of the suspended configured grant type 1 when the related UL BWP is activated
* Option 2: UE recalculate the occasion of the configured grant type 1 based on the r*eferenceSFNnumber , timeDomainOffset, and S* and the SFN number when the switch on is occurred.

If the above proposal is taken into account, it proposed that When an UL BWP is deactivated, UE still need to calculate the resources sequentially for each configured grant type 1. When an UL BWP is activated, UE continue to use the occasion of the suspended configured grant type 1 resources when the related UL BWP is activated.

It could be treated if the issues in the section 2.1 can be addressed in the meeting.

### ***5.2.2 Issue #7 Measurement gaps***

R2-2002657[1] proposes UE to transmit during the measurement gaps, since UE cannot transmit/receive during the measurement gap and it impacts the latency performance. However, there were other proposals before this meeting that even if allowing UE to send during measurement gap, it does not solve the issue for DL traffic and one simpler solution is to allow UE to be equipped with two radios. Therefore, we expect this topic to be contentious and unlikely to converge at e-Meeting.

It could be treated if the issues in the section 2.1 can be addressed in the meeting.

### ***5.2.3 Issue #8 Burst arrival time***

R2-2002708 [3] proposes a clarification of the burst arrival time defined in SA2 TS 23.501. It raised an issue that the aggregation process results in the 5G network identifying TSCAI information (e.g. Burst Arrival time) and QoS flow characteristics that are representative of the aggregated set of TSN flows. The gNB uses this information to allocate periodic resource in support of the corresponding TSN streams. Currently, the burst arrival time is defined as the beginning of the burst. Since it is more beneficial for RAN to get the knowledge of a burst arrival time that refers to the end of the burst, it is proposed that RAN2 send SA2 an LS stating “It is beneficial for RAN to obtain from TSCAI a burst arrival time that refers to the end of the burst rather than the beginning of the burst” [4].

It could be treated if the issues in the section 2.1 can be addressed in the meeting.

# **6 Proposals in summary contribution [13]**

This contribution summarized the contributions posted in the Agenda Item 6.7.2.2 related to scheduling enhancement and the proposals in these contributions related to UE capabilities moved into the Summary of 6.7.6 UE capabilities in the Agenda Item 6.7.6. Handling of scheduling enhancement, at this e-meeting, and suggested some possible agreements / way forward as follows:

Proposal 1: Not to introduce restrictions of how many SPS configurations are supported, e.g. per cell/ per UE (SPS/CG).

Proposal 2: No need to capture limitation of maximum CG/SPS configurations per MAC entity in TS 38.300.

Proposal 3: Support up to 32 SPS configurations per MAC entity.

**Proposal 4: Support CG periodicities of multiple of 2/7 symbols in IIoT.**

**Proposal 5: Progress further the issue of the step of determining the closest N needs to be added.by email discussion or on line discussion.**

**Proposal 6. SPS-Config and SPS-ConfigList in BWP-DownlinkDedicated cannot be configured simultaneously at a given time.**

**Proposal 7. ConfiguredGrantConfig and ConfiguredGrantConfigList in BWP-UplinkDedicated cannot be configured simultaneously at a given time.**

And for other open issues with little/no discussion listed in section 2.2 in the previous meetings, we propose that these issues could be treated if the above issues in the section 2.1 can be addressed in the meeting.