3GPP TSG-RAN2 Meeting #113bis-e R2-210xxxx

eMeeting, 12th – 20th April, 2021

Agenda Item: 5.4.3 UE capabilities and Capability Coordination

Source: Ericsson

Title: Summary of [Post113-e][051][NR15] DL scheduling slot offset

Document for: Discussion and Decision

# Introduction

The DL scheduling offset was discussed during RAN2#113-e [1,2], but no agreements were reached. It was decided to continue the discussion until RAN2#113bis-e:

* [Post113-e][051][NR15] DL scheduling slot offset (Ericsson)

Scope: Continue discussion from [AT113-e][012] R2-2101731

Intended outcome: Report with Agreeable proposals

Deadline: Long

The deadline of the email discussion is **Wednesday, 24th of March 2021, 11 UTC**.

# Contact information

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# Background

**K0>0 for System Information and Random Access**

During the offline discussion #012 during RAN2#113-e [2] the use of K0>0 for System Information (SI) and Random Access (RA) was mentioned. It is the understanding of the rapporteur that the use of K0>0 for SI is not possible, i.e. the network does not know if the UE has IOT-tested K0>0 in case of SI, and there can always be legacy UEs that did not IOT-test this feature. The network can also not use K0>0 for RA when the UE comes from Idle mode and the network does not know the UE capabilities or during Contention Based Random Access (CBRA) when the network does not know which UE responds. But in case of Contention Free Random Access (CFRA) in connected mode the network could use K0>0 with PDCCH/PDSCH transmissions when the UE has IOT-tested it.

The network can use K0>0 for Paging, when the (IOT) capability is signalled in the Paging message to the gNB. In case the UE(s) that are paged in the Paging Occasion (PO) have IOT-tested K0>0, then the network can safely use K0>0 in that PO. In case one or more UEs in the PO did not indicate to have IOT-tested K0>0, then the network cannot use K0>0 for that PO.

**PDSCH configuration in 38.331**

Up to 16 K0 values between 0-32 can be configured via *pdsch-TimeDomainAllocationList* in *SIB1* for the initial BWP used for Paging, System Information and Random Access in *PDSCH-ConfigCommon* IE:

pdsch-TimeDomainAllocationList PDSCH-TimeDomainResourceAllocationList OPTIONAL, -- Need R

PDSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation

PDSCH-TimeDomainResourceAllocation ::= SEQUENCE {

**k0 INTEGER(0..32)** OPTIONAL, -- Need S

…

maxNrofDL-Allocations INTEGER ::= 16 -- Maximum number of PDSCH time domain resource allocations

The *pdsch-TimeDomainAllocationList* provides the possible K0 values the NW may use for the time between PDCCH and following PDSCH transmission. The actual value that is used in a particular PDCCH transmission, from the possible list in *SIB1*, is dynamically indicated in the PDCCH.

So for SI and CBRA the network would only use K0 is 0 values in the PDCCH transmissions. But for CFRA in connected mode the network could use a K0 > 0, if configured in the list and if the UE has indicated to have IOT-tested it. The intention is to enable similar flexibility for Paging by introducing the capabilities in the Paging message.

# Discussion

**Introduction of DL scheduling offset capabilities in Paging message**

The proposal is to add *dl-SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* to the *UERadioPagingInformation* message so that the gNB can know if the UE has IOT-tested K0>0 for Paging:

UERadioPagingInformation ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE{

ueRadioPagingInformation UERadioPagingInformation-IEs,

spare7 NULL,

spare6 NULL, spare5 NULL, spare4 NULL,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

UERadioPagingInformation-IEs ::= SEQUENCE {

supportedBandListNRForPaging SEQUENCE (SIZE (1..maxBands)) OF FreqBandIndicatorNR OPTIONAL,

nonCriticalExtension UERadioPagingInformation-vxyz-IEs OPTIONAL

}

UERadioPagingInformation-vxyz-IEs ::= SEQUENCE {

dl-SchedulingOffset-PDSCH-TypeA-FDD-FR1-r15 ENUMERATED {supported} OPTIONAL,

dl-SchedulingOffset-PDSCH-TypeA-TDD-FR1-r15 ENUMERATED {supported} OPTIONAL,

dl-SchedulingOffset-PDSCH-TypeA-FDD-FR2-r15 ENUMERATED {supported} OPTIONAL,

dl-SchedulingOffset-PDSCH-TypeA-TDD-FR2-r15 ENUMERATED {supported} OPTIONAL,

dl-SchedulingOffset-PDSCH-TypeB-FDD-FR1-r15 ENUMERATED {supported} OPTIONAL,

dl-SchedulingOffset-PDSCH-TypeB-TDD-FR1-r15 ENUMERATED {supported} OPTIONAL,

dl-SchedulingOffset-PDSCH-TypeB-FDD-FR2-r15 ENUMERATED {supported} OPTIONAL,

dl-SchedulingOffset-PDSCH-TypeB-TDD-FR2-r15 ENUMERATED {supported} OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

**Issue 1**: Do companies agree to add *SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* to the *UERadioPagingInformation* message?

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| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes | We are not sure why these capabilities were not added from the beginning in REL-15, but perhaps the use of K0 > 0 was not considered in much details during that time period.  @Nokia:   * This proposal is not specifically for time multiplexing pattern2, nor specifically for FR2, i.e. the proposal is for both FR1 and FR2. This proposal is also not specifically for K0 = 1 but for values larger than 0 (in *PDSCH-TimeDomainResourceAllocationList* up to 32 slots can be configured for K0). We understand that the default table B for FR2 in 38.214 (Table 5.1.2.1.1-4) includes value K0 = 1, and therefore legacy UE supports K0 = 1 for FR2. This was discussed in previous RAN2 meeting, and companies think that the operator also for that case has to check that there is no IOT issue with legacy UEs. So we have come to understanding that the network can only use K0 > 0 when the UE explicitly indicates via the IOT capability bits that it has IOT-tested K0 > 0. * Thanks for spotting, i.e. I overlooked that. Please see updated ASN.1 above where the TDDx and FRx capabilities are explicitly signalled. |
| Huawei, HiSilicon | Yes | We share the view from rapporteur in the Background clause. We introduce IOT bit for paging, if the UE has IOT-tested K0>0 for paging, the network can safely use K0>0 for scheduling of paging. But for SI and RA (except for CFRA in connected mode), no specific IOT bit is introduced, so the network CANNOT use K0>0 for SI and RA in this case. In addition to the introduction of IOT capability for paging, it would be good to clarify (e.g. capture it in meeting minutes):  The network CANNOT use K0>0 before knows that the UE has IOT-tested K0>0. |
| MediaTek | Yes |  |
| Nokia | Yes, but | * We just wanted to be sure that this is about pattern2 where the option to use K0=1 is supposed to be needed/mandatory if network would use the default Type0 CSS. The use case would be for FR2? * The capabilities are differentiated for FRx and xDD, but there seems to be only 1 bit allocated in the Radio Paging Information IE. Can you please explain the usage of this single bit in network for all the combinations? |
| ZTE | Yes | We share the same view as Ericsson and Huawei. |
| CATT | Yes | Agree with Huawei, without the capability information for paging, NW can’t use K0>0 for paging the UE. As for SI and CBRA, considering SI and CBRA are configured for all the UEs including the UE for which the NW doesn’t have the capability information, so NW can only use K0=0 for SI and CBRA in initial BWP. |
| Intel | Yes | Even though R1 5-1 is mandatory feature without UE capability, it seems like this is not implemented. Hence we are fine to add these capabilities to the UERadioPagingInformation container so that paging gNB knows whether it can use K0=1 to page a UE. Since these capabilities are xDD and FRx diff, we also agree with the including xDD and FRx differentiation to the capabilities in the UERadioPagingInformation. |
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**Summary**: 7 companies replied, and all companies replied positive to add the DL scheduling offset capabilities to the *UERadioPagingInformation* message.

One company had some questions whether this was for pattern2/K0=1/FR2 only, and it was explained that the capabilities apply to both FR1 and FR2 and apply to value of K0 larger than zero. This company also mentioned that the FRx/xDD specific capabilities were missing in the proposed ASN.1 corrections, which was modified by the rapporteur.

**Proposal 1**: Add *SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* for FR1/FR2 and FDD/TDD to the *UERadioPagingInformation* message.

**Configuration of K0 > 0 in *pdsch-TimeDomainAllocationList***

It is the understanding of the rapporteur that a UE implementation supports the configuration of possible K0 values that the UE implementation might not have IOT-tested. In case the UE has not IOT-tested K0 > 0 then the network will not use K0 > 0 in PDCCH transmissions to that UE:

**Issue 2**: Do companies confirm that a UE that does not support *dl-SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* capability does support *pdsch-TimeDomainAllocationList* configuration including K0 values larger than 0?

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| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes | Companies are kindly invited to make a distinction between support/IOT-tested and configuration in this case. We agree that a UE may set *dl-SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* capability to false. But in our understanding any UE implementation should support the configuration of K0 > 0.  @MDT & @Nokia: We agree that in general the NW should not configure a feature that the UE does not support. But we think that this case is a bit different, i.e. the NW configures the possible values the UE may use for both UEs supporting K > 0 and UEs not supporting K > 0. For UEs that do not support the feature, i.e. that have not IOT-tested K > 0, the NW will not use K0 > 0.  @CATT: Good comment/question. Perhaps the answer depends on the outcome of the discussion for the common configuration, and whether the NW could have the same configuration in common and dedicated configuration, and use the K0 values according to the UE capabilities. We propose to discuss the dedicated configuration further in RAN2#113bis-e meeting. |
| Huawei, HiSilicon | Yes | We understand UE can support the *pdsch-TimeDomainAllocationList* configuration including K0>0, but if the UE does not have IOT-tested K0>0 for paging, the network can only use K0=0 for scheduling of paging, even though the *pdsch-TimeDomainAllocationList* configuration includes K0>0. |
| MediaTek | No | We believe that the general principle is that NW does not configure a feature that is NOT supported (or NOT IOT tested). That’s the main reason to have UE capability reporting. We are also wondering why NW want to provide a list of possible K0 value but only use K0=0 in real scheduling. |
| Nokia | Yes, but | But we were also wondering about the scenario from MTK, would it really be the case that the network never uses anything else than K0=0 but still publishes a list on SIB1 indicating other values? How is that supposed to be used?  We now understand based on other companies’ explanation that as pdsch-TimeDomainAllocationList is sent on the SIB for the paging, it is not UE specific and thus may include K0=0 and K0>0 entries to support UE supporting only K0=0 for paging and UE supporting K0=0 and K0>0 for paging in the cell. Network will only use the K0>0 on those UEs that can support K0>0 for paging.  To give a comment to MTK, the case they refer to is for dedicated configuration aspect only. |
| ZTE | Yes, but | We think the network can configure *pdsch-TimeDomainAllocationList*  with K0>0, and then only use k0=0 for the UE that not IOT tested with K0>0. But, It depends on UE vendors understanding/implementation on whether the UE that not IOT tested with K0>0 can support K0>0 configuration (though K0>0 would not be used for such kinds of UE). |
| CATT | See comments | For the case of *pdsch-TimeDomainAllocationList* configured in *PDSCH-ConfigCommon* it should be allowed, as it is cell-specific configuration but the NW should only use K0=0 for the UE which doesn’t support K0>0 to.  As for the case of *pdsch-TimeDomainAllocationList* configured in *PDSCH-Config*, as it is an UE-specific configuration, and the NW knows the UE capability, so we don’t think it is necessary for NW to configure the *pdsch-TimeDomainAllocationList* including value K0>0. |
| Intel | Yes | As pdsch-TimeDomainAllocationList is sent on the SIB for the paging, it is not UE specific and thus may include K0=0 and K0>0 entries to support UE supporting only K0=0 for paging and UE supporting K0=0 and K0>0 for paging in the cell. Network will only use the K0>0 on those UEs that can support K0>0 for paging. |
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**Summary**: 7 companies replied and 5 companies replied positive that a UE that does not support *dl-SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* capability does support *pdsch-TimeDomainAllocationList* configuration including K0 values larger than 0.

One company questioned whether the network can configure a feature in the UE that the UE does not support. It was commented by the rapporteur and other companies, that the common configuration in SIB is cell specific and applies to both UEs supporting and not-supporting the feature. The network would only use the feature for the UEs that indicated to support the feature.

One company replied that UE vendors need to confirm that the UE support configuration of K0 > 0 when the UE has not tested the use of K0 > 0.

One company raised a new question whether the configuration in dedicated configuration in connected mode may include K0 > 0 when the UE does not support the feature. The rapporteur proposes to discuss this issue further in RAN2#113bis-e.

**Proposal 2**: A UE that does not support *dl-SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* capability does support *pdsch-TimeDomainAllocationList* configuration in *PDSCH-ConfigCommon* in *SIB1* including K0 values larger than 0, but the network does not use K0 > 0 for that UE.

**Proposal 3**: Discuss the configuration of K0 > 0 in *PDSCH-ConfigCommon* in dedicated signalling in connected mode further in RAN2#113-e.

# Summary of email discussion

**Issue 1**: Do companies agree to add *SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* to the *UERadioPagingInformation* message?

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# Conclusions

Based on the company feedback it is proposed:

**Proposal 1**: Add *SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* for FR1/FR2 and FDD/TDD to the *UERadioPagingInformation* message.

**Proposal 2**: A UE that does not support *dl-SchedulingOffset-PDSCH-TypeA* or *dl-SchedulingOffset-PDSCH-TypeB* capability does support *pdsch-TimeDomainAllocationList* configuration in *PDSCH-ConfigCommon* in *SIB1* including K0 values larger than 0, but the network does not use K0 > 0 for that UE.

**Proposal 3**: Discuss the configuration of K0 > 0 in *PDSCH-ConfigCommon* in dedicated signalling in connected mode further in RAN2#113-e.

# References

1. [R2-2101731](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113-e/Docs/R2-2101731.zip), *DL scheduling slot offset capability*, Ericsson, Qualcomm, DISC, Rel-15, RAN2#113-e
2. [R2-2102374](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113-e/Docs/R2-2102374.zip), *Summary of [012][NR15] UE Capabilites IV*, Huawei, Report, RAN2#113-e