3GPP TSG RAN WG2 Meeting #110-e R2-200xxxx

**Electronic meeting,** **1st – 12th June 2020**

**Agenda item:** 6.11.1

**Source:** Intel Corporation

**Title:** Report of email discussion [Post109bis-e][941][PowSav] UE capabilities

**Document for:**  Discussion and decision

# Introduction

This contribution discusses the new RAN2 UE capabilities required to specify the features defined for Rel-16 UE power saving WI considering the related RAN2#109bis-e agreements and the related drafted CRs 38.306 [1] and 38.331 [2] under this email discussion until next RAN2#110-e meeting.

**[Post109bis-e][941][PowSav] UE capabilities (Intel)**

Intended outcome: draft CR for 38.306 and 38.331 to reflect the latest RAN2 capabilities agreements (on R2 capabilities and the description of related field on 38.331 email discussion) and to discuss if any new R2 capability is required

Deadline: Next Meeting

The deadline of this email discussion #941 is 2020-05-20 23:59 PST, however we suggest having 2 phases:

* **Phase 1** until 2020-**05-14** 23:59 PST for companies to provide their views on the discussion points listed that are related to the RAN2#109bis-e agreements and the drafted CRs to 38.306 and 38.331.
* **Phase 2** until 2020-**05-20** 23:59 PST for companies to provide their views on new discussion points and/or updated CRs, if this is identified necessary by rapporteur based on companies’ inputs during phase 1.

# Discussion

## Review of the drafted CRs on the new RAN2 UE capabilities for Rel-16 POW-SAV WI

This section discusses the drafted CRs to 38.306 and 38.331 that capture the following agreements on RAN2 UE capabilities taken in RAN2#109bis-e meeting:

1. *A new UE capability (referred e.g. as drx-Preference) is defined to indicate its preference on DRX parameters for power saving in RRC\_CONNECTED. It is included in section 4.2.2 “General parameters” of TS 38.306.*
2. *A new UE capability (referred e.g. as maxBW-Preference) is defined to indicate its preference on the maximum aggregated bandwidth for power saving in RRC\_CONNECTED. It is included in section 4.2.2 “General parameters” of TS 38.306.*
3. *A new UE capability (referred e.g. as maxCC-Preference) is defined to indicate its preference on the maximum number of secondary component carriers for power saving in RRC\_CONNECTED. It is included in section 4.2.2 “General parameters” of TS 38.306.*
4. *A new UE capability (referred e.g. as maxMIMO-LayerPreference) is defined to indicate its preference on the maximum number of MIMO layers for power saving in RRC\_CONNECTED. It is included in section 4.2.2 “General parameters” of TS 38.306.*
5. *It is not agreed to bundle into a separate new UE capability the support for UE’s assistance of the maxCC, maxBW and maxMIMO.*
6. *A new UE capability (referred e.g. as release-Preference) is defined to indicate its preference assistance information to transition out of RRC\_CONNECTED for power saving. It is included in section 4.2.2 “General parameters” of TS 38.306.*
7. *New UE capability is defined for the relaxed measurement feature without signalling to the gNB, i.e. gNB will not know whether a UE supports or not this feature. It is included in section 5 “Optional features without UE radio access capability parameters” of TS 38.306.*
8. *For drx-Preference, maxCC-Preference, release-Preference, maxMIMO-LayerPreference, and maxBW-Preference, its characteristics are defined as as “Per: UE” (to the characteristic associated to the UE), “M: No” (to the characteristic associated with mandatory/optional features), “FDD-TDD DIFF: No” (to the characteristic associated with the applicability for FDD/TDD).*
9. *For drx-Preference, maxCC-Preference, and release-Preference, its characteristics are defined as “FR1-FR2 DIFF: No” (to the characteristic associated to FR1/FR2 equally applicable for FR1/FR2).*
10. *For maxMIMO-LayerPreference, and maxBW-Preference, its characteristics are defined as “FR1-FR2 DIFF: Yes” (to the characteristic associated to FR1/FR2 are not equally applicable for FR1/FR2).*
11. *Rel-16 capability maxMIMO-LayerPreference is not linked to Rel-15 capability maxLayersMIMO-Indication*

Note that these drafted CRs may have further updates based on companies’ views provided in the section 2.2 below.

### Discussion point 1 in 38.306 drafted CR on RAN2 UE capabilities

1. Companies are invited to provide their views on the 38.306 drafted CR [1] that aims to capture the RAN2 UE capability related agreements shown above.

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| **Company’s name** | **Company’s comments, if any** |
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### Discussion point 2 - 4 in 38.331 drafted CR on RAN2 UE capabilities

1. How to do you prefer capturing the POW-SAV feature within the *UE-NR-Capability* IE? Note that exemplary ASN.1 of a similar legacy structure is also added as reference in Annex A.
2. All power saving features are bundled together in ASN.1 within a POW-SAV group, for example, as shown in **version #2** of drafted CR to 38.331 (reference of related TP also copied below).

UE-NR-Capability-v16xy ::=               SEQUENCE {

   inDeviceCoexInd-r16 E NUMERATED {supported} OPTIONAL,

   dl-DedicatedMessageSegmentation-r16 ENUMERATED OPTIONAL,

   nru-Parameters-r16 NRU-Parameters-r16 OPTIONAL,

   pow-sav-Preference-r16 POW-SAV-Preference-r16 OPTIONAL,

   fr1-Add-UE-NR-Capabilities-v16xy UE-NR-CapabilityAddFRX-Mode-v16xy OPTIONAL,

   fr2-Add-UE-NR-Capabilities-v16xy UE-NR-CapabilityAddFRX-Mode-v16xy OPTIONAL,

   nonCriticalExtension SEQUENCE {} OPTIONAL

}

UE-NR-CapabilityAddFRX-Mode-v16xy ::=    SEQUENCE {

   pow-sav-PreferencesFRX-Diff     POW-SAV-PreferencesFRX-Diff                OPTIONAL

}

-- TAG-POW-SAV-PREFERENCES-START

POW-SAV-Preference-r16 ::=         SEQUENCE {

   pow-sav-PreferencesCommon POW-SAV-PreferencesCommon OPTIONAL,

   pow-sav-PreferencesFRX-Diff POW-SAV-PreferencesFRX-Diff OPTIONAL,

    ...

}

POW-SAV-PreferencesCommon ::=   SEQUENCE {

    drx-Preference-r16 ENUMERATED {supported} OPTIONAL,

    maxCC-Preference-r16 ENUMERATED {supported} OPTIONAL,

    release-Preference-r16 ENUMERATED {supported} OPTIONAL,

    ...

}

POW-SAV-PreferencesFRX-Diff ::= SEQUENCE {

    maxBW-Preference-r16 ENUMERATED {supported} OPTIONAL,

    maxMIMO-LayerPreference-r16 ENUMERATED {supported} OPTIONAL,

    ...

}

-- TAG-POW-SAV-PREFERENCES-STOP

1. Each power saving features is captured in ASN.1 separately, for example, as shown in **version #0** of drafted CR to 38.331 (reference of related TP also copied below).

UE-NR-Capability-v16xy ::= SEQUENCE {

 inDeviceCoexInd-r16 ENUMERATED {supported} OPTIONAL,

 dl-DedicatedMessageSegmentation-r16 ENUMERATED {supported} OPTIONAL,

 nru-Parameters-r16 NRU-Parameters-r16 OPTIONAL,

 drx-Preference-r16 ENUMERATED {supported} OPTIONAL,

 maxBW-Preference-r16 ENUMERATED {supported} OPTIONAL,

 maxCC-Preference-r16 ENUMERATED {supported} OPTIONAL,

 maxMIMO-LayerPreference-r16 ENUMERATED {supported} OPTIONAL,

 release-Preference-r16 ENUMERATED {supported} OPTIONAL,

 fr1-Add-UE-NR-Capabilities-v16xy UE-NR-CapabilityAddFRX-Mode-v16xy OPTIONAL,

 fr2-Add-UE-NR-Capabilities-v16xy UE-NR-CapabilityAddFRX-Mode-v16xy OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

UE-NR-CapabilityAddFRX-Mode-v16xy ::= SEQUENCE {

 maxBW-Preference-r16 ENUMERATED {supported} OPTIONAL,

 maxMIMO-LayerPreference-r16 ENUMERATED {supported} OPTIONAL

}

1. If other approach is preferable, please explain your motivation and your suggested TP.

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| **Company’s name** | **Option** | **Company’s comments, if any** |
| Intel | Option a) |  |
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1. If companies supported option a) in previous discussion point 2) or other approach that also requires the usage of the “UE power saving” terminology. Companies are invited to provide their views on the preferable term to be used when abbreviating “UE power saving” reference in 38.331 drafted CR [2] considering e.g. POW-SAV (currently used on version \_v2), PS, UPS or UPW.

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| **Company’s name** | **Preferred terminology** | **Company’s comments, if any** |
| Intel | POW-SAV | We are OK going with majority view on the term to use |
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1. Companies are invited to provide their views on other aspects of the 38.306 drafted CR [2] that aims to capture the RAN2 UE capability related agreements shown above.

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| **Company’s name** | **Company’s comments, if any** |
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## Additional RAN2 UE capabilities for Rel-16 POW-SAV WI or other miscellaneous topics

This section discusses additional RAN2 UE capabilities that may need to be considered based on the following agreements taken in RAN2#109bis-e meeting:

1. *In NR-DC, SCG specific UAI for power saving can be configured by the network*
2. *The reported UAI for power saving is specific to a cell group*
3. *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).*
4. *In (NG)EN-DC, SCG specific UAI for power saving is transmitted in ULInformationTransferMRDC on the LTE leg.*
5. *In (NG)EN-DC, SCG specific UAI for power saving is transmitted on the NR leg via SRB3, if SRB3 is configured.*
6. *In NR-DC, SCG specific UAI for power saving can be configured by the network via SRB1 (using mrdc-SecondaryCellGroup) or SRB3 (using RRCReconfiguration).*
7. *In NR-DC, SCG specific UAI for power saving is transmitted in ULInformationTransferMRDC on SRB1.*
8. *In NR-DC, SCG specific UAI for power saving is transmitted on the SCG via SRB3, if SRB3 is configured.*

The latest POW-SAV CR to 38.331 describe how the new UAI features for *drx-Preference, maxBW-Preference, maxCC-Preference, maxMIMO-Preference,* and *releasePreference* are associated to an **specific cell group**. Therefore these UAI related features (with their specific prohibit timers) can be configured specifically for (NG)EN-DC and NR-DC, as shown below:

***In*** ***(NG)EN-DC and NR-DC****, SRB3 can be used for measurement configuration and reporting****, for UE assistance (re-)configuration and reporting for power savings****, to (re-)configure MAC, RLC, physical layer and RLF timers and constants of the SCG configuration, and to reconfigure PDCP for DRBs associated with the S-KgNB or SRB3, and to reconfigure SDAP for DRBs associated with S-KgNB in NGEN-DC and NR-DC, and to add/modify/release conditional PSCell change configuration, provided that the (re-)configuration does not require any MN involvement.* ***In (NG)EN-DC and NR-DC****, only measConfig, radioBearerConfig, conditionalReconfiguration,* ***otherConfig*** *and/or secondaryCellGroup are included in RRCReconfiguration received via SRB3.*

The corresponding *UEAssistanceInformation* message is sent differently depending on the intended cell group, as shown in reference below from TS 38.331:

*The UE shall:*

***1> if the UE is in (NG)EN-DC:***

*2> if SRB3 is configured:*

*3> submit the UEAssistanceInformation message* ***via SRB3*** *to lower layers for transmission;*

*2> else:*

*3> submit the UEAssistanceInformation message* ***via the E-UTRA MCG embedded in E-UTRA RRC message ULInformationTransferMRDC as specified in TS 36.331 [10]****.*

***1> else if the UE is in NR-DC:***

*2> if the UE assistance configuration that triggered this UE assistance information is associated with the SCG:*

*3> if SRB3 is configured:*

*4> submit the UEAssistanceInformation message* ***via SRB3*** *to lower layers for transmission;*

*3> else:*

*4> submit the UEAssistanceInformation message* ***via the NR MCG embedded in NR RRC message ULInformationTransferMRDC as specified in 5.7.2a.3****;*

*2> else:*

*3> submit the UEAssistanceInformation message via SRB1 to lower layers for transmission;*

*1> else:*

*2> submit the UEAssistanceInformation message to lower layers for transmission.*

### Discussion point 5

1. Should different NR UE capabilities be defined to indicate the UE support of new UE assistance feature for power saving purposes (i.e. *drx-Preference, maxBW-Preference, maxCC-Preference, maxMIMO-Preference,* and *releasePreference*) to an specific cell group for NR vs (NG)EN-DC vs NR-DC?
2. No.
3. Yes. If so, please explained your motivation and your suggested change.

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| **Company’s name** | **Option** | **Company’s comments, if any** |
| Intel | No | We do not see essential to define different UE capabilities for each specific cell group as the minimum that the UE needs to support is the setup (or release) of the related prohibit timer when the feature is configured (or release). Understanding that later it is up to UE whether to report/trigger UAI or not. |
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### Discussion point 6

1. Companies are invited to provide their views on other RAN2 UE capabilities related aspects for Rel-16 UE power saving WI that was not addressed in previous discussion points.

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| **Company’s name** | **Company’s comments, if any** |
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# Report summary

*<If needed, to be updated when doing the summary>*

1. *<If needed, to be updated when doing the summary>*.

# Conclusion

The proposals captured are the following:

**Proposal 1.** *<If needed, to be updated when doing the summary>*.

# References

1. R2-200xxxx UE capabilities for Rel-16 Power Saving WI, Intel Corporation, Rel-16, TS 38.306, v16.0.0, draftCR, category B, NR\_UE\_pow\_sav.
2. R2-200xxxx UE capabilities for Rel-16 Power Saving WI, Intel Corporation, Rel-16, TS 38.331, v16.0.0, draftCR, category B, NR\_UE\_pow\_sav.

# Annex A

The features that can be configured different for FR1/FR2 or TDD/FDD are defined in a way that a UE can indicate via the general section whether it support it for both (e.g. FR1/FR2), or if it only supports it for one (e.g. FR1 or FR2). For better understanding, an example on how this is captured in TS 38.306 is shown below. It is highlighted in yellow the common structure that includes amongst others, the features that are supported for both FR1/FR2 and, in blue the section that is used by UE to indicate when the feature is only supported for FR1 or FR2. For further reference, it is highlighted in green the common field that is used for those features that could be supported differently for FR1 or FR2.

UE-NR-Capability-v1540 ::=              SEQUENCE {

    sdap-Parameters                     SDAP-Parameters                                               OPTIONAL,

    overheatingInd                          ENUMERATED {supported}                                        OPTIONAL,

    ims-Parameters                          IMS-Parameters                                                OPTIONAL,

    fr1-Add-UE-NR-Capabilities-v1540        UE-NR-CapabilityAddFRX-Mode-v1540                             OPTIONAL,

    fr2-Add-UE-NR-Capabilities-v1540        UE-NR-CapabilityAddFRX-Mode-v1540                             OPTIONAL,

    fr1-fr2-Add-UE-NR-Capabilities          UE-NR-CapabilityAddFRX-Mode                                   OPTIONAL,

    nonCriticalExtension                    UE-NR-Capability-v1550                                        OPTIONAL

}

UE-NR-CapabilityAddFRX-Mode-v1540 ::=    SEQUENCE {

    ims-ParametersFRX-Diff                   IMS-ParametersFRX-Diff                                       OPTIONAL

}

-- TAG-IMS-PARAMETERS-START

IMS-Parameters ::=         SEQUENCE {

    ims-ParametersCommon       IMS-ParametersCommon                  OPTIONAL,

    ims-ParametersFRX-Diff     IMS-ParametersFRX-Diff                OPTIONAL,

    ...

}

IMS-ParametersCommon ::=   SEQUENCE {

    voiceOverEUTRA-5GC         ENUMERATED {supported}                OPTIONAL,

    ...,

    [[

    voiceOverSCG-BearerEUTRA-5GC       ENUMERATED {supported}        OPTIONAL

    ]]

}

IMS-ParametersFRX-Diff ::= SEQUENCE {

    voiceOverNR                ENUMERATED {supported}                OPTIONAL,

    ...

}

-- TAG-IMS-PARAMETERS-STOP

For further clarification, the UE’s expected handling of the capability signaling just explained is also described within the following procedural text:

1>  set all fields of UE-NR/MRDC-Capability except fdd-Add-UE-NR/MRDC-Capabilities, tdd-Add-UE-NR/MRDC-Capabilities, fr1-Add-UE-NR/MRDC-Capabilities and fr2-Add-UE-NR/MRDC-Capabilities, to include the values applicable for all duplex mode(s) and frequency range(s) that the UE supports;

1>  if UE supports both FDD and TDD and if (some of) the UE capability fields have a different value for FDD and TDD

2>  if for FDD, the UE supports additional functionality compared to what is indicated by the previous fields of UE-NR/MRDC-Capability:

3>  include field fdd-Add-UE-NR/MRDC-Capabilities and set it to include fields reflecting the additional functionality applicable for FDD;

2>  if for TDD, the UE supports additional functionality compared to what is indicated by the previous fields of UE-NR/MRDC-Capability:

3>  include field tdd-Add-UE-NR/MRDC-Capabilities and set it to include fields reflecting the additional functionality applicable for TDD;

1>  if UE supports both FR1 and FR2 and if (some of) the UE capability fields have a different value for FR1 and FR2:

2>  if for FR1, the UE supports additional functionality compared to what is indicated by the previous fields of UE-NR/MRDC-Capability:

3>  include field fr1-Add-UE-NR/MRDC-Capabilities and set it to include fields reflecting the additional functionality applicable for FR1;

2>  if for FR2, the UE supports additional functionality compared to what is indicated by the previous fields of UE-NR/MRDC-Capability:

3>  include field fr2-Add-UE-NR/MRDC-Capabilities and set it to include fields reflecting the additional functionality applicable for FR2;