**3GPP TSG-RAN WG4 Meeting # 110 R4-2403638**

**Athens, Greece, Feb. 26th – Mar. 1st , 2024**

**Title:** WF on NR UE power classes

**Agenda Item:** 12.2.1

**Source: Huawei, HiSilicon**

**Document for:** Approval

# Background

It has been observed that:

**Observation 1:** RAN2 adopts the principle of capability inheritance. A fallback band combination shall not be reported if it has the same or lower capabilities as a parent band combination.

**Observation 2:** The UE may report fallback BCs having additional functionality, either by adding entries in *FeatureSetCombination* of the same *BandCombination* IE, or by separate *BandCombination* entries.

**Observation 3:** RAN2 spec states that:

*The Network configures serving cell(s) and BWP(s) configuration to comply with capabilities derived from the combination of FeatureSets at the same position in the FeatureSetsPerBand, regardless of activated/deactivated serving cell(s) and BWP(s).*

# Way Forward

## <General Aspects>

* Whether the UE max Tx power is affected by cell activation/deactivation and/or dynamic scheduling?

Option 1:

No. The network determines the max Tx power for a UE based on the capabilities of the configured band combination, regardless of cell activation/deactivation or dynamic scheduling.

Option 2:

As baseline, the network determines the max Tx power for a UE based on the capabilities of the configured band combination. As enhancement, FFS whether the max Tx power can change based on cell activation/deactivation and/or dynamic scheduling in an open release.

Option 3:

Yes. Make necessary changes to the TS since Rel-17.

WF: Option 1 or 2

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* If the high power class (PC2 or PC1.5) applicability note as in Clause 5 is not applied for a BC in the TS, can a UE still indicate the high power class for this BC? If yes, how to verify the MSD requirements for this high power class?

Option 1: Yes, if the MOP requirements for the UL are specified. The UE shall meet the MSD requirements for a lower power class while transmitting at this high power class.

Option 2: No. This would bypass the HPUE basket WI procedure and complicate conformance tests.

WF: Option 2

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* For any DL CA with single-carrier UL, shall the UE mandatorily support the power class indicated in ue-PowerClass for the UL band?

Option 1: Yes

Option 2: No. Allow the UE to only support a lower power class for the BC.

WF: Option 2

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* If a BC is not explicitly reported, how to determine the power class for the BC as well as the power class(es) for the UL component band(s)?

Option 1: Follow RAN2’s principle of capability inheritance, and derive the power class capabilities from a parent BC;

Option 2: Define RAN4’s own rules and inform RAN2 when necessary.

WF: Option 1

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For brevity, the impact on max Tx power from p-max, duty cycle, P-MPR and etc are omitted in the following discussions. Those factors should be included in the formulas for PCMAX,f,c as in the current spec.

## <Max Tx power PCMAX,f,c for UL inter-band CA>

* **Inter-band UL CA (2UL2CC)**:

The max Tx power PCMAX,f,c for a UL component band is determined by:

Option 1:

* If ue-PowerClassPerBandPerBC-r17 is present, min(ue-PowerClassPerBandPerBC-r17, power class of this BC);
* Otherwise, min(ue-PowerClass, power class of this BC).

Option 2:

 Please propose.

WF: Option 1

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* **Inter-band+Intra-band UL CA (2UL3CC)**:

The max Tx power PCMAX,f,c for a UL component band is determined by:

Option 1:

* If ue-PowerClassPerBandPerBC-r17 is present, min(ue-PowerClassPerBandPerBC-r17, power class of this BC);
* Otherwise:
	+ min(ue-PowerClass, power class of this BC) for the single-carrier UL
	+ ue-PowerClass for the intra-band CA UL

Option 2:

* If ue-PowerClassPerBandPerBC-r17 is present, min(ue-PowerClassPerBandPerBC-r17, power class of this BC);
* Otherwise:
	+ min(ue-PowerClass, power class of this BC) for both ULs

Option 3:

* If ue-PowerClassPerBandPerBC-r17 is present, min(ue-PowerClassPerBandPerBC-r17, power class of this BC);
* Otherwise:
	+ min(ue-PowerClass, power class of this BC) for the single-carrier UL
	+ default power class (i.e. PC3 or PC5) for the intra-band CA UL

WF: option 3

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## <Max Tx power PCMAX,f,c for Single-carrier UL with inter-band CA DL>

This type of BC is typically viewed as a fallback of a parent BC (e.g. having UL CA). Based on RAN2’s reporting rules, a UE is allowed to report a fallback BC if its power class capability is **higher** than the parent BC.

* **The BC is reported**:

The max Tx power PCMAX,f,c for the UL component band is determined by:

Option 1:

* ue-PowerClassPerBandPerBC-r17 if present
* Otherwise, power class of this BC.

Option 2:

Power class of this BC;

Option 3:

 ue-PowerClass for the UL band

WF: Option 1

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* **The BC is NOT reported**:

The max Tx power PCMAX,f,c for the UL component band is determined by:

Option 1:

the power class derived from a parent BC

Option 2:

 ue-PowerClass for the UL band

WF: Option 1

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## <Max Tx power PCMAX,f,c for Intra-band CA UL with Inter+Intra-band CA DL>

Similarly, this type of BC may be viewed as a fallback of a parent BC (e.g. having UL CA). Based on RAN2’s reporting rules, a UE is allowed to report a fallback BC if its power class capability is **higher** than the parent BC.

* **The BC is reported**:

The max Tx power PCMAX,f,c for the UL component band is determined by:

Option 1:

* ue-PowerClassPerBandPerBC-r17 if present
* Otherwise, power class of this BC.

Option 2:

Power class of this BC;

Option 3:

 ue-PowerClass for the UL band

WF: Option 1

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| **Company** | **Comments** |
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* **The BC is NOT reported**:

The max Tx power PCMAX,f,c for the UL component band is determined by:

Option 1:

the power class derived from a parent BC

Option 2:

 ue-PowerClass for the UL band

Option 3:

 default power class (i.e. PC3 or PC5) for the UL band

WF: Option 1

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## <Other agreements>

Agreement:

* For UE that is configured in the single carrier mode (1 DL + 1 UL on this band), the power class is determined by ue-PowerClass for this NR band.

Agreement:

* The RAN4 common understanding is the ue-PowerClassPerBandPerBC-r17 capability can be used for 3Tx band combinations such as UL CA+TxD and UL CA+UL MIMO

# Reference

[1] R4-2401102 Topic summary for [110][143] NR\_power\_class Moderator (Samsung) RAN4#110