3GPP TSG-RAN WG4 Meeting #101-e R4-22xxxxx

**Electronic Meeting, 17th – 25th January, 2022**

**Agenda Item: 6.11.2.3**

**Source: Apple**

**Title: WF on NCSG**

**Document for: Approval**

# **Introduction**

This WF is to capture all agreements and open issues for NCSG in RAN4#101e meeting based on email discussion [101-bis-e][211] NR\_MG\_enh\_3.

# **Sub-topic 1: Scenarios and use cases**

**Issue 1-1: NCSG for CSI-RS based inter-frequency measurement with gap**

Agreement:

* Option 1: NCSG for CSI-RS based inter-frequency measurement with gap is supported in R17.
* Option 1a: NCSG can be used for CSI-RS inter-frequency measurement. UE reports supported CSI-RS BW for each band.
* Option 2: NCSG for CSI-RS based inter-frequency measurement with gap is NOT supported in R17.
* Option 3: RAN4 to work on CSI-RS based inter-frequency measurement requirement via NCSG after stabilizing the SSB-based requirements.
* Option 4: NCSG for CSI-RS based inter-frequency measurement with gap is supported in R17. However, corresponding requirements will not be defined in R17.
* Option 5: NCSG for CSI-RS based inter-frequency measurement with gap is supported in R17. Corresponding requirements will be defined in R17. Introduce a new optional UE capability to indicate support of using NCSG for inter-frequency measurement with gap.

**Issue 1-2: NCSG for dormant SCell**

Agreement

* RRM measurement for dormant Scell is supported in R17. (CATT, Apple, vivo, HW, E///, ZTE, MTK, vivo)

**Issue 1-3: whether NCSG under EN-DC, NE-DC and NR-DC is supported in R17**

Agreement

* RAN4 will not further discuss feasibility of NCSG in EN-DC, NE-DC and NR-DC. The feasibility is expected to be decided in RAN2.

**Issue 1-4: NCSG in FR2**

Agreements:

* NCSG can be applied without scheduling restrictions under the following conditions
	+ The serving cell(s) and the target cell are on different bands.
	+ UE is capable of IBM on the serving cell band and the target cell band.
	+ UE is capable of simultaneous Tx/Rx on the serving cell band and the target cell band
* For other cases NCSG can be applied with scheduling restrictions

# **Sub-topic 2: NCSG patterns**

**Issue 2-1: On top of #0 and #1, whether additional NCSG gap patterns shall be mandatorily supported if UE supports NCSG.**

Agreements:

NCSG patterns corresponding to legacy patterns #13 and #14 are mandatorily supported in FR2 for per-FR capable UE. FFS on other mandatory patterns:

* Option 1:For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory.
* Option 2: no additional mandatory NCSG patterns

**Issue 2-2: The existing gap applicability in Rel-16 for NR-only measurement are reused for NCSG**

Agreements:

UE can indicate support of some NCSG patterns which can only be used for NR-only measurement. FFS on how to indicate support of NR-only NCSG pattern:

* Option 1: reuse *supportedGapPattern-Nronly* (require mapping between legacy gap patterns and NCSG patterns)
* Option 2: introduce a new signaling, e.g. *supportedNCSGPattern-Nronly*
* Option 3:up to RAN2

**Issue 2-3: time offset for NCSG:**

Agreement:

* Option 1:The offset of NCSG refers to the starting point of VIL1.
* Option 2: The offset of NCSG refers to the starting point of ML – RRT. Allow 2 slots interruption for 15kHz, sync, mgta=0.



**Issue 2-4: mgta for NCSG:**

Agreement:

Introduce a new mgta 0.75ms for NCSG in FR2 only

# **Sub-topic 3: UE capability and NW configuration**

**Issue 3-1-1: meaning of “measurement within gap”**

Agreement:

* Option 1: basic time interval which is expressed as with gap or without gap in the current spec.
* Option 2: CSSF is derived within gap which is expressed as within gap or outside gap in the current spec

**Issue 3-1-2: when UE indicates ‘ncsg’ and NW configures MG**

Agreement:

When UE indicates ‘ncsg’ and NW configures MG, UE shall perform measurement within MG.

**Issue 3-1-2A: when UE indicates ‘no-gap-no-ncsg’ and NW configures NCSG**

Agreement:

* If RS occasion (e.g. SMTC) is fully overlapped with NCSG, measurement is performed within NCSG
* If RS occasion (e.g. SMTC) is not fully overlapped with NCSG, measurement is performed outside NCSG

**Issue 3-1-3: when UE indicates ‘no-gap-no-ncsg’ and NW configures MG**

Agreement:

* If RS occasion (e.g. SMTC) is fully overlapped with MG, measurement is performed within MG
* If RS occasion (e.g. SMTC) is not fully overlapped with MG, measurement is performed outside MG

**Issue 3-1-4: other assumptions when discussing NW configuration and corresponding UE behaviour**

Agreement:

* Only those measurement types RAN4 agreed to be measured via NCSG will be considered
* When NCSG is configured, for a frequency layer that can be measured without MG
	+ when SMTC is partially overlapped with NCSG, Kp = 1/(1- (SMTC period /VIRP)) applies
	+ when SMTC is fully overlapped with NCSG, the frequency layer should be measured within NCSG and be accounted in the CSSF with NCSG.
* FFS: When UE reports the NCSG capability (‘no-gap-no-ncsg’, ’ncsg’ and ‘gap’) on a target band to network, the reported capability applies to all measurement types agreed by RAN4 on that target band.

**Issue 3-2: Whether additional UE capability is needed for per-UE and per-FR differentiation for NCSG on top of that defined for legacy gap**

Agreement:

* Option 1: No
* Option 2: Define a per BC indication for per FR NCSG.
* Option 3: do not rely on R15 capability *independentGapConfig*. Define a new NCSG per-UE and per-FR capability, e.g. *independentNCSGConfig*

# **Sub-topic 4: measurement related requirements**

**Issue 4-0: new signaling deriveSSB-IndexFromCell-inter**

Agreement:

RAN4 agreed to introduce a new network signaling [*deriveSSB-IndexFromCell-inter*] informing UE that the SSB indexes of target cell(s) on a frequency different than serving cell frequency can be derived from a serving cell, and which serving cell to utilize for target SSB indexes derivation.

* *deriveSSB-IndexFromCell-inter* can only be configured if the SCS of SSB is the same between target cell and the serving cell which is used for SSB indexes derivation.
* *deriveSSB-IndexFromCell-inter* is applicable in both FR1 and FR2.
* UE needs to know which serving cell to be referred under CA.
* The indication is to be per-MO.

**Issue 4-1: scheduling restriction in FR1**

Issue 4-1-1: for intra-frequency measurement

Agreement:

* For intra-frequency measurement, existing scheduling restriction requirements apply

Issue 4-1-2: for intra-band inter-frequency measurement

Agreement:

* If *deriveSSB-IndexFromCell-inter* is false, existing scheduling restriction requirements apply except that all symbols in SMTC windows are restricted.
* If *deriveSSB-IndexFromCell-inter* is true,
	+ For single CC and single MO case: existing scheduling restriction requirements apply.
	+ For multiple CCs and/or Multiple MOs cases: FFS

Issue 4-1-3: for inter-band measurement

Agreement:

* No scheduling restrictions for UE supporting simultaneous Rx/Tx.
* Scheduling restrictions apply for UE doesn’t support simultaneous Rx/Tx.
	+ If *deriveSSB-IndexFromCell-inter* is false, existing scheduling restriction requirements apply except that all symbols in SMTC windows are restricted.
	+ If *deriveSSB-IndexFromCell-inter* is true,
		- For single CC and single MO case: existing scheduling restriction requirements apply.
		- For multiple CCs and/or Multiple MOs cases: FFS

**Issue 4-2: scheduling restriction in FR2**

Issue 4-2-1: for intra-frequency measurement

Agreement:

* Existing scheduling restriction requirements apply.

Issue 4-2-2: for intra-band inter-frequency measurement

Agreement:

* If *deriveSSB-IndexFromCell-inter* is false, existing scheduling restriction requirements apply except that all symbols in SMTC windows are restricted.
* If *deriveSSB-IndexFromCell-inter* is true,
	+ For single CC and single MO case: existing scheduling restriction requirements apply.
	+ For multiple CCs and/or Multiple MOs cases: FFS

**Issue 4-2-3: for inter-band measurement, the serving band and the target band are with CBM**

Agreement:

* If *deriveSSB-IndexFromCell-inter* is false, existing scheduling restriction requirements apply except that all symbols in SMTC windows are restricted.
* If *deriveSSB-IndexFromCell-inter* is true,
	+ For single CC and single MO case: existing scheduling restriction requirements apply.
	+ For multiple CCs and/or Multiple MOs cases: FFS

**Issue 4-2-4: for inter-band measurement, the serving band and the target band are with IBM**

Agreement:

* No scheduling restrictions for UE supporting simultaneous Rx/Tx.
* Scheduling restrictions apply for UE doesn’t support simultaneous Rx/Tx.
	+ If *deriveSSB-IndexFromCell-inter* is false, existing scheduling restriction requirements apply except that all symbols in SMTC windows are restricted.
	+ If *deriveSSB-IndexFromCell-inter* is true,
		- For single CC and single MO case: existing scheduling restriction requirements apply.
		- For multiple CCs and/or Multiple MOs cases: FFS

**Issue 4-3: CSSF**

Agreement:

* The value of CSSF within NCSG is the number of all frequency layers that are assumed to be measured by NCSG. FFS on how to handle the overlapping between SMTC and NCSG.

**Issue 4-4: void**

**Issue 4-5: measurement on deactivated SCC**

Agreement:

* A deactivated SCC is measured in the same way as Rel-15/16 if its SMTC is fully non-overlapped with NCSG, and the Rel-15/16 interruption requirements apply.

**Issue 4-6: impact on L1 measurement**

* FFS on the impact. The following proposals are only for reference for further discussion.
* For L1 measurement in an FR1 serving cell, NCSG is not to be considered in P factor provided that VIL of NCSG is not overlapped with any of the RS for L1 measurement.
* For L1 measurement in an FR2 serving cell,
	+ if L1 measurement is impacted by L3 measurement of any target carrier measured with NCSG, P is calculated in the same way as in Rel-15 with VIRP replacing legacy MGRP,
	+ if L1 measurement is not impacted by L3 measurement of any target carrier measured with NCSG, NCSG is not to be considered in P factor provided that VIL of NCSG is not overlapped with any of the RS for L1 measurement.
	+ L1 measurement is impacted by L3 measurement of a target carrier if the target carrier is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or if the target carrier is inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell, otherwise there is no impact.

# **Sub-topic 5: others**

**Issue 5-1: transformation between NCSG and legacy gap**

Agreement:

* No need to define new transformation between NCSG and legacy gap, given the transformation between NCSG and legacy MG can already be done by NW via RRC reconfiguration

**Issue 5-2: void**

**Issue 5-3: Whether to introduce a mapping table between legacy measurement gap patterns and corresponding NCSG patterns**

Agreement:

* Option 1: No
* Option 2: Yes

**Issue 5-4: UE feature list discussion on NCSG support**

Agreements:

* X-1 is agreed. FFS on X-2 and X-3

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| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| X-1 | Network controlled small gap (NCSG) | Support of NCSG (Apple, Intel, MTK, ZTE) |  | yes | no | UE cannot be configured with NCSG | per-UE | No | No |  |  | Optional with capability signalling |
| X-2 | Network controlled small gap (NCSG) | Supported NCSG patterns (Apple, MTK) |  | yes | no | Network does not know whether some NCSG patterns can be configured to UE | per-UE | No | No |  |  | Optional with capability signallingNCSGpatterns #0, #1, [x, y, …] are conditional mandatory if UE support X-1 |
| X-3 | Network controlled small gap (NCSG) | Support of NCSG per band in target MO in a band combination for inter-frequency measurement (ZTE) |  |  |  |  | Per-band |  |  |  |  |  |

# **Reference**

[1] R4-2120415, WF on NCSG, Apple

[2] R4-2115344, WF on NCSG, Apple

[2] R4-2108348, WF on R17 NR MG enhancements –NCSG (RAN4#99e), Intel

[3] R4-2105792, WF on R17 NR MG enhancements –NCSG (RAN4#98-bis-e), Intel

[4] R4-2117602, General issues for measurement gap enhancement WI, MediaTek Inc., Intel Corporation, Apple