**3GPP TSG-RAN WG2 Meeting #130 R2-25xxxxx**

**St Julian, Malta, 19th – 23rd May 2025**

**Agenda item:**  **7.0.2.10**

**Title: Offline discussion on way forward of servingCellMO for SSB-less SCell**

**Source: ZTE Corporation**

**Document for:** **Discussion and Decision**

# Introduction

This is the summary of the following offline discussion:

* [AT130][017][NES] SSBless (ZTE)

 Intended outcome: Way forward and CR Deadline: Thursday

# Discussion

## Definition of the UE capability

The following definition of the UE capability has been proposed by merging the proposal from R2-2503761, R2-2503762 and R2-2503936.

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| **Definitions for parameters** | **Per** | **M** | **FDD-TDD DIFF** | **FR1-FR2 DIFF** |
| ***servingCellMOConfigForSCellWithoutSSB***Indicates whether the UE supports the configuration of *servingCellMO* for SCell that does not transmit SS/PBCH block. A UE supporting this feature shall also support NR intra-frequency measurements on neighbor cells based on *servingCellMO* associated with SCell that does not transmit SS/PBCH block. | UE | No | No | FR1 only |

**Question 1: Do companies agree with the above definition of the UE capability to be introduced to address the *servingCellMO* for SSB-less SCell?**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | On the field description: agree with the first sentence, no strong view on the second sentence.On the name: prefer “ intraF-NeighMeasForSCellWithoutSSB” because this mainly concerns intra-frequency measurements. Even if we go with the suggested name above, it should be “servingCellMO-ConfigForSCellWithoutSSB” according to the naming convention. |
| Ericsson | Yes | We are fine with the description. About the name, we tend to agree with Huawei. Maybe “IntraFreqMeasForSCellWithoutSSB” seems okay, but we are fine to have another name as far as we hint that this for intra-frequency measurements. |
| ZTE | Yes | No strong view for the name of this field. We can change to “IntraFreqMeasForSCellWithoutSSB” and keep the field description as it is. |
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## Other changes required

### Stage 3

The following changes have been proposed in R2-2503936:

1. Clarify in the procedure text that that SSB-based serving cell measurements are skipped.

-------------------------------Changes in the text-------------------------------

The UE shall:

1> whenever the UE has a *measConfig*, perform RSRP and RSRQ measurements for each serving cell for which *servingCellMO* is configured as follows:

2> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *ssb* and *ssb-ConfigMobility* is configured in the *measObject* indicated by the *servingCellMO*, and *absoluteFrequencySSB* is configured in*ServingCellConfigCommon*:

3> if the *reportConfig* contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:

4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;

3> derive serving cell measurement results based on SS/PBCH block, as described in 5.5.3.3;

2> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *csi-rs* and *CSI-RS-ResourceConfigMobility* is configured in the *measObject* indicated by the *servingCellMO*:

3> if the *reportConfig* contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:

4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on CSI-RS, as described in 5.5.3.3a;

3> derive serving cell measurement results based on CSI-RS, as described in 5.5.3.3;

1> for each serving cell for which *servingCellMO* is configured, if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains SINR as trigger quantity and/or reporting quantity:

2> if the *reportConfig* contains *rsType* set to *ssb* and *ssb-ConfigMobility* is configured in the *servingCellMO*, and *absoluteFrequencySSB* is configured in *ServingCellConfigCommon*:

3> if the *reportConfig*contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:

4> derive layer 3 filtered SINR per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;

3> derive serving cell SINR based on SS/PBCH block, as described in 5.5.3.3;

-------------------------------Changes in the text-------------------------------

**Question 2: Do companies agree with the above clarification in the procedure text that that SSB-based serving cell measurements are skipped for SSB-less SCell?**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes |  |
| Ericsson | Yes |  |
| ZTE | Yes |  |
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1. Clarify in the field description of servingCellMO that the ssbFrequency value is same as absoluteFrequencySSB only when the serving cell is associated with SSB; if the serving cell is not associated with SSB, the carrier frequency indicated by ssbFrequnecy of the corresponding MeasObjectNR, if configured, is within the frequency range indicated by any entry of the scs-SpecificCarrierList.

-------------------------------Changes in the text-------------------------------

– *ServingCellConfig*

The IE *ServingCellConfig* is used to configure (add or modify) the UE with a serving cell, which may be the SpCell or an SCell of an MCG or SCG. The parameters herein are mostly UE specific but partly also cell specific (e.g. in additionally configured bandwidth parts). Reconfiguration between a PUCCH and PUCCHless SCell is only supported using an SCell release and add.

***ServingCellConfig* information element**

-- ASN1START

-- TAG-SERVINGCELLCONFIG-START

ServingCellConfig ::= SEQUENCE {

 tdd-UL-DL-ConfigurationDedicated TDD-UL-DL-ConfigDedicated OPTIONAL, -- Cond TDD

 initialDownlinkBWP BWP-DownlinkDedicated OPTIONAL, -- Need M

 downlinkBWP-ToReleaseList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id OPTIONAL, -- Need N

 downlinkBWP-ToAddModList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Downlink OPTIONAL, -- Need N

 firstActiveDownlinkBWP-Id BWP-Id OPTIONAL, -- Cond SyncAndCellAdd

 bwp-InactivityTimer ENUMERATED {ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30,

 ms40,ms50, ms60, ms80,ms100, ms200,ms300, ms500,

 ms750, ms1280, ms1920, ms2560, spare10, spare9, spare8,

 spare7, spare6, spare5, spare4, spare3, spare2, spare1 } OPTIONAL, --Need R

 defaultDownlinkBWP-Id BWP-Id OPTIONAL, -- Need S

 uplinkConfig UplinkConfig OPTIONAL, -- Need M

 supplementaryUplink UplinkConfig OPTIONAL, -- Need M

 pdcch-ServingCellConfig SetupRelease { PDCCH-ServingCellConfig } OPTIONAL, -- Need M

 pdsch-ServingCellConfig SetupRelease { PDSCH-ServingCellConfig } OPTIONAL, -- Need M

 csi-MeasConfig SetupRelease { CSI-MeasConfig } OPTIONAL, -- Need M

 sCellDeactivationTimer ENUMERATED {ms20, ms40, ms80, ms160, ms200, ms240,

 ms320, ms400, ms480, ms520, ms640, ms720,

 ms840, ms1280, spare2,spare1} OPTIONAL, -- Cond ServingCellWithoutPUCCH

 crossCarrierSchedulingConfig CrossCarrierSchedulingConfig OPTIONAL, -- Need M

 tag-Id TAG-Id,

 dummy ENUMERATED {enabled} OPTIONAL, -- Need R

 pathlossReferenceLinking ENUMERATED {spCell, sCell} OPTIONAL, -- Cond SCellOnly

 servingCellMO MeasObjectId OPTIONAL, -- Cond MeasObject

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 lte-CRS-ToMatchAround SetupRelease { RateMatchPatternLTE-CRS } OPTIONAL, -- Need M

 rateMatchPatternToAddModList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern OPTIONAL, -- Need N

 rateMatchPatternToReleaseList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL, -- Need N

 downlinkChannelBW-PerSCS-List SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier OPTIONAL -- Need S

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}

UplinkConfig ::= SEQUENCE {

 initialUplinkBWP BWP-UplinkDedicated OPTIONAL, -- Need M

 uplinkBWP-ToReleaseList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id OPTIONAL, -- Need N

 uplinkBWP-ToAddModList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Uplink OPTIONAL, -- Need N

 firstActiveUplinkBWP-Id BWP-Id OPTIONAL, -- Cond SyncAndCellAdd

 pusch-ServingCellConfig SetupRelease { PUSCH-ServingCellConfig } OPTIONAL, -- Need M

 carrierSwitching SetupRelease { SRS-CarrierSwitching } OPTIONAL, -- Need M

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 powerBoostPi2BPSK BOOLEAN OPTIONAL, -- Need M

 uplinkChannelBW-PerSCS-List SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier OPTIONAL -- Need S

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}

-- TAG-SERVINGCELLCONFIG-STOP

-- ASN1STOP

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| ***ServingCellConfig* field descriptions** |
| ***bwp-InactivityTimer***The duration in ms after which the UE falls back to the default Bandwidth Part (see TS 38.321 [3], clause 5.15). When the network releases the timer configuration, the UE stops the timer without switching to the default BWP. |
| ***crossCarrierSchedulingConfig***Indicates whether this serving cell is cross-carrier scheduled by another serving cell or whether it cross-carrier schedules another serving cell. |
| ***defaultDownlinkBWP-Id***The initial bandwidth part is referred to by BWP-Id = 0. ID of the downlink bandwidth part to be used upon expiry of the BWP inactivity timer. This field is UE specific. When the field is absent the UE uses the initial BWP as default BWP. (see TS 38.213 [13], clause 12 and TS 38.321 [3], clause 5.15). |
| ***downlinkBWP-ToAddModList***List of additional downlink bandwidth parts to be added or modified. (see TS 38.213 [13], clause 12). |
| ***downlinkBWP-ToReleaseList***List of additional downlink bandwidth parts to be released. (see TS 38.213 [13], clause 12). |
| ***downlinkChannelBW-PerSCS-List***A set of UE specific channel bandwidth and location configurations for different subcarrier spacings (numerologies). Defined in relation to Point A. The UE uses the configuration provided in this field only for the purpose of channel bandwidth and location determination. If absent, UE uses the configuration indicated in *scs-SpecificCarrierList* in *DownlinkConfigCommon* / *DownlinkConfigCommonSIB*. Network only configures channel bandwidth that corresponds to the channel bandwidth values defined in TS 38.101-1 [15] and TS 38.101-2 [39]. |
| ***firstActiveDownlinkBWP-Id***If configured for an SpCell, this field contains the ID of the DL BWP to be activated upon performing the RRC (re-)configuration. If the field is absent, the RRC (re-)configuration does not impose a BWP switch.If configured for an SCell, this field contains the ID of the downlink bandwidth part to be used upon MAC-activation of an SCell. The initial bandwidth part is referred to by BWP-Id = 0.Upon reconfiguration with *reconfigurationWithSync*, the network sets the *firstActiveDownlinkBWP-Id* and *firstActiveUplinkBWP-Id* to the same value. |
| ***initialDownlinkBWP***The dedicated (UE-specific) configuration for the initial downlink bandwidth-part (i.e. DL BWP#0). If any of the optional IEs are configured within this IE, the UE considers the BWP#0 to be an RRC configured BWP (from UE capability viewpoint). Otherwise, the UE does not consider the BWP#0 as an RRC configured BWP (from UE capability viewpoint). Network always configures the UE with a value for this field if no other BWPs are configured. NOTE1 |
| ***lte-CRS-ToMatchAround***Parameters to determine an LTE CRS pattern that the UE shall rate match around. |
| ***pathlossReferenceLinking***Indicates whether UE shall apply as pathloss reference either the downlink of SpCell (PCell for MCG or PSCell for SCG) or of SCell that corresponds with this uplink (see TS 38.213 [13], clause 7). |
| ***pdsch-ServingCellConfig***PDSCH related parameters that are not BWP-specific. |
| ***rateMatchPatternToAddModList***Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources indicated in the rate match patterns. Rate match patterns defined here on cell level apply only to PDSCH of the same numerology. See TS 38.214 [19], clause 5.1.4.1. |
| ***sCellDeactivationTimer***SCell deactivation timer in TS 38.321 [3]. If the field is absent, the UE applies the value infinity. |
| ***servingCellMO****measObjectId* of the *MeasObjectNR* in *MeasConfig* which is associated to the serving cell. If the serving cell is associated with SSB, the following relationship applies between the corresponding *MeasObjectNR* and *frequencyInfoDL* in *ServingCellConfigCommon/ServingCellConfigCommonSIB* of the serving cell: if *ssbFrequency* is configured, its value is the same as the *absoluteFrequencySSB* and if *csi-rs-ResourceConfigMobility* is configured, the value of its *subcarrierSpacing* is present in one entry of the *scs-SpecificCarrierList*, *csi-RS-CellListMobility* includes an entry corresponding to the serving cell (with *cellId* equal to *physCellId* in *ServingCellConfigCommon*) and the frequency range indicated by the *csi-rs-MeasurementBW* of the entry in *csi-RS-CellListMobility* is included in the frequency range indicated by in the entry of the *scs-SpecificCarrierList*.If the serving cell is not associated with SSB (i.e. SSB-less SCell), the carrier frequency indicated by *ssbFrequnecy* of the corresponding *MeasObjectNR*, if configured, is within the frequency range indicated by any entry of the *scs-SpecificCarrierList*.  |
| ***supplementaryUplink***Network may configure this field only when *supplementaryUplinkConfig* is configured in *ServingCellConfigCommon* or *supplementaryUplink* is configured in *ServingCellConfigCommonSIB*. |
| ***tag-Id***Timing Advance Group ID, as specified in TS 38.321 [3], which this cell belongs to. |
| ***uplinkConfig***Network may configure this field only when *uplinkConfigCommon* is configured in *ServingCellConfigCommon* or *ServingCellConfigCommonSIB*. Addition or release of this field can only be done upon SCell addition or release (respectively). |
| ***UplinkConfig* field descriptions** |
| ***carrierSwitching***Includes parameters for configuration of carrier based SRS switching (see TS 38.214 [19], clause 6.2.1.3. |
| ***firstActiveUplinkBWP-Id***If configured for an SpCell, this field contains the ID of the UL BWP to be activated upon performing the RRC (re-)configuration. If the field is absent, the RRC (re-)configuration does not impose a BWP switch.If configured for an SCell, this field contains the ID of the uplink bandwidth part to be used upon MAC-activation of an SCell. The initial bandwidth part is referred to by BandiwdthPartId = 0. |
| ***initialUplinkBWP***The dedicated (UE-specific) configuration for the initial uplink bandwidth-part (i.e. UL BWP#0). If any of the optional IEs are configured within this IE as part of the IE *uplinkConfig*, the UE considers the BWP#0 to be an RRC configured BWP (from UE capability viewpoint). Otherwise, the UE does not consider the BWP#0 as an RRC configured BWP (from UE capability viewpoint). Network always configures the UE with a value for this field if no other BWPs are configured. NOTE1 |
| ***powerBoostPi2BPSK***If this field is set to *true*, the UE determines the maximum output power for PUCCH/PUSCH transmissions that use pi/2 BPSK modulation according to TS 38.101-1 [15], clause 6.2.4. |
| ***pusch-ServingCellConfig***PUSCH related parameters that are not BWP-specific. |
| ***uplinkBWP-ToAddModList***The additional bandwidth parts for uplink to be added or modified. In case of TDD uplink- and downlink BWP with the same *bandwidthPartId* are considered as a BWP pair and must have the same center frequency. |
| ***uplinkBWP-ToReleaseList***The additional bandwidth parts for uplink to be released. |
| ***uplinkChannelBW-PerSCS-List***A set of UE specific channel bandwidth and location configurations for different subcarrier spacings (numerologies). Defined in relation to Point A. The UE uses the configuration provided in this field only for the purpose of channel bandwidth and location determination. If absent, UE uses the configuration indicated in *scs-SpecificCarrierList* in *UplinkConfigCommon* / *UplinkConfigCommonSIB*. Network only configures channel bandwidth that corresponds to the channel bandwidth values defined in TS 38.101-1 [15] and TS 38.101-2 [39]. |

NOTE 1: If the dedicated part of initial UL/DL BWP configuration is absent, the initial BWP can be used but with some limitations. For example, changing to another BWP requires *RRCReconfiguration* since DCI format 1\_0 doesn't support DCI-based switching.

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| **Conditional Presence** | **Explanation** |
| *MeasObject* | This field is mandatory present for the SpCell if the UE has a *measConfig*, and it is optionally present, Need M, for SCells. For SSB-less SCell(s), this field is not present if *servingCellMOConfigForSCellWithoutSSB* is not supported by the UE, otherwise this field is optionally present, Need M. |
| *SCellOnly* | This field is optionally present, Need R, for SCells. It is absent otherwise.  |
| *ServingCellWithoutPUCCH* | This field is optionally present, Need S, for SCells except PUCCH SCells. It is absent otherwise. |
| *SyncAndCellAdd* | This field is mandatory present for a SpCell upon reconfiguration with *reconfigurationWithSync* and upon *RRCSetup*/*RRCResume*.The field is optionally present for a SpCell, Need N, upon reconfiguration without *reconfigurationWithSync*.The field is mandatory present for an SCell upon addition, and absent for SCell in other cases, Need M. |
| *TDD* | This field is optionally present, Need R, for TDD cells. It is absent otherwise. |

**Question 3: Do companies agree with the clarifications on the *ssbFrequnecy* in *servingCellMO*?**

* **Clarify in the field description of *servingCellMO* that the *ssbFrequency* value is same as *absoluteFrequencySSB* only when the serving cell is associated with SSB; if the serving cell is not associated with SSB, the carrier frequency indicated by *ssbFrequnecy* of the corresponding *MeasObjectNR*, if configured, is within the frequency range indicated by any entry of the *scs-SpecificCarrierList*.**
* **Clarify that for SSB-less SCell(s), *servingCellMO* is not present if *servingCellMOConfigForSCellWithoutSSB* is not supported by the UE.**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes |  |
| Ericsson | Yes | We just need to update the name of the capability. |
| ZTE | Yes | Just to update the name of the capability. |
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1. Clarify the presence condition of ssbFrequency in servingCellMO for a SSB-less SCell.

-------------------------------Changes in the text-------------------------------

*– MeasObjectNR*

The IE *MeasObjectNR* specifies information applicable for SS/PBCH block(s) intra/inter-frequency measurements and/or CSI-RS intra/inter-frequency measurements.

***MeasObjectNR* information element**

-- ASN1START

-- TAG-MEASOBJECTNR-START

MeasObjectNR ::= SEQUENCE {

 ssbFrequency ARFCN-ValueNR OPTIONAL, -- Cond SSBorAssociatedSSB2

 ssbSubcarrierSpacing SubcarrierSpacing OPTIONAL, -- Cond SSBorAssociatedSSB

 smtc1 SSB-MTC OPTIONAL, -- Cond SSBorAssociatedSSB

 smtc2 SSB-MTC2 OPTIONAL, -- Cond IntraFreqConnected

 refFreqCSI-RS ARFCN-ValueNR OPTIONAL, -- Cond CSI-RS

 referenceSignalConfig ReferenceSignalConfig,

 absThreshSS-BlocksConsolidation ThresholdNR OPTIONAL, -- Need R

 absThreshCSI-RS-Consolidation ThresholdNR OPTIONAL, -- Need R

 nrofSS-BlocksToAverage INTEGER (2..maxNrofSS-BlocksToAverage) OPTIONAL, -- Need R

 nrofCSI-RS-ResourcesToAverage INTEGER (2..maxNrofCSI-RS-ResourcesToAverage) OPTIONAL, -- Need R

 quantityConfigIndex INTEGER (1..maxNrofQuantityConfig),

 offsetMO Q-OffsetRangeList,

 cellsToRemoveList PCI-List OPTIONAL, -- Need N

 cellsToAddModList CellsToAddModList OPTIONAL, -- Need N

 blackCellsToRemoveList PCI-RangeIndexList OPTIONAL, -- Need N

 blackCellsToAddModList SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeElement OPTIONAL, -- Need N

 whiteCellsToRemoveList PCI-RangeIndexList OPTIONAL, -- Need N

 whiteCellsToAddModList SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeElement OPTIONAL, -- Need N

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 freqBandIndicatorNR FreqBandIndicatorNR OPTIONAL, -- Need R

 measCycleSCell ENUMERATED {sf160, sf256, sf320, sf512, sf640, sf1024, sf1280} OPTIONAL -- Need R

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}

ReferenceSignalConfig::= SEQUENCE {

 ssb-ConfigMobility SSB-ConfigMobility OPTIONAL, -- Need M

 csi-rs-ResourceConfigMobility SetupRelease { CSI-RS-ResourceConfigMobility } OPTIONAL -- Need M

}

SSB-ConfigMobility::= SEQUENCE {

 ssb-ToMeasure SetupRelease { SSB-ToMeasure } OPTIONAL, -- Need M

 deriveSSB-IndexFromCell BOOLEAN,

 ss-RSSI-Measurement SS-RSSI-Measurement OPTIONAL, -- Need M

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}

Q-OffsetRangeList ::= SEQUENCE {

 rsrpOffsetSSB Q-OffsetRange DEFAULT dB0,

 rsrqOffsetSSB Q-OffsetRange DEFAULT dB0,

 sinrOffsetSSB Q-OffsetRange DEFAULT dB0,

 rsrpOffsetCSI-RS Q-OffsetRange DEFAULT dB0,

 rsrqOffsetCSI-RS Q-OffsetRange DEFAULT dB0,

 sinrOffsetCSI-RS Q-OffsetRange DEFAULT dB0

}

ThresholdNR ::= SEQUENCE{

 thresholdRSRP RSRP-Range OPTIONAL, -- Need R

 thresholdRSRQ RSRQ-Range OPTIONAL, -- Need R

 thresholdSINR SINR-Range OPTIONAL -- Need R

}

CellsToAddModList ::= SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CellsToAddMod

CellsToAddMod ::= SEQUENCE {

 physCellId PhysCellId,

 cellIndividualOffset Q-OffsetRangeList

}

-- TAG-MEASOBJECTNR-STOP

-- ASN1STOP

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| ***CellsToAddMod* field descriptions** |
| ***cellIndividualOffset***Cell individual offsets applicable to a specific cell. |
| ***physCellId***Physical cell identity of a cell in the cell list. |

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| ***MeasObjectNR* field descriptions** |
| ***absThreshCSI-RS-Consolidation***Absolute threshold for the consolidation of measurement results per CSI-RS resource(s) from L1 filter(s). The field is used for the derivation of cell measurement results as described in 5.5.3.3 and the reporting of beam measurement information per CSI-RS resource as described in 5.5.5.2. |
| ***absThreshSS-BlocksConsolidation***Absolute threshold for the consolidation of measurement results per SS/PBCH block(s) from L1 filter(s). The field is used for the derivation of cell measurement results as described in 5.5.3.3 and the reporting of beam measurement information per SS/PBCH block index as described in 5.5.5.2. |
| ***blackCellsToAddModList***List of cells to add/modify in the black list of cells. It applies only to SSB resources. |
| ***blackCellsToRemoveList***List of cells to remove from the black list of cells. |
| ***cellsToAddModList***List of cells to add/modify in the cell list. |
| ***cellsToRemoveList***List of cells to remove from the cell list.  |
| ***freqBandIndicatorNR***The frequency band in which the SSB and/or CSI-RS indicated in this *MeasObjectNR* are located and according to which the UE shall perform the RRM measurements. This field is always provided when the network configures measurements with this *MeasObjectNR*. |
| ***measCycleSCell***The parameter is used only when an SCell is configured on the frequency indicated by the measObjectNR and is in deactivated state, see TS 38.133 [14]. gNB configures the parameter whenever an SCell is configured on the frequency indicated by the *measObjectNR*, but the field may also be signalled when an SCell is not configured. Value *sf160* corresponds to 160 sub-frames, value *sf256* corresponds to 256 sub-frames and so on. |
| ***nrofCSI-RS-ResourcesToAverage***Indicates the maximum number of measurement results per beam based on CSI-RS resources to be averaged. The same value applies for each detected cell associated with this *MeasObjectNR*. |
| ***nrofSS-BlocksToAverage***Indicates the maximum number of measurement results per beam based on SS/PBCH blocks to be averaged. The same value applies for each detected cell associated with this *MeasObject*. |
| ***offsetMO***Offset values applicable to all measured cells with reference signal(s) indicated in this *MeasObjectNR*. |
| ***quantityConfigIndex***Indicates the n-*th* element of *quantityConfigNR-List* provided in *MeasConfig*. |
| ***referenceSignalConfig***RS configuration for SS/PBCH block and CSI-RS. |
| ***refFreqCSI-RS***Point A which is used for mapping of CSI-RS to physical resources according to TS 38.211 [16] clause 7.4.1.5.3. |
| ***smtc1***Primary measurement timing configuration. (see clause 5.5.2.10). |
| ***smtc2***Secondary measurement timing configuration for SS corresponding to this *MeasObjectNR* with PCI listed in *pci-List*. For these SS, the periodicity is indicated by *periodicity* in *smtc2* and the timing offset is equal to the offset indicated in *periodicityAndOffset* modulo *periodicity*. *periodicity* in smtc2 can only be set to a value strictly shorter than the periodicity indicated by *periodicityAndOffset* in *smtc1* (e.g. if *periodicityAndOffset* indicates *sf10*, *periodicity* can only be set of *sf5*, if *periodicityAndOffset* indicates *sf5*, *smtc2* cannot be configured). |
| ***ssbFrequency***Indicates the frequency of the SS associated to this *MeasObjectNR*. |
| ***ssbSubcarrierSpacing***Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable. |
| ***whiteCellsToAddModList***List of cells to add/modify in the white list of cells. It applies only to SSB resources. |
| ***whiteCellsToRemoveList***List of cells to remove from the white list of cells. |

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| ***ReferenceSignalConfig* field descriptions** |
| ***csi-rs-ResourceConfigMobility***CSI-RS resources to be used for CSI-RS based RRM measurements. |
| ***ssb-ConfigMobility***SSB configuration for mobility (nominal SSBs, timing configuration). |

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| ***SSB-ConfigMobility* field descriptions** |
| ***deriveSSB-IndexFromCell***If this field is set to *true*, UE assumes SFN and frame boundary alignment across cells on the same frequency carrier as specified in TS 38.133 [14]. Hence, if the UE is configured with a serving cell for which (*absoluteFrequencySSB*, *subcarrierSpacing*) in *ServingCellConfigCommon* is equal to (*ssbFrequency*, *ssbSubcarrierSpacing*) in this *MeasObjectNR*, this field indicates whether the UE can utilize the timing of this serving cell to derive the index of SS block transmitted by neighbour cell. Otherwise, this field indicates whether the UE may use the timing of any detected cell on that target frequency to derive the SSB index of all neighbour cells on that frequency. |
| ***ssb-ToMeasure***The set of SS blocks to be measured within the SMTC measurement duration. The first/leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not to be measured while value 1 indicates that the corresponding SS/PBCH block is to be measured (see TS 38.215 [9]). When the field is not configured the UE measures on all SS blocks. Regardless of the value of this field, SS/PBCH blocks outside of the applicable *smtc* are not to be measured. See TS 38.215 [9] clause 5.1.1. |

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| **Conditional Presence** | **Explanation** |
| *CSI-RS* | This field is mandatory present if *csi-rs-ResourceConfigMobility* is configured, otherwise, it is absent. |
| *SSBorAssociatedSSB* | This field is mandatory present if *ssb-ConfigMobility* is configured or *associatedSSB* is configured in at least one cell. Otherwise, it is absent, Need R. |
| *SSBorAssociatedSSB2* | If the *measObject* is associated to an SSB-less SCell, this field is optionally present if *ssb-ConfigMobility* is configured or *associatedSSB* is configured in at least one cell, otherwise, this field is mandatory present if *ssb-ConfigMobility* is configured or *associatedSSB* is configured in at least one cell. If *ssb-ConfigMobility* is not configured and *associatedSSB* is not configured for any cell, the field is absent, Need R. |
| *IntraFreqConnected* | This field is optionally present, Need R if the UE is configured with a serving cell for which (absoluteFrequencySSB, subcarrierSpacing) in ServingCellConfigCommon is equal to (*ssbFrequency*, *ssbSubcarrierSpacing*) in this *MeasObjectNR*, otherwise, it is absent. |

-------------------------------Changes in the text-------------------------------

**Question 4: Do companies agree with the above clarification on the presence condition of *ssbFrequnecy* in *servingCellMO*?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes |  |
| Ericsson | Yes |  |
| ZTE | Yes |  |
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### Stage 2

The following changes on stage 2 have been proposed in R2-2503936:

-------------------------------Changes in the text-------------------------------

9.2.4 Measurements

In RRC\_CONNECTED, the UE measures multiple beams (at least one) of a cell and the measurements results (power values) are averaged to derive the cell quality. In doing so, the UE is configured to consider a subset of the detected beams. Filtering takes place at two different levels: at the physical layer to derive beam quality and then at RRC level to derive cell quality from multiple beams. Cell quality from beam measurements is derived in the same way for the serving cell(s) and for the non-serving cell(s). Measurement reports may contain the measurement results of the *X* best beams if the UE is configured to do so by the gNB.

The corresponding high-level measurement model is described below:

****

**Figure 9.2.4-1: Measurement Model**

NOTE 1: K beams correspond to the measurements on SSB or CSI-RS resources configured for L3 mobility by gNB and detected by UE at L1.

- **A**: measurements (beam specific samples) internal to the physical layer.

- **Layer 1 filtering**: internal layer 1 filtering of the inputs measured at point A. Exact filtering is implementation dependent. How the measurements are actually executed in the physical layer by an implementation (inputs A and Layer 1 filtering) in not constrained by the standard.

- **A1**: measurements (i.e. beam specific measurements) reported by layer 1 to layer 3 after layer 1 filtering.

**- Beam Consolidation/Selection**: beam specific measurements are consolidated to derive cell quality. The behaviour of the Beam consolidation/selection is standardised and the configuration of this module is provided by RRC signalling. Reporting period at B equals one measurement period at A1.

**- B**: a measurement (i.e. cell quality) derived from beam-specific measurements reported to layer 3 after beam consolidation/selection.

- **Layer 3 filtering for cell quality**: filtering performed on the measurements provided at point B. The behaviour of the Layer 3 filters is standardised and the configuration of the layer 3 filters is provided by RRC signalling. Filtering reporting period at C equals one measurement period at B.

- **C**: a measurement after processing in the layer 3 filter. The reporting rate is identical to the reporting rate at point B. This measurement is used as input for one or more evaluation of reporting criteria.

- **Evaluation of reporting criteria**: checks whether actual measurement reporting is necessary at point D. The evaluation can be based on more than one flow of measurements at reference point C e.g. to compare between different measurements. This is illustrated by input C and C1. The UE shall evaluate the reporting criteria at least every time a new measurement result is reported at point C, C1. The reporting criteria are standardised and the configuration is provided by RRC signalling (UE measurements).

- **D**: measurement report information (message) sent on the radio interface.

- **L3 Beam filtering**: filtering performed on the measurements (i.e. beam specific measurements) provided at point A1. The behaviour of the beam filters is standardised and the configuration of the beam filters is provided by RRC signalling. Filtering reporting period at E equals one measurement period at A1.

- **E**: a measurement (i.e. beam-specific measurement) after processing in the beam filter. The reporting rate is identical to the reporting rate at point A1. This measurement is used as input for selecting the X measurements to be reported.

- **Beam Selection for beam reporting**: selects the X measurements from the measurements provided at point E. The behaviour of the beam selection is standardised and the configuration of this module is provided by RRC signalling.

- **F**: beam measurement information included in measurement report (sent) on the radio interface.

Layer 1 filtering introduces a certain level of measurement averaging. How and when the UE exactly performs the required measurements is implementation specific to the point that the output at B fulfils the performance requirements set in TS 38.133 [13]. Layer 3 filtering for cell quality and related parameters used are specified in TS 38.331 [12] and do not introduce any delay in the sample availability between B and C. Measurement at point C, C1 is the input used in the event evaluation. L3 Beam filtering and related parameters used are specified in TS 38.331 [12] and do not introduce any delay in the sample availability between A1 and E.

Measurement reports are characterized by the following:

- Measurement reports include the measurement identity of the associated measurement configuration that triggered the reporting;

- Cell and beam measurement quantities to be included in measurement reports are configured by the network;

- The number of non-serving cells to be reported can be limited through configuration by the network;

- Cells belonging to a blacklist configured by the network are not used in event evaluation and reporting, and conversely when a whitelist is configured by the network, only the cells belonging to the whitelist are used in event evaluation and reporting;

- Beam measurements to be included in measurement reports are configured by the network (beam identifier only, measurement result and beam identifier, or no beam reporting).

Intra-frequency neighbour (cell) measurements and inter-frequency neighbour (cell) measurements are defined as follows:

- SSB based intra-frequency measurement: a measurement is defined as an SSB based intra-frequency measurement provided the SSB frequency configured in the measurement object indicated by *servingCellMO* and the center frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs is also the same.

- SSB based inter-frequency measurement: a measurement is defined as an SSB based inter-frequency measurement provided the center frequency of the SSB of the serving cell and the center frequency of the SSB of the neighbour cell are different, or the subcarrier spacing of the two SSBs is different.

NOTE 2: For SSB based measurements, one measurement object corresponds to one SSB and the UE considers different SSBs as different cells.

- CSI-RS based intra-frequency measurement: a measurement is defined as a CSI-RS based intra-frequency measurement provided that:

- The SCS of CSI-RS resources on the neighbour cell configured for measurement is the same as the SCS of CSI-RS resources on the serving cell indicated for measurement; and

- For SCS = 60kHz, the CP type of CSI-RS resources on the neighbour cell configured for measurement is the same as the CP type of CSI-RS resources on the serving cell indicated for measurement; and

- The centre frequency of CSI-RS resources on the neighbour cell configured for measurement is the same as the centre frequency of CSI-RS resource on the serving cell indicated for measurement.

- CSI-RS based inter-frequency measurement: a measurement is defined as a CSI-RS based inter-frequency measurement if it is not a CSI-RS based intra-frequency measurement.

NOTE 3: Extended CP for CSI-RS based measurement is not supported in this release.

Whether a measurement is non-gap-assisted or gap-assisted depends on the capability of the UE, the active BWP of the UE and the current operating frequency:

- For SSB based inter-frequency, a measurement gap configuration is always provided in the following cases:

- If the UE only supports per-UE measurement gaps;

- If the UE supports per-FR measurement gaps and any of the serving cells are in the same frequency range of the measurement object.

- For SSB based intra-frequency measurement, a measurement gap configuration is always provided in the following case:

- Other than the initial BWP, if any of the UE configured BWPs do not contain the frequency domain resources of the SSB associated to the initial DL BWP.

In non-gap-assisted scenarios, the UE shall be able to carry out such measurements without measurement gaps. In gap-assisted scenarios, the UE cannot be assumed to be able to carry out such measurements without measurement gaps.

-------------------------------Changes in the text-------------------------------

**Question 5: Do companies agree with the above clarification on the clarification on SSB based intra-frequency measurement in stage 2?**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes |  |
| Ericsson | Yes |  |
| ZTE | Yes |  |
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## Changes from R15 or R18

**Question 6: From which release we can introduce the UE capability and the other changes in stage 3 and stage 2 (if agreed in Q1-Q5), Rel-15 or Rel-18?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Rel-15/Rel-18** | **Comments** |
| Huawei, HiSilicon | R15 | The issue exists for intra-band SSB-less as well. With the introduction of a UE capability, there is no inter-operability issue so we can start from R15. |
| Ericsson | R15 |  |
| ZTE | R15 |  |
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# Conclusion and proposals

**Proposal 1: Introduce per UE capability to indicate whether the UE supports the configuration of servingCellMO for SCell that does not transmit SS/PBCH block. A UE supporting this feature shall also support NR intra-frequency measurements on neighbor cells based on servingCellMO associated with SCell that does not transmit SS/PBCH block. NW can optionally configure servingCellMO for SCell that does not transmit SS/PBCH block if UE indicate such capability.**

**Proposal 2: Clarify in the procedure text that that SSB-based serving cell measurements are skipped.**

**Proposal 3: Clarify in the field description of servingCellMO that the ssbFrequency value is same as absoluteFrequencySSB only when the serving cell is associated with SSB; if the serving cell is not associated with SSB, the carrier frequency indicated by ssbFrequnecy of the corresponding MeasObjectNR, if configured, is within the frequency range indicated by any entry of the scs-SpecificCarrierList.**

**Proposal 4: Clarify the presence condition of ssbFrequency in servingCellMO for a SSB-less SCell that “If the measObject is associated to an SSB-less SCell, this field is optionally present if ssb-ConfigMobility is configured or associatedSSB is configured in at least one cell, otherwise, this field is mandatory present if ssb-ConfigMobility is configured or associatedSSB is configured in at least one cell. If ssb-ConfigMobility is not configured and associatedSSB is not configured for any cell, the field is absent, Need R.”**

**Proposal 5: Clarify in stage 2 that SSB based intra-frequency measurement: a measurement is defined as an SSB based intra-frequency measurement provided the SSB frequency configured in the measurement object indicated by servingCellMO and the center frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs is also the same.**

**Proposal 6: The above changes are introduced from Rel-15.**