**3GPP TSG-RAN4 Meeting #102-e *R4-2207123***

**Electronic Meeting, Feb. 21 – Mar. 3, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.133** | **CR** | **2265** | **rev** | **-** | **Current version:** | **17.4.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:*** | Big CR: RRM requirements for Rel-17 NR feMIMO | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_feMIMO-Core | | | | |  | ***Date:*** | | | 2022-03-09 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)  Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | RRM requirements for NR feMIMO are introduced into TS 38.133 from draft CRs endorsed in RAN4 #102-e meeting. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | RRM requirements for NR feMIMO endorsed in the following draft CRs are added to TS 38.133   1. R4-2206938 Draft CR on Inter-cell L1-RSRP measurements 2. R4-2206939 draft CR on L1-RSRP measurement requirements for inter-cell BM in R17 3. R4-2206940 CR for measurement restriction and scheduling availability for inter cell L1-RSRP measurement in R17 4. R4-2206937 DraftCR on Introduction of L1-RSRP measurements on NSC for Rel-17 FeMIMO 5. R4-2206941 DraftCR on QCL definition for R17 unified TCI 6. R4-2207115 Drfat CR on TRP specific Beam Failure Recovery 7. R4-2206944 draft CR on active DL and UL TCI state list update delay in R17 8. R4-2206945 DraftCR to TS 38.133: MAC-CE based downlink/uplink TCI state switch delay for unified TCI state 9. R4-2206946 Draft CR for Introduction of DL TCI state swithcing delay for unified TCI 10. R4-2206947 Draft CR for Introduction of UL TCI state swithcing delay for unified TCI 11. R4-2207097 DraftCR on DCI based DL and UL TCI switching delay requirements 12. R4-2206949 DraftCR on known condition requirements for R17 unified TCI | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | No RRM requirements for NR feMIMO in Rel-17 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.1, 8.5, 8.X1, 8.X2, 8.X3, 9.5.4, 9.X4 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.533 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | 8.X1, 8.X2, 8.X3 and 9.X4 are 8.5B, 8.15, 8.16 and 9.12 in original draft CR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | 1st version. | | | | | | | | |

==========================Start of change 1 =============================

3.6.7 Applicability of QCL

For the requirements specified in this version of the specification for TCI state switching, DL TCI state switching for unified TCI or UL TCI state switching for unified TCI, a reference signal is considered to be QCLed to another reference signal if it is in the same TCI chain as the other reference signal, provided that the number of Reference Signals in the chain is no more than 4. It is assumed there is single QCL type per TCI chain.

A DL TCI chain consists of an SSB, and one or more CSI-RS resources, and the TCI state of each Reference Signal includes another Reference Signal in the same TCI chain, where the SSB can be associated with serving cell PCID or associated with a PCID different from serving cell PCID.

DMRS of PDCCH or PDSCH is QCLed with the reference signal in its active TCI state and any other reference signal that is QCLed, based on the criteria for DL TCI chain, with the reference signal in the active TCI state.

A UL TCI chain consists of an SSB, and one or more CSI-RS resources, and the TCI state of each Reference Signal includes another Reference Signal in the same TCI chain, where the SSB can be associated with serving cell PCID or associated with a PCID different from serving cell PCID.

DMRS of PUCCH or PUSCH is QCLed with the reference signal in its active TCI state and any other reference signal that is QCLed, based on the criteria for UL TCI chain, with the reference signal in the active TCI state.

==========================End of change 1 =============================

==========================Start of change 2 =============================

## 8.1 Radio Link Monitoring

### 8.1.1 Introduction

The requirements in clause 8.1 apply for radio link monitoring on:

- PCell in SA NR, NR-DC and NE-DC operation mode,

- PSCell in NR-DC and EN-DC operation mode.

The UE shall monitor the downlink radio link quality based on the reference signal configured as RLM-RS resource(s) in order to detect the downlink radio link quality of the PCell and PSCell as specified in TS 38.213 [3]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. UE is not required to perform RLM outside the active DL BWP.

On each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell.

When a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the UE shall estimate the downlink radio link quality and compare it to the single thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell(s). How to compute the single hypothetical PDCCH SNR based on two active TCI states is up to UE implementation.

The threshold Qout is defined as the level at which the downlink radio link cannot be reliably received and shall correspond to the out-of-sync block error rate (BLERout) as defined in Table 8.1.1-1. For SSB based radio link monitoring, Qout\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.2.1-1. For CSI-RS based radio link monitoring, Qout\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.3.1-1.

The threshold Qin is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout and shall correspond to the in-sync block error rate (BLERin) as defined in Table 8.1.1-1. For SSB based radio link monitoring, Qin\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.2.1-2. For CSI-RS based radio link monitoring, Qin\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.3.1-2.

The out-of-sync block error rate (BLERout) and in-sync block error rate (BLERin) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When UE is not configured with *rlmInSyncOutOfSyncThreshold* from the network, UE determines out-of-sync and in-sync block error rates from Configuration #0 in Table 8.1.1-1 by default. All requirements in clause 8.1 are applicable for BLER Configuration #0 in Table 8.1.1-1.

Table 8.1.1-1: Out-of-sync and in-sync block error rates

|  |  |  |
| --- | --- | --- |
| Configuration | BLERout | BLERin |
| 0 | 10% | 2% |

UE shall be able to monitor up to NRLM RLM-RS resources of the same or different types in each corresponding carrier frequency range, depending on a maximum number  of SSBs per half frame according to TS 38.213 [3], where NRLM is specified in Table 8.1.1-2 according TS 38.213 [3], and meet the requirements as specified in clause 8.1. UE is not required to meet the requirements in clause 8.1 if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 8.1.1-2: Maximum number of RLM-RS resources NRLM

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell/PSCell |  | Maximum number of RLM-RS resources, NRLM |
| FR1, ≤ 3 GHzNote | 4 | 2 |
| FR1, > 3 GHzNote | 8 | 4 |
| FR2 | 64 | 8 |
| NOTE: For unpaired spectrum operation with Case C - 30 kHz SCS, 3GHz is replaced by 1.88GHz, as specified in clause 4.1 in TS 38.213 [3]. | | |

### 8.1.2 Requirements for SSB based radio link monitoring

#### 8.1.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell or PSCell, provided that the SSB configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1.2.2.

==========================End of change 2 =============================

==========================Start of change 3 =============================

## 8.5 Link Recovery Procedures

### 8.5.1 Introduction

The UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set  as specified in TS 38.213 [3] in order to detect beam failure on:

- PCell in SA, NR-DC, or NE-DC operation mode,

- PSCell in NR-DC and EN-DC operation mode,

- SCell in SA, NR-DC, NE-DC or EN-DC operation mode.

The RS resource configurations in the set  on PCell or PSCell can be periodic CSI-RS resources and/or SSBs. RS resource configuration in the set  on SCell shall be periodic CSI-RS. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.5.2 and 8.5.3 if UE does not have set . UE is not required to perform beam failure detection on a deactivated SCell, and also not required to perform beam failure detection on resources which is implicitly configured for a deactivated SCell. When more than 2 periodic CSI-RS resources on a CC are configured in the set  for current SCell or implicitly configured in the set  for other SCell, it is up to UE implementation to select two of CSI-RS resources in active BWP in current CC to perform beam failure detection. UE is not required to perform beam failure detection on a SCell on which  is not configured.

On each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell beams.

When a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the UE shall estimate the downlink radio link quality and compare it to the single thresholds Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell beams. How to compute the single hypothetical PDCCH SNR based on two active TCI states is upto UE implementation.

The threshold Qout\_LR is defined as the level at which the downlink radio level link of a given resource configuration on set  cannot be reliably received and shall correspond to the BLERout = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5.2.1-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5.3.1-1.

Upon request the UE shall deliver configuration indexes from the set as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the set  can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources. UE is not required to perform candidate beam detection outside the active DL BWP. UE is not required to perform candidate beam detection on a SCell on which  is not configured.

### 8.5.2 Requirements for SSB based beam failure detection

#### 8.5.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5.2.2. The requirements in this clause could not be applicable if UE is required to perform beam failure detection on more than 1 serving cell per band.

==========================End of change 3 =============================

==========================Start of change 4=============================

## 8.X1 TRP specific Link Recovery Procedures

### 8.X1.1 Introduction

The UE shall assess the downlink radio link quality of a serving cell and cell with different PCI based on the reference signal provided in the two sets and as specified in TS 38.213 [3] in order to detect beam failure on:

- PCell in SA, NR-DC, or NE-DC operation mode,

- PSCell in NR-DC and EN-DC operation mode,

- SCell in SA, NR-DC, NE-DC or EN-DC operation mode.

The RS resource configurations in the two sets and on PCell or PSCell can be periodic CSI-RS resources and/or SSBs. RS resource configuration in the two sets and on SCell shall be periodic CSI-RS. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.5.2 and 8.5.3 if UE does not have configured sets and . UE is not required to perform beam failure detection on a deactivated SCell, and also not required to perform beam failure detection on resources which is implicitly configured for a deactivated SCell. UE is not required to perform beam failure detection on a SCell on which and is not configured.

On each RS resource configuration in the two sets and , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell and cell with different PCI beams.

The threshold Qout\_LR is defined as the level at which the downlink radio level link of a given resource configuration on set two sets and cannot be reliably received and shall correspond to the BLERout = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.X1.2.1-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.X1.3.1-1.

Upon request the UE shall deliver configuration indexes from the two sets and as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the two sets and can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources. UE is not required to perform candidate beam detection outside the active DL BWP. UE is not required to perform candidate beam detection on a SCell on which and is not configured.

### 8.X1.2 Requirements for TRP specific SSB based beam failure detection

#### 8.X1.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set two sets and configured for a serving cell and cell with different PCI, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.X1.2.2.

Table 8.X1.2.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.X1.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in two sets and estimated over the last TEvaluate\_BFD\_SSB ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB ms period.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-2 for FR2 with scaling factor N=8

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB.

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TSSB <MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by SSB-ToMeasure and 1 data symbol before each consecutive SSB symbols indicated by SSB-ToMeasure and 1 data symbol after each consecutive SSB symbols indicated by SSB-ToMeasure, given that SSB-ToMeasure is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by ss-RSSI-Measurement and 1 data symbol before each RSSI symbol indicated by ss-RSSI-Measurement and 1 data symbol after each RSSI symbol indicated by ss-RSSI-Measurement, given that ss-RSSI-Measurement is configured.- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, given the SMTC offset of all CCs in FR2 provided the same offset.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell/cell with different PCI, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell/cell with different PCI, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of PTRP defined in table 8.X1.2.2-2 is defined as 2. [When two sets and are failed at the same time, an UE shall be able to evaluate BFR-RS resource in the set with the values of PTRP defines as 1.]

Table 8.X1.2.2-1: Evaluation period TEvaluate\_BFD\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P) × TDRX |
| Note: TSSB is the periodicity of SSB in the two sets and . TDRX is the DRX cycle length. | |

Table 8.X1.2.2-2: Evaluation period TEvaluate\_BFD\_SSB for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P × N\*PTRP) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P × N\*PTRP) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P × N\*PTRP) × TDRX |
| Note: TSSB is the periodicity of SSB in the two sets and . TDRX is the DRX cycle length. | |

#### 8.X1.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction.

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

For FR2, when the SSB for BFD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for BFD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions on the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 8.X1.3 Requirements for CSI-RS based beam failure detection

#### 8.X1.3.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the two sets and of resource configurations for a serving cell or cell with different PCI, provided that the CSI-RS resource(s) in two sets and for beam failure detection are actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5.3.2. UE is not expected to perform beam failure detection measurements on the CSI-RS configured for BFD if the CSI-RS is not QCL-ed, with QCL-TypeD when applicable, with the RS in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.X1.3.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.X1.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in two sets and estimated over the last TEvaluate\_BFD\_CSI-RS ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS ms period.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.X1.3.2-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.X1.3.2-2 for FR2 with N=1. The requirements of TEvaluate\_BFD\_CSI-RS apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS.

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when the BFD-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TCSI-RS < MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Note: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell/cell with different PCI, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell/cell with different PCI, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of MBFD used in Table 8.5.3.2-1 and Table 8.5.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in the two sets and used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PBFD used in Table 8.5.3.2-1 and Table 8.5.3.2-2 are defined as

For each CSI-RS resource in the two sets and configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PBFD = 1.

For each CSI-RS resource in the two sets and configured for PSCell in NR-DC

PBFD = 2 if UE is configured for beam failure detection on SCell, 1 otherwise.

For each CSI-RS resource in the two sets and configured for a SCell

- PBFD = Z in EN-DC or NE-DC or SA.

- PBFD = 2\* Z in NR-DC.

Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell.

The values of PTRP define in table 8.X1.3.2-2 is defined as 2. [FFS : if SSB/CSI-RS resource in the two sets and are received using different QCL type-D else it is 1]. [When two sets and are failed at the same time, an UE shall be able to evaluate BFR-RS resource in the set with the values of PTRP defines as 1.]

**Table 8.X1.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1**

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, Ceil(MBFD × P × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the two sets and . TDRX is the DRX cycle length. | |

**Table 8.X1.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS for FR2**

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, Ceil(MBFD × P × N × PBFD\*PTRP) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × N × PBFD\*PTRP) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × N × PBFD\*PTRP) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the two sets and . TDRX is the DRX cycle length. | |

#### 8.X1.3.3 Measurement restrictions for CSI-RS beam failure detection

The UE is required to be capable of measuring CSI-RS for BFD without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following scenarios.

For both FR1 and FR2, when the CSI-RS for BFD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for BFD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for BFD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for BFD measurement and the other CSI-RS. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

- The CSI-RS for BFD measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in two sets and and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

==========================End of change 4 =============================

==========================Start of change 5 =============================

## 8.X2 Active downlink TCI state switching delay for unified TCI

### 8.X2.1 Introduction

The requirements in this clause apply for a UE configured with one or more [TCI state] configurations for DL channels/signals and/or one or more [joint TCI state] configurations for both DL and UL channels/signals and/or one or more [pair of TCI states] configurations with one TCI state for DL channels/signals and one TCI state for UL channels/signals on serving cell or a cell with PCI different from a serving cell in MR-DC or standalone NR. UE shall complete the switch of active downlink TCI state within the delay defined in this clause.

The requirements in this clause for a cell with different PCI from serving cell are applicable for such cell is known for a UE. A cell with different PCI from serving cell is known if the the following conditions are met

* [Active BWP of cell with different PCI shall be equal to the active BWP of serving cell or initial DL BWP of UE]
* Center frequency, SCS and SFN offset of a cell with different PCI from serving cell are as the same as serving cell.
* During the last [X]s before L1-RSRP measurement is configured, the UE has sent a valid L3 measurement report for the cell with different PCI;
* Timing offset between serving cell and the cell with different PCI from serving cell are within CP.

Otherwise, the cell with different PCI from serving cell is unknown.

8.X2.2 Known conditions for downlink TCI state

The downlink TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target downlink TCI state to the completion of active downlink TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target downlink TCI state or QCLed to the target downlink TCI state

- Downlink TCI state switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target downlink TCI state before the downlink TCI state switch command

- The target downlink TCI state remains detectable during the downlink TCI state switching period

- The SSB associated with the downlink TCI state remain detectable during the downlink TCI switching period

- SNR of the downlink TCI state ≥ -3dB

- The SSB can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

Otherwise, the downlink TCI state is unknown.

8.X2.3 MAC-CE based downlink TCI state switch delay

The requirements in this clause shall apply for DL TCI state switch using separate DL TCI state or joint TCI state of unified TCI state switch framework.

In case that source RS in DL TCI state or joint TCI state is associated with a PCI different from that of the serving cell, the requirements in this clause shall apply if the cell with different PCI satisfies the known cell condition defined in 8.X2.1. If the known cell condition is not met, longer delay may be expected.

In case of joint TCI state switch, UE is not expected to recieve on DL before UE completes the DL and UL TCI state switch.

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive UE-dedicated PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. The UE shall be able to receive UE-dedicated PDCCH/PDSCH with the old TCI state until slot n+ THARQ + .Where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TSSB-proc = 2 ms;

- TOk = 1 if target TCI state is not in the active TCI state list for PDSCH/PDCCH, 0 otherwise.

If the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive UE-dedicated PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc) / *NR slot length*. The UE shall be able to receive UE-dedicated PDCCH/PDSCH with the old TCI state until slot n+ THARQ + .

Where

- T L1-RSRP = 0 in FR1 or when the TCI state switching not involving QCL-TypeD in FR2. Otherwise,

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS for CSI-RS as specified in clause 9.5.4.2

- CSI-RS based L1-RSRP measurement only apply for TCI state switch when source RS is associated with serving cell

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

- TOuk = 1 for CSI-RS based L1-RSRP measurement, and 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

- TOuk = 1 when TCI state switching involves other QCL types only

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

### 8.X2.4 DCI based downlink TCI state switch delay

When a UE is configured with the higher layer parameter with [*tci-StateId\_r17*] for *unified TCI switching* and receives DCI format 1\_1/1\_2 with or without DL assignment providing indicated TCI-State with [*tci-StateId\_r17*] in the active TCI list for a CC or [all CCs with a common indicated TCI-State in the same CC list configured by *simultaneousTCI-UpdateList1 or simultaneousTCI-UpdateList2]*, the UE transmits a PUCCH with HARQ-ACK information corresponding to the DCI carrying the TCI-State indication.

If the target TCI state is known, the downlink TCI switching to the indicated TCI-State in the DCI format shall be completed starting from the first slot that is at least [*BeamAppTime\_r17]* symbols after the last symbol of the PUCCH carrying HARQ-ACK in response to the DCI triggering TCI state activation. The first slot and the [*BeamAppTime\_r17*] symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. The value of [*BeamAppTime\_r17]* is defined in TS 38.331 [2]. The known condition for TCI state defined in clause [8.X2.2] is applied.

### 8.X2.5 Active Downlink TCI state list update delay

The requirements specified in this clause apply to

- Separate active TCI list update delay, while the separate TCI list comprises more than one target separate TCIs, and at least one DL TCI is included.

- Joint active TCI list update delay, while the joint TCI list comprises more than one target joint TCI.

Upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI states at the first slot that is after

n + + (THARQ + TO\*(Tfirst-SSB\_List + TSSB-proc)) / *NR slot length*.

Where

- If all TCIs are known, TO is TOk,

- if any target TCI state is not in the active TCI state list, TOk = 1,

- If the number of cells associated with the target TCIs that are not in the active TCI list is larger than 1, and SSBs associated to the TCIs are overlapped,

- Tfirst-SSB\_List = Ncell \* Tfirst-SSB, where Ncell is the number of cells associated with the target TCIs that are not in the active TCI list, whose SSBs are overlapped. Ncell ≤ [Nmax] + 1, where [Nmax] is the number of cells with PCI different from serving cell, and [Nmax] = 1.

*-* Otherwise,

- Tfirst-SSB\_List = Tfirst-SSB.

- THARQ, Tfirst-SSB, TSSB-proc are defined in clause 8.X2.3.

When UE receives PDSCH carrying MAC-CE active TCI state list update for

- joint TCI state list update, or

- separate TCI list update, while the separate TCI list comprises at least one DL TCI and one UL TCI,

UE is not expected to recieve on DL before UE completes the DL and UL TCI state switch.

==========================End of change 5 =============================

==========================Start of change 6 =============================

## 8.X3 Active uplink TCI state switching delay for unified TCI

### 8.X3.1 Introduction

The requirements in this clause apply for a UE configured with one or more [TCI state] configurations for UL channels/signals and/or one or more [joint TCI state] configurations for both DL and UL channels/signals and/or one or more [pair of TCI states] configurations with one TCI state for DL channels/signals and one TCI state for UL channels/signals on serving cell or a cell with PCI different from a serving cell in MR-DC or standalone NR. There is no requirement when the UE is requested to switch to a TCI state with the higher layer parameter [TCI state] associated to SRS. UE shall complete the switch of active uplink TCI state within the delay defined in this clause when the UE is requested to switch to a TCI state with the higher layer parameter [TCI state] associated to a DL RS.

The requirements in this clause for a cell with different PCI from serving cell are applicable for such cell is known for a UE. A cell with different PCI from serving cell is known if the the following conditions are met

* [Active BWP of cell with different PCI shall be equal to the active BWP of serving cell or initial DL BWP of UE]
* Center frequency, SCS and SFN offset of a cell with different PCI from serving cell are as the same as serving cell.
* During the last [X]s before L1-RSRP measurement is configured, the UE has sent a valid L3 measurement report for the cell with different PCI;
* Timing offset between serving cell and the cell with different PCI from serving cell are within CP.

Otherwise, the cell with different PCI from serving cell is unknown.8.X3.2 Known conditions for uplink TCI state

The uplink TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target uplink TCI state to the completion of active uplink TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target uplink TCI state or QCLed to the target uplink TCI state

- Uplink TCI state switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target uplink TCI state before the uplink TCI state switch command

- The target uplink TCI state remains detectable during the uplink TCI state switching period

- The SSB associated with the uplink TCI state remain detectable during the uplink TCI switching period

- SNR of the uplink TCI state ≥ -3dB

- The SSB can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

Otherwise, the uplink TCI state is unknown.

8.X3.3 MAC-CE based uplink TCI state switch delay

The requirements in this clause shall apply for UL TCI state switch using separate UL TCI state or joint TCI state of unified TCI state switch framework.

PL-RS may be associated with or included in UL TCI state or joint TCI state. The requirements in this clause shall apply if the following conditions are met:

* PL-RS is identical to source RS in UL TCI state or joint TCI state
* PL-RS and source RS in UL TCI state or joint TCI state are QCL-Type D

In case that source RS in UL TCI state or joint TCI state is associated with a PCI different from that of the serving cell, the requirements in this clause shall apply if the cell with different PCI satisfies the known cell condition defined in 8.X3.1. If the known cell condition is not met, longer delay may be expected.

In case of joint TCI state switch, UE is not expected to transmit on UL before UE completes the DL and UL TCI state switch.

For separate UL TCI state switch or joint TCI state switch for PUCCH or PUSCH, or semi-persistent/aperiodic/periodic SRS, when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1, upon receiving PDSCH carrying MAC-CE activation command in slot n on serving cell,

* + - If target TCI state is known,
* The UE shall be able to transmit uplink signal with the target TCI state in the slot n+THARQ + 3ms + NM*\** (Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms).
  + - If target TCI state is unknown,
* The UE shall be able to transmit uplink signal with the target TCI state in the slot n+THARQ + 3ms *+* TL1-RSRP+ Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms.

Where,

- THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

- NM = 1, if the target PL-RS is not maintained by the UE, 0 otherwise.

- Tfirst\_target-PL-RS is time to first pathloss RS transmission after L1-RSRP measurement when target TCI state is unknown.

- Tfirst\_target-PL-RS is time to first pathloss RS transmission after MAC CE command is decoded by the UE for known TCI State.

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal which would be SSB or NZP CSI-RS when PL-RS is associated with serving cell

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal which would be SSB when PL-RS is associated with PCI different from serving cell

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS for CSI-RS as specified in clause 9.5.4.2

- CSI-RS based L1-RSRP measurement only apply for TCI state switch when source RS is associated with serving cell

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

Editor note: when PL-RS is SSB in FR2, the delay requirement is FFS.

### 8.X3.4 DCI based uplink TCI state switch delay

When a UE is configured with the higher layer parameter with [*tci-StateId\_r17*] for *unified TCI switching* and receives DCI format 1\_1/1\_2 with or without DL assignment providing indicated TCI-State with [*tci-StateId\_r17*] for a CC, the UE transmits a PUCCH with HARQ-ACK information corresponding to the DCI carrying the TCI-State indication.

If the target TCI state is known, the uplink TCI switching to the indicated TCI-State in the DCI format shall be completed starting from the first slot that is at least [*BeamAppTime\_r17]* symbols after the last symbol of the PUCCH carrying HARQ-ACK in response to the DCI triggering TCI state activation. The first slot and the [*BeamAppTime\_r17* ] symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. The value of [*BeamAppTime\_r17]* is defined in TS 38.331 [2]. The known condition for TCI state defined in clause [8.X3.2] is applied. [Editor note : PL-RS is maintained for DCI based UL TCI state switch.]

Editor note : TBD how to capture that pathloss reference singal is switched as a part of uplink TCI state switching.

### 8.X3.5 Active Uplink TCI state list update delay

The requirements specified in this clause apply to

- Separate active TCI list update delay, while the separate TCI list comprises more than one target separate TCIs, and at least one UL TCI is included.

- Joint active TCI list update delay, while the joint TCI list comprises more than one target joint TCI.

Upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to [FFS: ‘receive PDCCH to schedule PDSCH’ or ‘transmit PUCCH, PUSCH or SRS ’] with the new target TCI states at the first slot that is after

n+ + (THARQ + NM \* (Tfirst\_target-PL-RS\_List + 4 \* Ttarget\_PL-RS\_List + 2ms))) / *NR slot length*,

Where

- If all TCIs are known,

- if the target PL-RS associated with or included in any UL TCI is not maintained by the UE, NM = 1,

- If the number of cells associated with the target TCIs that are [not in the active TCI list] is larger than 1, and SSBs associated to the TCIs are overlapped,

- Tfirst\_target-PL-RS\_List = Ncell \* Tfirst\_target-PL-RS, Ttarget-PL-RS\_List = Ncell \* Ttarget-PL-RS, where Ncell is the number of cells associated with the target TCIs that are not in the active TCI list, whose SSBs are overlapped. Ncell ≤ [Nmax] + 1, where [Nmax] is the number of cells with PCI different from serving cell, and [Nmax] = 1.

- Otherwise,

- Tfirst\_target-PL-RS\_List = Tfirst\_target-PL-RS, Ttarget-PL-RS\_List = Ttarget-PL-RS.

- THARQ, Tfirst\_target-PL-RS, Ttarget-PL-RS are defined in clause 8.X3.3.

When UE receives PDSCH carrying MAC-CE active TCI state list update for

- joint TCI state list update, or

- separate TCI list update, while the separate TCI list comprises at least one DL TCI and one UL TCI,

UE is not expected to transmit on UL before UE completes the DL and UL TCI state switch.

==========================End of change 6 =============================

==========================Start of change 7 =============================

### 9.5.4 L1-RSRP measurement requirements

#### 9.5.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB.

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-1 for FR1 and Table 9.5.4.1-2 for FR2, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N= 8.

For FR1,

- P=, when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- P=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- P=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- P=, when SSB is partially overlapped with measurement gap (TSSB <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

Where:

- TSSB = ssb-periodicityServingCell of the serving cell

- TSMTCperiod = the configured SMTC period

- PSC = [2] if the SSB measurement occasions of the cell with PCI different from serving cell are fully overlapped with SSB measurement occasions of the serving cell, and TSSB = TSSB\_CDP < TSMTCperiod

- PSC = if the SSB measurement occasions of the cell with PCI different from serving cell are fully overlapped with SSB measurement occasions of the serving cell, and TSSB < TSSB\_CDP < TSMTCperiod

- PSC = 1 if the SSB measurement occasions of the cell with PCI different from serving cell are partially overlapped with SSB measurement occasions of the serving cell, and TSSB\_CDP < TSSB, and SSB measurement occasions of the serving cell are either fully overlapped with SMTC, or partially overlapped with SMTC (TSSB ≤ TSMTC).

- TSSB\_CDP = SSB periodicity of the cell with PCI different from serving cell

[*Editor’s Note: FFS PSC = 1 for HST scenario*]

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1 when TSSB ≤ 40 ms and *highSpeedMeasFlag-r16* are configured; otherwise K = 1.5.  Note 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]* | |

Table 9.5.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

==========================End of change 7 =============================

==========================Start of change 8 =============================

## 9.X4 L1-RSRP measurements for a cell with different PCI from serving cell

### 9.X4.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured measurement resources from cell with different PCI in addition to serving cell (including PCells and SCells), with the measurement resources configured as SSBs the cell with different PCI.

For the requirements defined in this clause, the SSB resource(s) for L1-RSRP measurement on cell(s) with different PCI should meet the following conditions

* + - associated with PCI indices different from PCell PCI indicated in *physCellId*
    - the same center frequency, SCS and *sfn-SSB-Offset* as the SSB from PCell
    - indicated by the *csi-SSB-ResourceSet* within the *CSI-ResourceConfig* settings configured for L1-RSRP
    - completely contained in the active BWP or associated with initial downlink BWP of the UE

[and the number of SSB resources does not exceed [X]].

*Editor’s Note*: pending on ongoing discussion in RAN1 and RAN2, RAN4 further study the value of [X], e.g. [X] is the higher layer parameter [*NumberOfAdditionalPCI*] or is UE capability indicated by *beamManagementSSB-CSI-RS.*

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the higher layer parameter *reportConfigType* of each reporting setting *CSI-ReportConfig* for the active BWP.

The requirements defined in this clause are applicable to NR SA operation mode.

### 9.X4.2 Requirements Applicability

The requirements in clause 9.X4 apply, provided the SSB from cell with PCI different from serving cell configured for L1-RSRP if the following conditions are met:

- The SSB resources configured for L1-RSRP measurements are measurable

An SSB resource configured for L1-RSRP for cell with different PCI from serving cell shall be considered measurable when for each relevant SSB the following conditions are met:

-  L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

-  SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

The cell with different PCI from serving cell is considered as known if the following conditions are met in this requirement:

- The SSB of the cell with different PCI from serving cell has the same SCS and center frequency as the SSB of the PCell

- The timing difference of arrival at UE between the SSBs of serving cell and cell with different PCI is less than CP length of the corresponding SCS

- The UE has sent a valid L3 measurement report during the last 5 seconds, and

- The SSB from the cell with different PCI remains detectable according to the cell identification requirements specified in clause 9.2.

Otherwise, the cell is unknown.

### 9.X4.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 and 10.1.20 for FR2 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting-r17* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1 and 10.1.20 for FR2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

9.X4.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

9.X4.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

9.X4.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement report if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.X4.4 L1-RSRP measurement requirements

#### 9.X4.4.1 Inter-cell SSB based L1-RSRP Reporting

If a cell with PCI different from serving cell is known according 9.X4.2, the UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_InterCell\_Known.

The requirements specified in this clause is applicable if the number of cells with PCI different from seving cells Nmax, on which UE is required to perform inter-cell BM, is no more than one.

The value of TL1-RSRP\_Measurement\_Period\_SSB\_InterCell\_Known is defined in Table 9.X4.4.1-1 for FR1 and Table 9.X4.4.1-2 for FR2, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N= 8.

For FR1,

- P=, when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- P=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod).

- P=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB\_CDP < 0.5\*TSMTCperiod

- P= ,when SSB is partially overlapped with measurement gap (TSSB\_CDP <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

Where:

- TSSB\_CDP = SSB periodicity of the cell with PCI different from serving cell

- TSMTCperiod = the configured SMTC period

- PCDP = [2] if the SSB measurement occasions of the cell with PCI different from serving cell are fully overlapped with SSB measurement occasions of the serving cell, and TSSB\_SC = TSSB\_CDP < TSMTCperiod

- PCDP = 1 if the SSB measurement occasions of the cell with PCI different from serving cell are fully overlapped with SSB measurement occasions of the serving cell, and TSSB\_SC < TSSB\_CDP < TSMTCperiod

- PCDP = 1 if the SSB measurement occasions of the cell with PCI different from serving cell are partially overlapped with SSB measurement occasions of the serving cell, and TSSB\_CDP < TSSB\_SC = TSMTCperiod, and SSB measurement occasions of the serving cell are fully overlapped with SMTC.

- PCDP = , if the SSB measurement occasions of the cell with PCI different from serving cell are partially overlapped with SSB measurement occasions of the serving cell, and TSSB\_CDP < TSSB\_SC, and SSB measurement occasions of the serving cell are partially overlapped with SMTC (TSSB\_SC < TSMTC)

- TSSB\_SC = ssb-periodicityServingCell of the serving cell

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 cell with PCI different from serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 cell with PCI different from serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.X4.4.1-1: Inter-cell L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_InterCell\_Known for known cells with different PCIs in FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_InterCell\_Known (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB\_CDP) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB\_CDP)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB\_CDP is the periodicity of the SSB-Index configured for inter-cell L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: [K = 1 when TSSB\_CDP ≤ 40 ms and *highSpeedMeasFlag-r16* are configured; otherwise] K = 1.5.  [Note 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]]*  *[Editor’s Note: Whether inter-cell L1-RSRP measurement requirements are applicable in HST scenario]* | |

Table 9.X4.4.1-2: Inter-cell L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_InterCell\_Known for known cells with different PCIs in FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_InterCell\_Known (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB\_CDP) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB\_CDP)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB\_CDP is the periodicity of the SSB-Index configured for inter-cell L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

### 9.X4.5 Measurement restriction for L1-RSRP measurement

The UE is required to be capable of measuring SSB for L1-RSRP without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

Unless explicitly stated, the SSB to be measured for L1-RSRP measurement is transmitted from cell(s) with PCI different from serving cell(s).

#### 9.X4.5.1 Measurement restriction for SSB based L1-RSRP

For FR1,

when the SSB for L1-RSRP measurement is in the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

when the SSB for L1-RSRP measurement is in the same OFDM symbol as SSB for L1-RSRP measurement,

- UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

when the SSB for L1-RSRP measurement is in the same OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports [*simultaneousRxDataSSB-DiffNumerology*], UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support [*simultaneousRxDataSSB-DiffNumerology*], UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

*Editor’s note: FFS whether the existing IE simultaneousRxDataSSB-DiffNumerology can be reused for non-serving cell.*

For FR2,

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both the two SSBs. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB for L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both the two SSBs. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for L1-RSRP measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

*Editor’s note: FFS the joint requirement of inter-cell BM and IBM.*

### 9.X4.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions described in the following clauses apply for the following conditions:

* when the UE is performing L1-RSRP measurement on cell(s) with PCI different from serving cell(s)

#### 9.X4.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH on serving cell(s) and cell(s) with PCI different from serving cell(s) in FR1.

#### 9.X4.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *[simultaneousRxDataSSB-DiffNumerology]* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support [*simultaneousRxDataSSB-DiffNumerology]* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement, where the transmission of PUCCH/PUSCH/SRS and reception of PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI may be on serving cell(s) and cell(s) with PCI different from serving cell(s).

*Editor’s note: FFS simultaneousRxDataSSB-DiffNumerology can be reused for non-serving cell.*

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on cell(s) with PCI different from serving cell(s) where L1-RSRP measurement is performed apply to all serving cells and cell(s) with PCI different from serving cell(s) in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) and cell(s) with PCI different from serving cell(s) configured in other bands than the bands in which the serving cell where L1-RSRP measurement is performed is configured.

#### 9.X4.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement, where where the transmission of PUCCH/PUSCH/SRS and reception of PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI may be on serving cell(s) and cell(s) with PCI different from serving cell(s).

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on cell(s) with PCI different from serving cell(s) where L1-RSRP measurement is performed apply to all serving cells and cell(s) with PCI different from serving cell(s) in the band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to L1-RSRP measurement performed on FR2 serving cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

*Editor’s note: FFS the joint requirement of inter-cell BM and IBM.*

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.X4.6.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) and cell(s) with PCI different from a serving cell(s) due to L1-RSRP measurement performed on FR2 cell(s) with PCI different from a serving cell(s).

There are no scheduling restrictions on FR2 serving cell(s) and cell with PCI different from a serving cell(s) due to L1-RSRP measurement performed on FR1 cell with PCI different from a serving cell(s).

*Editor’s note: FFS whether the scheduling availability on non-serving cell is needed or not when the UE is performing L1-RSRP measurement on serving cell(s)*

==========================End of change 8 =============================