**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item: 8.17.1**

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for RAN4#94e\_#67\_NR\_HST\_RRM

**Document for:** Information

# Introduction

This email discussion focuses on RRM for Rel-16 NR HST, and in particular the agenda items:

8.17.1 RRM core requirements

8.17.1.1 Cell re-selection

8.17.1.2 Cell identification delay

8.17.1.3 RLM

8.17.1.4 Beam management

8.17.1.5 Inter-RAT measurement

8.17.1.6 Network assistance and UE capability signalling

The targets of email discussion for 1st round and 2nd round are:

* 1st round: focus on discussing the open issues and strive to minimize the open issues
* 2nd round: according to 1st round discussion, discuss left open issues for 2nd round, and strive to minimize the open issues. For the open issues which have agreement in the 1st round, strive to agree on CR/TP

# Topic #1: Cell re-selection

*Agenda 8.17.1.1*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000572**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000572.zip) | CATT | Proposal 1: It is not necessary to define scaling factor M2, M3 and M4 when DRX = 0.32s.  Proposal 2: Not to enhance the SSB index detection requirement for non-DRX case in NR HST scenario.  Proposal 3: it is not necessary to define relaxation factor of 1.5 and scaling factor CSSFintra in cell identification requirements in HST scenario.  Proposal 4: For DRX cycle ≤ 320ms case, the cell identification requirement in HST scenario can be enhanced by reducing the measurement period from 5 samples to 3 samples.  Proposal 5: For DRX cycle>320ms case, not to enhance the cell identification requirements in HST scenario.  Proposal 6: the cell identification requirement in DRX mode for HST scenario can be enhanced as follows:   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle | TPSS/SSS\_sync\_intra | TSSB\_time\_index\_intra | T SSB\_measurement\_period\_intra | | DRX cycle≤ 320ms | max( 600ms, ceil(5 x Kp) x max(SMTC period,DRX cycle)) | max(120ms, ceil (3 x Kp) x max(SMTC period,DRX cycle)) | max(200ms, ceil(3 x Kp) x max(SMTC period,DRX cycle)) | | DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFintra | Ceil(3 x Kp) x DRX cycle x CSSFintra | ceil( 5 x Kp ) x DRX cycle x CSSFintra | |
| [**R4-2000632**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000632.zip) | CMCC | Proposal 1: for intra-frequency cell reselection requirements of NR high speed scenario, the number of samples are proposed as following:   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle length [s] | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) | | | 0.32 | 2.56 x M2 (8 x M2) | 0.32 x M2 (1 x M2) | 0.96 x M2 (3x M2) | | 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) | | 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) | | 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) | | Note: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. | | | |   Proposal 2: for intra-frequency measurement, it is proposed to only consider the case of without measurement gap in Rel-16 NR HST WI.  Proposal 3: for no DRX case, all the candidate SMTC periods can be applied to high speed train scenario.  Proposal 4: for no DRX case, the Rel-15 PSS/SSS detection delay requirements, measurement delay requirements and SSB index acquiring delay requirements are applicable to high speed train scenario.  Observation 1: It is possible to perform measurement during DRX-off if one DRX cycle covers multiple SMTC occasions.  Observation 2: For the case of DRX cycle < 320ms, it is difficult to find a unified upper bound of SMTC to guarantee multiple SMTC occasions during one DRX cycle for different DRX cycle length.  Proposal 5: For the case of DRX cycle < 320ms, it is proposed to reuse Rel-15 cell identification requirements. And all the candidate SMTC period can be considered.  Proposed 6: For the case of DRX cycle > = 320ms, the PSS/SSS detection delay and measurement period is proposed to be 3 DRX cycles. And the applied SMTC periodicity can be further studied. |
| [**R4-2000772**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000772.zip) | Qualcomm, Inc. | Proposal 1: NR HST Pcell measurement requirement in idle mode under 500km/h train speed is given in Table 2‑2.   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle length [s] | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) | | | 0.32 | 2.56 x M2 (8 x M2) | 0.32 x M3 (1 x M3) | 0.96 x M3 (3 x M3) | | 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) | | 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) | | 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) | | Note 1: M2 = 1.5 and M3 = 2 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=M3=1. | | | |   Table 2‑2 Pcell idle mode measurement enhancement for NR HST under 500km/h train speed  Proposal 2: In connected mode, intra-frequency measurement requirement is specified in Table 2‑5 and Table 2‑6.   |  |  | | --- | --- | | DRX cycle | TPSS/SSS\_sync\_intra | | No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFintra | | DRX cycle≤ 320ms | max( 600ms, ceil(M x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra | | DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFintra | | NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M = 1.5 if SMTC >= 40ms, otherwise M = 1 | |   Table 2‑5 PSS/SSS detection time requirement for HST   |  |  | | --- | --- | | DRX cycle | T SSB\_measurement\_period\_intra | | No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra | | DRX cycle < 320ms | ma(200ms, ceil(Mx 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra | | DRX cycle= 320ms | ma(200ms, ceil(Mx 4 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra | | DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFintra | | NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M = 1.5 if SMTC >= 40ms, otherwise M = 1 | |   Table 2‑6 Measurement period requirement for HST  Proposal 3: No enhancement is needed for SSB index reading time.  Proposal 4: Follow L1-RSRP measurement period in non-HST NR requirement in Table 2‑9 and Table 2‑10, the requirement only applies in HST scenario when higher layer parameter *timeRestrictionForChannelMeasurement* is configured, i.e., M=1.   |  |  | | --- | --- | | Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) | | non-DRX | max(TReport, ceil(M\*P)\*TSSB) | | DRX cycle ≤ 320ms | max(TReport, ceil(M1\*M\*P)\*max(TDRX,TSSB)) | | DRX cycle > 320ms | ceil(M\*P)\*TDRX | | Note1: 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.  Note2: M1 = 1.5 if SMTC >= 40ms, otherwise M1 = 1 | |   Table 2‑9 Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR1 when HST is configured   |  |  | | --- | --- | | Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms) | | non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) | | DRX cycle ≤ 320ms | max(TReport, ceil(M1\*M\*P)\*max(TDRX,TCSI-RS)) | | DRX cycle > 320ms | ceil(M\*P)\*TDRX | | Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3.  Note 3: M1 = 1.5 if SMTC >= 40ms, otherwise M1 = 1 | |   Table 2‑10 Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS for FR1 when HST is configured  Proposal 5: Follow RLM evaluation period requirement in Table 2‑12 and BFD evaluation period requirement in Table 2‑13   |  |  |  | | --- | --- | --- | | Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) | | no DRX | max(200,ceil(10\*P)\*TSSB) | max(100,ceil(5\*P)\*TSSB) | | DRX cycle≤320 | max(200,ceil(M1\*10\*P)\*max(TDRX,TSSB)) | max(100,ceil(M1\*5\*P)\*max(TDRX,TSSB)) | | DRX cycle>320 | ceil(10\*P)\*TDRX | ceil(5\*P)\*TDRX | | NOTE1: TSSB is the periodicity of SSB configured for RLM. TDRX is the DRX cycle length.  NOTE2: M1 = 1.5 if SMTC >= 40ms, otherwise M1 = 1 | | |   Table 2‑12 Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1 under HST   |  |  | | --- | --- | | Configuration | TEvaluate\_BFD\_SSB (ms) | | no DRX | max([50], ceil(5\*P)\*TSSB) | | DRX cycle ≤ 320ms | max([50], ceil(M1\*5\*P)\*max(TDRX,TSSB)) | | DRX cycle > 320ms | ceil(5\*P)\*TDRX | | Note1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.  Note2: M1 = 1.5 if SMTC >= 40ms, otherwise M1 = 1 | |   Table 2‑13 Evaluation period TEvaluate\_BFD\_SSB for FR1 under HST  Proposal 6: HST can reuse the RSRP accuracy requirement in non-HST case.  Proposal 7: SINR accuracy requirement is not applicable to HST scenario when SNR > 5dB.  Proposal 8: Inter-RAT cell identification for LTE in NR SA requirement is specified by Table 2‑16.   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle length [s] | TdetectEUTRA\_FDD [s] (number of DRX cycles) | TmeasureEUTRA\_FDD [s] (number of DRX cycles) | TevaluateEUTRA\_FDD  [s] (number of DRX cycles) | | 0.32 | 7.68 (24) | 1.28 (4) | 1.6(5) | | 0.64 | 12.8 (16) | 1.28 (2) | 1.92 (3) | | 1.28 | 12.8(10) | 1.28 (1) | 3.84 (3) | | 2.56 Note1 | 58.88 (23) | 2.56 (1) | 7.68 (3) |   Table 2‑16 Inter-RAT cell identification for LTE in NR SA requirement  Proposal 9: Inter-RAT measurement on LTE in NR SA mode only applicable to HST when Tinter1=60ms (gap pattern 0) is used.  Proposal 10: Inter-RAT cell identification for LTE in NR SA requirement is specified by Table 2‑19.   |  |  |  | | --- | --- | --- | | DRX cycle length (s) | TIdentify, E-UTRAN TDD (s) (DRX cycles) | | |  | Gap period = 40 ms, 20 ms | Gap period = 80 ms | | ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply | | 0.256 | 3.84\*K (15\*CSSFinterRAT) | 3.84\*K (15\*CSSFinterRAT) | | 0.32 | 4.8\*K (15\*CSSFinterRAT) | 4.8\*K (15\*CSSFinterRAT) | | 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT) | Note1 (20\*CSSFinterRAT) | | NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2. | | |   Table 2‑19 Requirement to identify a newly detectable E-UTRAN cell in HST  Proposal 11: No enhancement on Inter-RAT idle mode measurement on NR before EN-DC requirement for HST.  Proposal 12: No enhancement on Inter-RAT connected mode measurement on NR before EN-DC requirement for HST. |
| [**R4-2001346**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001346.zip) | Nokia, Nokia Shanghai Bell | From the simulation results we make a number of observations:   1. A lower HO failure rate is observed when 1.5 scaling factor is removed for the intermediate DRX cycles (80-320 ms) and with high network load . 2. Lower failure HO rate is observed when using 3 L1 samples compared to 5 samples per measurement period, particularly with long DRX cycles . 3. A significant decrease in the Time-of-outage is observed for intermediate DRX cycles when 1.5 scaling factor is removed compare to when 1.5 scaling is applied . 4. Time-of-outage decreases when L1 measurement period of 3 samples is used compared to when using 5 samples.   Based on which we propose:   1. For NR HST in FR1 cell detection and measurement evaluation delay shall be reduced . 2. RAN4 tightens the FR1 cell detection and measurement requirements when DRX is in use. 3. Under HST condition the 1.5 scaling factor shall not be applied in general. 4. RAN4 defines the 1.5 scaling factor does not apply under HST conditions. 5. Use Rel-16 LTE HST cell reselection tightening as baseline, unless shown not to work. 6. Intra-frequency cell detection for no DRX stay unchanged. 7. RAN4 tightens the FR1 cell detection and measurement requirements when DRX is in use from 5 samples to 3 samples. 8. Add signaling indicating when HST conditions apply in a cell. 9. For RLM in DRX RAN4 shall remove the 1.5 scaling factor under HST, when DRX is applied. 10. RAN4 also need to remove the 1.5 scaling used for RLM L1 indication (TIndication\_interval) when DRX ≤ 320ms is used. 11. Beam management requirements seems not to need changes for HST. 12. RAN4 also need to remove the 1.5 scaling used for BFD L1 indication (TIndication\_interval) when DRX ≤ 320ms is used.   with the observation:   1. Although the simulations do include non-ideal beam management not all BM aspects are simulated. |
| [**R4-2001389**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001389.zip) | Ericsson | Proposal 1 : M2, M3 and M4 are not kept (or equivalently set equal to 1)  Proposal 2: Applicability of requirements for idle high speed operation excludes at least 160ms SMTC periodicity (80ms FFS)  Proposal 3 : The enhanced requirement for time index reading is max([120 OR 60]ms, ceil( 3 x Kp ) x SMTC period)  Proposal 4 : cDRX 1.5x relaxation factor is not kept  Proposal 5: Applicability of requirements for cDRX high speed operation excludes at least 160ms SMTC periodicity (80ms FFS)  Proposal 6 : 3 samples is used for measurement period  Observation 1 : The requirements for interRAT high speed measurements cannot be different for SA and EN-DC preparation  Proposal 7 : For interRAT reselection, reuse the same reselection requirements as for enhanced NR intrafrequency reselection. M2, M3 and M4 are not kept (or equivalently set equal to 1)  Proposal 8: Applicability of requirements for RRC connected non-DRX high speed operation excludes at least 160ms MGRP periodicity (80ms FFS)  Proposal 9: Non DRX requirements for interRAT measurements are  Time period for PSS/SSS detection is max( 600ms, ceil( 5 x Kp) x max(MRGP,SMTC period ))  Time period for time index detection is max(120ms, ceil( 3 x Kp ) x max(MGRP,SMTC period))  Measurement period is max(200ms, ceil( 3 x Kp) x max(MGRP,SMTC period))  Proposal 10: Non DRX requirements for interRAT measurements are  Time period for PSS/SSS detection is max( 600ms, ceil( 5 x Kp) x max(MRGP,SMTC period, DRX period ))  Time period for time index detection is max(120ms, ceil( 3 x Kp ) x max(MGRP,SMTC period, DRX period))  Measurement period is max(200ms, ceil( 3 x Kp) x max(MGRP,SMTC period)) |
| [**R4-2001659**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001659.zip) | Huawei, HiSilicon | Proposal 1: M2, M3 and M4 shall be kept for cell reselection in NR HST where M2=1.5, M3=M4=2.  Proposal 2: Rel-15 requirements for non-DRX SSB index acquiring delay requirements case are reused to the high speed scenario.  Proposal 3: No enhancements of the cell detection, measurement and SSB index acquiring are allowed for DRX<320ms cases in NR HST.  Proposal 4: 1.5x relaxation factor shall be used for DRX cycle ≤ 320ms.  Proposal 5: The measurement samples can be reduced from 5 to 3 for DRX>320. It shall be noted that the power saving gain is lost.  Proposal 6: 1.5x shall be kept for RLM in NR HST.  Proposal7: In NR HST scenario, network is suggested to configure timeRestrictionForChannelMeasurement to perform L1-RSRP measurement.  Proposal 8: The existing requirements for L1-RSRP measurement, CBD and BFD can be reused for HST (including SSB and CSI-RS based).  Proposal 9: For inter-RAT measurement  -NR to EUTRA inter-RAT measurements (in NR SA) follows the R16 EUTRA enhanced measurement requirements,  -EUTRA-NR inter-RAT measurement (before ENDC) follows the R16 HST NR measurement requirements. |
| [**R4-2000573**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000573.zip) | CATT | CR on cell re-selection requirements for NR HST |
| [**R4-2000639**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000639.zip) | CMCC | 38.133 CR on cell re-selection requirements for Rel-16 NR HST |
| [**R4-2001390**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001390.zip) | Ericsson | TP:High speed enhancements for NR idle mode |

## Open issues summary

### Sub topic 1-1: Cell re-selection requirements

**Agreements in RAN4#93 meeting (R4-1915887):**

Cell re-selection requirements specified in Rel-16 LTE HST WI can be reused for NR HST

* The details are as following table:

|  |  |  |  |
| --- | --- | --- | --- |
| **DRX cycle length [s]** | **Tdetect,NR\_Intra [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra**  **[s] (number of DRX cycles)** |
| 0.32 | [2.56 x M2 (8 x M2)] | [0.32 x M3 (1 x M3)] | [0.96 x M4 (3 x M4)] |
| 0.64 | [5.12 (8)] | [0.64 (1)] | [1.92 (3)] |
| 1.28 | [8.96 (7)] | [1.28 (1)] | [3.84 (3)] |
| 2.56 | [58.88 (23)] | [2.56 (1)] | [7.68 (3)] |
| Note 1: FFS whether to keep M2, M3, M4 | | | |

* No enhancement applied for 2.56s DRX length for NR HST
* Capture a note in the requirements table that 2.56s requirement has not been enhanced to support high speed operation.

**Issue 1-1: Whether to keep M2, M3, M4 for cell re-selection**

* Proposals
  + Option 1 (CATT, NOKIA, Ericsson): remove M2, M3, M4
  + Option 2 (CMCC, HW, QC): keep M2, M3, M4
* Recommended WF
  + 6 companies discuss issue 1-1, 3 companies propose to remove the scaling factor, while 3 companies prefer to keep it.
  + Moderator feels it is difficult to move forward due to the current situation, and would like to suggest more companies provide comments and possible compromise in order to move forward. One example compromise is “remove the 1.5x scaling factor provided the applied SMTC period is <=TBD”.

**Issue 1-2: Applied SMTC in cell re-selection requirements for HST**

* Proposals
  + Option 1 (Ericsson): at least 160ms is excluded (FFS 80ms)
  + Option 2 (CMCC): all the candidate SMTC periodicity can be configured if the 1.5x scaling factor is kept
* Recommended WF
  + 2 companies discuss issue 1-2, 1 company propose that at least 160ms SMTC is excluded, 1 company thinks whether to restrict the applied SMTC period is related to whether to remove the 1.5x scaling factor.
  + Moderator feels it is difficult to move forward due to the current situation, and would like to suggest more companies provide comments and possible compromise in order to move forward. One example compromise is “the applied SMTC period is <= TBD, if the 1.5x scaling factor is removed”

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | **Issue 1-1: Whether to keep M2, M3, M4 for cell re-selection**  QC proposes the following compromise to proceed:  When SMTC < 40, remove M2,M3,M4  When SMTC >= 40, M2 = 1.5, M3 = M4 = 2 (to avoid waking up UE in the middle of DRX OFF)  **Issue 1-2: Applied SMTC in cell re-selection requirements for HST**  Following the proposal in issue 1-1, we suggest candidate SMTC < 40ms |
| CATT | **Issue 1-1: Whether to keep M2, M3, M4 for cell re-selection**  **We propose to remove M2, M3 and M4. In HST scenario, there is no need to introduce scaling factor, and too relaxed requirement may degrade mobility performance.**  **Issue 1-2: Applied SMTC in cell re-selection requirements for HST**  **Support exclude 160ms, and keep for others.** |
| Huawei, HiSilicon | Issue 1-1: M2 considers the scenario that SMTC is far from DRX-ON and UE needs to additionally wake up for AGC adjustment. In current spec, the condition for apply M2=1.5 is if SMTC periodicity of measured intra-frequency cell > 20 ms. We suggest no changes of the current condition and remain M2/3/4.  Issue 1-2: support option 2. The SMTC configuration is up to network configuration. |
| vivo | **Issue 1-1:**  **Support QC’s compromised proposal. If the range of SMTC periodicity for removing M2, M3, M4 can not be decided in this meeting, a possible way is leave it FFS.** |
| NTT DOCOMO, INC. | Issue 1-1: We prefer Option 1, but moderator’s suggestion seems reasonable.  Issue 1-2: This issue could be discussed after issue 1-1 is concluded. |
| Ericsson | Sub topic 1-1: We agree with the moderator that issue 1-1 and 1-2 are quite tightly coupled. Our view is as follows:   * 700m ISD with 500km/h (138m/s) is a very demanding scenario for DRX in general. Although some companies have argued that there is no problem with 1.5x scaling factor and 320ms DRX cycle based on moving speed analysis our concern is that the neighbor RRH will not be detectable according to -6dB Es/Iot condition when the UE is at the centre of another RRH coverage, So the UE probably has less than 350m to detect PSS/SSS, evaluate, trigger reselection, decode system information and camp on the new cell even with hysteresis. This corresponds to about 2.5s or 8 DRX cycles at 320ms which is already the same as Tdetect without any scaling factor . * Based on this analysis, we don’t think that the system needs can be met with 1.5x scaling factor and 320ms DRX cycle, at least for the most demanding HST deployments that are driving the requirements. * The 1.5x scaling factor can be avoided even in R15 by configuring 20ms SMTC period, because there are less issues with UE power consumption * Since our view is that it is quite restrictive to be forced to use 20ms in practice, we would prefer a bit of a “shared pain” approach when it comes to high speed operation   + Network should provide sufficient SSB / SMTC to enable the high speed operation with reasonable power efficiency at the UE, while UE design should also accept that power consumption cannot be as good as in low speed scenarios.   Hence we would support the example compromise proposed by the moderator “that the applied SMTC period is <= TBD, if the 1.5x scaling factor is removed”. We would support a TBD value of 40ms. In addition, if there are other scenarios where 1.5 scaling factor is still used in the requirements we would also like to see a note such as “Note x : Operation with scaling factor M=1.5 may not be sufficient in all high speed deployments considered in this release of the specifications” or something like that (we could discuss the exact wording of the note in the 2nd round).  Sub topic 1-2: we can agree the WF proposed by the moderator if in addition there is a note such as “Note x : Operation with scaling factor M=1.5 may not be sufficient in all high speed deployments considered in this release of the specifications” for any requirements which still include the scaling factor . We are of course open to discussion on the exact wording. |
| Nokia | Sub topic 1-1: From system simulation results (although they are for connected mode) it is clear that not applying the 1.5 scaling factor significantly improves the mobility robustness. It is straight forward to conclude the same will be the same for idle mode mobility. Hence, option 1.  Sub topic 1-2: We do not see any reason to limit the SMTC periodicity as this must be a network configuration issue and not a RAN4 requirement. We support Option 2. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2000573**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000573.zip) |  |
| [**R4-2000639**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000639.zip) |  |
| [**R4-2001390**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001390.zip) |  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Cell identification delay

*Agenda 8.17.1.2*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000159**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000159.zip) | vivo | Proposal 1: The current SSB index acquiring delay requirements can be reused in the high speed scenario.  Observation 1: In LTE HST, enhancement on intra-frequency cell identification delay and measurement delay was only done for DRX cycle > 0.04s and DRX cycle ≤ 1.28s.  Proposal 2: For non-DRX and DRX cycle ≤ 0.04s in NR HST, reuse R15 requirement for cell measurement delay, i.e. 5 samples.  Proposal 3: For DRX cycle > 0.16s in NR HST, tightening R15 requirement for cell identification and/or measurement delay can be considered.  Proposal 4: The enhancement of intra-frequency RRM requirement in NR HST is only done for DRX cycle ≤ 1.28s.  Proposal 5: The configuration of both SSB and CSI-RS periodicity larger than 40ms is not supported in NR HST scenario.  Proposal 6: For SS-SINR requirement in HST, slightly prefer option 1, i.e. SINR accuracy requirement is not applicable to HST scenario. |
| [**R4-2000574**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000574.zip) | CATT | CR on cell identification requirements for NR HST |
| [**R4-2000859**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000859.zip) | NTT DOCOMO, INC. | Observation 1:  In case of EN-DC or NE-DC, it is straightforward to utilize the same DRX cycle and align the timing between MCG and SCG from UE power saving perspective.  Proposal 1:  At least 1280ms DRX cycle should be included as the maximum DRX cycle for HST scenario.  Proposal 2:  The measurement sample is reduced from 5 to 3 when longer DRX cycle than 320ms is configured. |
| [**R4-2001391**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001391.zip) | Ericsson | TP:High speed enhancements for NR RRC connected mode |
| [**R4-2001660**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001660.zip) | Huawei, HiSilicon | Observation 1: The accuracy of SS-SINR deteriorates as the frequency offset increases.  Observation2: At high side condition, the accuracy of SS-SINR deteriorates seriously degraded.  Proposal 1: SS-SINR measurement is not supported in HST scenario. |

## Open issues summary

### Sub topic 2-1: Cell identification delay requirements for non-DRX case

**Agreements in RAN4#93 meeting:**

* Rel-15 PSS/SSS detection delay requirements, measurement delay requirements for non-DRX case are applicable to the high speed scenario
* Further study SSB index acquiring delay requirements

**Issue 2-1: Whether Rel-15 SSB index acquiring delay requirements can be reused for NR HST**

* Proposals
  + Option 1(CMCC, CATT, HW, QC, vivo): Rel-15 SSB index acquiring delay requirements can be reused for NR HST
  + Option 2 (Ericsson): Time index reading is max([120 OR 60]ms, ceil( 3 x Kp ) x SMTC period)
* Recommended WF
  + 6 companies discuss issue 2-1, 5 companies propose to reuse Rel-15 SSB index acquiring delay requirements for NR HST, 1 company propose to consider reducing the fixed 120ms term from the max() formulation to 60ms.
  + Moderator would like to suggest companies check whether following suggestion is acceptable:
    - For non-DRX, reusing Rel-15 SSB index acquiring delay requirements for NR HST.

### Sub topic 2-2: Cell identification delay requirements for DRX case

**Agreements in RAN4#93 meeting:**

* For DRX cycle ≤ 320ms
  + FFS whether 3 or 5 samples shall be used for measurement period
  + [5] samples shall be used for cell detection
  + FFS whether 1.5x relaxation factor shall be used
* For DRX cycle > 320ms
  + Option 1: measurement period is enhanced from 5 samples to 3 samples
  + Option 2: no enhancement
  + Other option is not precluded
  + FFS if requirements for all SMTC periodicities shall be enhanced

**Issue 2-2: Whether to keep the relaxation factor of 1.5 for DRX cycle <= 0.32s**

* Proposals
  + Option 1(CMCC, HW): keep the factor
  + Option 2 (CATT, NOKIA, Ericsson): remove the factor
  + Option 3 (QC): keep the factor of 1.5 if SMTC >= 40ms, otherwise remove the factor of 1.5
* Recommended WF
  + 6 companies discuss Issue 2-2, 2 companies prefer to keep the factor, 3 companies prefer to remove the factor and 1 company provides a condition to remove the factor. Removing the scaling factor with a condition seems like a way to move forward.
  + Moderator would like to suggest companies to check whether following suggestion is acceptable:
    - For DRX cycle <= 0.32s, the scaling factor can be removed if SMTC <= [40] ms

**Issue 2-3: For DRX <= 320ms, whether 3 or 5 samples shall be used for measurement period**

* Proposals
  + Option 1(CATT, NOKIA, Ericsson): 3 samples for DRX <= 320ms
  + Option 2 (CMCC): 5 samples for DRX < 320ms, 3 samples for DRX cycle = 320ms
  + Option 3 (QC): 5 samples for DRX < 320ms, 4 samples for DRX cycle = 320ms
  + Option 4 (HW): 5 samples for DRX <= 320ms
  + Option 5 (vivo): No enhancement for DRX <= 160ms, but for DXR cycle > 160ms, enhancement on measurement can be considered
* Recommended WF
  + 7 companies discuss Issue 2-3, 3 companies prefer to use 3 samples for DRX cycle < =0.32s, 2 companies prefer to use 3 or 4 samples only for DRX cycle = 0.32s, 1 company prefer to keep 5 samples for DRX cycle <= 0.32s, and one company suggest enhancement can be considered for DRX cycle > 160ms
  + At least for DRX cycle = 0.32s, most companies share the similar view that enhancement can be considered. Moderator suggest companies to check whether following suggestion is acceptable:
    - For DRX cycle = 0.32s, measurement delay is 3 samples
    - For DRX cycle < 0.32s, measurement delay is 5 samples

**Issue 2-4: Whether to enhance the cell identification requirements for DRX > 320ms**

* Proposals
  + Option 1(HW, Ericsson, DOCOMO): measurement delay is 3 samples for DRX cycle > 0.32s
  + Option 2 (CMCC): both PSS/SSS detection and measurement period is 3 samples for DRX > 0.32s
  + Option 3 (CATT, QC): no enhancement (keep 5 samples)
* Recommended WF
  + 6 companies discuss Issue 2-4, 2 companies do not prefer to enhance the requirements for DRX > 0.32s, while 4 companies find it is necessary to have enhancement, among which 3 companies prefer to enhance the measurement delay from 5 samples to 3 samples and 1 company suggests both PSS/SSS detection and measurement delay are enhanced from 5 samples to 3 samples.
  + Moderator would like to suggest more companies provide comments and possible compromise in order to move forward. One example compromise is: for DRX cycle > 320ms, the PSS/SSS detection and measurement delay can be reduced from 5 to 3 samples provided the applied SMTC period is <= TBD ms

**Issue 2-5: Applied SMTC in cell identification requirements for HST**

* Proposals
  + Option 1(Ericsson): at least 160ms is excluded
  + Option 2 (CMCC): For DRX < 0.32s, if the 1.5x scaling factor is removed, the restriction on applied SSB periodicity can be considered. For DRX >= 0.32s, if both the PSS/SSS detection delay and measurement delay are reduced from 5 to 3, the restriction on applied SSB periodicity can be considered
  + Option 3 (vivo): The configuration of both SSB and CSI-RS periodicity larger than 40ms is not supported in NR HST scenario
* Recommended WF
  + 3 companies discuss Issue 2-5, and 3 options are provided
  + Issue 2-5 is related to Issue 2-2, 2-3 and 2-4. Moderator would like to suggest focus on discussing Issue 2-2, 2-3 and 2-4. And Issue 2-5 can be considered together when Issue 2-2, 2-3 and 2-4 are discussed

**Issue 2-6: Applied DRX cycle in cell identification requirements for HST**

* Proposals
  + Option 1(vivo, DOCOMO): At least 1280ms DRX cycle should be included as the maximum DRX cycle for HST scenario
* Recommended WF
  + Moderator would like to suggest companies check whether following suggestion is acceptable:
    - the maximum DRX cycle applied for HST requirements is 1280ms

### Sub topic 2-3: SS-SINR

**Agreements in RAN4#93 meeting:**

* Option 1: SINR accuracy requirement is not applicable to HST scenario
* Option 2: SS-SINR measurement is not supported in HST scenario
* Option 3: identify the SNR upper bound below which the Rel-15 SS-SINR measurement requirements are reused. For the SNR larger than the upper bound, FFS whether to introduce new requirements or do not specify requirements

**Issue 2-7: SS-SINR**

* Proposals
  + Option 1(QC): SINR accuracy requirement is not applicable to HST scenario when SNR > 5dB
  + Option 2 (vivo, HW): SINR accuracy requirement is not applicable to HST scenario
* Recommended WF
  + Moderator would like to suggest more companies provide comments and possible compromise in order to move forward.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | **Issue 2-1: Whether Rel-15 SSB index acquiring delay requirements can be reused for NR HST**  QC agrees with moderator suggestion  **Issue 2-2: Whether to keep the relaxation factor of 1.5 for DRX cycle <= 0.32s**  QC agree with moderator suggestion but with SMTC “<” 40ms instead of <= 40ms to be consistent with Topic 1 comment  **Issue 2-3: For DRX <= 320ms, whether 3 or 5 samples shall be used for measurement period**  “For DRX cycle < 0.32s, measurement delay is 5 samples” this suggestion from moderator aligns to our proposal, we agree with it.  For DRX cycle = 0.32s, we suggest to discuss based on Ericsson’s analysis framework, since we use the same analysis framework in LTE. But two modification is needed for the framework to make it better align to HST scenario:   * + - 1. Hysteresis is needed, especially in HST scenario where train runs faster       2. In HST, SNR change across 5 PSS samples collected to detect a cell is large, hence UE can detect PSS/SSS with 5 samples when the first sample is collected long before SINR reaches -6dB   With the above modifications, in our paper (R4-2000772) we derive that the measurement requirement should set to 4 DRx cycles when DRx cycle period = 0.32s. Our proposal in last meeting which computed based only on ISD is 5 DRx cycle for DRx cycle period = 0.32s, but we agree with Ericsson’s analysis framework and update our proposal accordingly. Therefore, we would like to know companies’ comment to Ericsson and ours analysis and see if 4 DRx cycle is agreeable.  **Issue 2-4: Whether to enhance the cell identification requirements for DRX > 320ms**  We can follow moderator’s suggestion to compromise here. We still would like to keep PSS/SSS detection time as Rel-15, but for measurement period, if SMTC is reduced to < 40ms as we proposed in Topic 1, by slightly extending on duration, UE can measure more samples per DRx cycle and achieve the same performance. For HST scenario, we as UE vendor can compromise to slightly higher power consumption to ensure system performance. Hence measurement period of 3 DRx cycle for DRx cycle > 0.32s when SMTC < 40ms is agreeable for QC.  **Issue 2-5: Applied SMTC in cell identification requirements for HST**  As proposed in previous issues, we suggest to have SMTC < 40ms. |
| CATT | **Issue 2-1: Whether Rel-15 SSB index acquiring delay requirements can be reused for NR HST**  Support option 1, Rel-15 SSB index acquiring delay requirements can be reused for NR HST.  **Issue 2-2: Whether to keep the relaxation factor of 1.5 for DRX cycle <= 0.32s**  Support option 2, in HST scenario, there is no need to introduce scaling factor, and too relaxed requirement may degrade mobility performance.  **Issue 2-3: For DRX <= 320ms, whether 3 or 5 samples shall be used for measurement period**  If Kp is not considered in HST scenario, we can compromise to 5 sample for DRX < 320ms. And the upper bound of SMTC periodicity should be defined.  **Issue 2-4: Whether to enhance the cell identification requirements for DRX > 320ms**  If Kp is not considered in HST scenario, we can discuss the enhanced cell identification requirements for DRX > 320ms, the upper bound of DRX cycle shall be discussed to define the enhanced cell identification requirement, similar the way in idle mode.  **Issue 2-5: Applied SMTC in cell identification requirements for HST**  Support exclude 160ms, and keep for others.  **Issue 2-6: Applied DRX cycle in cell identification requirements for HST**  The upper bound of DRX cycle shall be discussed to define the enhanced cell identification requirement, similar the way in idle mode. |
| Huawei, HiSilicon | **Issue 2-1 Whether Rel-15 SSB index acquiring delay requirements can be reused for NR HST**  Does the moderator’s suggestion is only for non-DRX scenario? Does it mean that for DRX the SSB index delay requirements for NR HST is FFS? If yes, we agree with the suggestion.  **Issue 2-2: Whether to keep the relaxation factor of 1.5 for DRX cycle <= 0.32s**  **Issue 2-3: For DRX <= 320ms, whether 3 or 5 samples shall be used for measurement period**  **Issue 2-4: Whether to enhance the cell identification requirements for DRX > 320ms**  **Issue 2-5: Applied SMTC in cell identification requirements for HST**  Issues 2-2, 2-3 and 2-4 can be discussed in a package. As a compromise, the factor 1.5 can be removed for both cell identification and measurement requirements. However the samples shall remain unchanged, i.e., 5 for cell identification, and 5 for measurement for all DRX cycles.  **Issue 2-6: Applied DRX cycle in cell identification requirements for HST**  Agree with moderator’s suggestion. |
| vivo | **Issue 2-1:**  **Support the moderator WF.**  **Issue 2-2:**  **Support the moderator WF. Similar to issue 1-2, the range of applicable SMTC periodicity for removing 1.5x factor can be FFS.**  **Issue 2-3:**  **At least for DRX cycle < 0.32s, we support the current WF.**  **When DRX cycle = 0.32s, and 1.5x scaling factor is removed for some SMTC periodicity and some DRX cycle configuration, since the majority companies view on the required measurement samples are within the range 3 to 5, we can leave the detailed number FFS.**  **Issue 2-4:**  **Clarify that vivo’s view is aligned with option 1, while applicable DRX cycle should be 1.28s => DRX > 0.32s.**  **Issue 2-6:**  **Support moderators WF.**  **Issue 2-7:**  **Support option 2. Our understanding is that HST is a high SINR scenario, therefore it is difficult to define a range for applicable SINR requirement.** |
| NTT DOCOMO, INC. | Sub topic 2-1:  Issue 2-1: Support the moderator WF.  Sub topic 2-2:  Issue 2-2 and 2-3, we prefer Option 1, but moderator’s suggestion seems reasonable.  Issue 2-4, we prefer Option 1 (It is our original proposal.).  Issue 2-5, moderator’s suggestion is fine.  Issue 2-6, we prefer Option 1 (It is our original proposal and the same as moderator’s WF.).  Issue 2-7, we understand the problem. We slightly prefer option1 and would like to identify the limit point which SS-SINR could be applicable. |
| Ericsson | 2-1: We are Ok with reusing rel15 time index requirements, this was one possibility within the scope of the proposal that we provided. Our point was anyway that there isn’t an easy way to reduce the number of samples needed by the UE to decode time index,  Issue 2-2 : Similar to the idle mode discussion on 1.5x scaling factor, we can agree the WF proposed by the moderator if in addition there is a note such as “Note x : Operation with scaling factor M=1.5 may not be sufficient in all high speed deployments considered in this release of the specifications” for any requirements which still include the scaling factor  Issue 2-3: As for idle mode, we think operation with 320ms DRX, 700m ISD and 500km/h is a very demanding scenario,. In Reno we provided accuracy results in high speed where we concluded that 3 samples was sufficient so we support the moderator’s suggestion to reduce the measurement period to 3 samples.  Issue 2-4: DRX cycle >320ms becomes difficult for 500km/h 700m ISD regardless of number of samples. For instance the UE may move from cell centre to cell edge in 4 DRX cycles during which time it would need to detect PSS/SSS, measure, transmit a measurement report and receive a handover command. So although we welcome enhancements which could be used in less demanding scenario and we support proposal 1, it is again a case where even with the enhancement such requirements may not work in all rel16 envisaged deployments.  Issue 2-5 : Agree with the moderator’s suggestion  Issue 2-6 : Similar comment to issue 2-4. We can enhance 1.28s DRX requirements and that may be useful with some maximum UE speed<500km/h and/or moderately large ISD>700m but for the most demanding R16 scenario the UE moves from the cell centre to the cell edge in ~2 DRX cycles @ 1.28s DRX cycle. It does not seem like any enhancement can help in this case.  So in general we need to talk about how to handle enhancements which are perhaps useful for certain high speed deployments but not sufficient for the full requirements of R16 high speed operation.  Issue2-7: We have a preference towards option 1. |
| Nokia | Issue 2-1: We support the reduced index reading time Option 2 proposed by Ericsson. As can be seen from the simulation results the HST scenario is sensitive any delays in the UE latencies related to measurements and reporting. The simulations are without Index reading but Index reading will just increase the UE latency leading to less robust mobility for HST. Otherwise, this would need further study before being able to agree.  issue 2-2: Not removing the 1.5 scaling in general will reduce the possible need of longer DRX cycles forcing the network configuration to use short DRX cycles. It is clear from the simulation results that the scaling factor removal has significant positive impact on the mobility robustness. From the results in our table 2 it is shown that a significant improvement is gained when removing the 1.5 scaling factor. Time-of-outage is improved between 32% and 47.7%.  Issue 2-3: Not reducing the number of measurement samples from 5 to 3 (reducing the UE latencies) will have negative impact on the mobility robustness as shown in our simulations. We have provided results showing the impact when reducing the assumed measurement sample numbers during the measurement period from 5 to 3 in table 3 of R4-2001346. There is a clear improvement in the time-of-outage when the when the number of samples is tightened from 5 to 3. Depending on the DRX cycle used we see an improvement between 12.5% and 25.4%.  Issue 2-4: In a similar view as for Issue 2-3. Our simulation results are based on tightened cell detection time as well. We see from the results that the combined improvement from not applying the 1.5 scaling factor and tightening the UE requirements (5 to 3 samples) improves the time-of-outage between 45% and 61% - which is a significant improvement.  Issue 2-5: Although we agree that using SMTC of 160ms is likely not most common in HST we do see this as a network configuration issue and nothing would need to be captured in the RAN4 specification.  Issue 2-6: This is also a network configuration issue and nothing needs to be captured in RAN4. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2000574**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000573.zip) |  |
| [**R4-2001391**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001391.zip) |  |
|  |  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: RLM

*Agenda 8.17.1.3*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2001355**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001355.zip) | Ericsson | Proposal: 1.5x relaxation factor for DRX cycle <= 320ms is not kept for RLM L1 evaluation period in HST. |

## Open issues summary

### Sub topic 3-1: RLM

**Agreements in RAN4#93 meeting:**

* Reuse Rel-15 RLM requirements for NR HST
  + FFS whether 1.5x relaxation factor shall be used

**Issue 3-1: Whether 1.5x relaxation factor for RLM shall be kept**

* Proposals
  + Option 1 (HW): keep the 1.5x scaling factor
  + Option 2 (QC): 1.5x relaxation factor is kept if SMTC >= 40ms, otherwise, 1.5x relaxation factor can be removed
  + Option 3 (NOKIA, Ericsson): remove the 1.5x scaling factor
* Recommended WF
  + 4 companies discuss issue 3-1, 3 options are proposed.
  + Moderator feels it is difficult to move forward due to the current situation, and would like to suggest more companies provide comments and possible compromise in order to move forward.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | **Issue 3-1: Whether 1.5x relaxation factor for RLM shall be kept**  We suggest to come back to this issue after issue 2-5 is resolved. It makes more sense to have uniform 1.5 relaxation factor usage across all the requirement as SMTC would not change too often. |
| Huawei, HiSilicon | **Issue 3-1: Whether 1.5x relaxation factor for RLM shall be kept**  We doubt whether the faster RLM monitoring is expected for NR HST. As the path trajectory is fixed in high speed trail rain, even RLF is detected for example the train enters into a tunnel, it is no need to declare RLF since the channel quality will become better later. To some extent, slow RLM is more appropriate for HST scenario. |
| Ericsson | Issue 3-1-1: Similar discussion as RRM, so whatever the outcome it should be common between RLM and RRM |
| Nokia | Sub topic 3-1: While the non-DRX requirements likely can be re-used directly we see from our simulation results in R4-2001346, challenges with using the 1.5 scaling factor when DRX is used. Hence, when removing the 1.5 scaling factor applicability from other UE requirements when under HST conditions, the 1.5 scaling shall also not be applied for RLM under HST. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: Beam management

*Agenda 8.17.1.4*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2001356**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001356.zip) | Ericsson | Proposal 1: 1.5x relaxation factor for DRX <= 320ms is not kept for BFD L1 evaluation period in HST.  Observation 1: SSB based L1-RSRP measurement accuracy is not impacted with the Rel-16 NR high speed train scenario.  Proposal 2: Rel-15 SSB based L1-RSRP measurement/accuracy requirements can be reused for Rel-16 NR HST.  Proposal 3: 1.5x relaxation factor for DRX cycle <= 320ms is not kept for L1-RSRP measurement period in HST.  Observation 2: CSI-RS based L1-RSRP accuracy is degraded significantly due to the Rel-16 NR high speed train scenario.  Proposal 4: Rel-15 CSI based L1-RSRP measurement requirements can be reused for Rel-16 NR HST, but 1.5x relaxation factor for DRX cycle <= 320ms is not kept for L1-RSRP measurement period.  Proposal 5: RAN4 investigate the impact of CSI-RS based L1-RSRP measurement accuracy performance, if necessary, for Rel-16 HST scenario.  Proposal 6: Rel-15 Candidate beam detection requirements can be reused for Rel-16 NR HST. |
| [**R4-2001721**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001721.zip) | Nokia, Nokia Shanghai Bell | Proposal 1:SSB-based L1-RSRP measurement accuracy for Rel-15 NR can be reused for NR HST and the number of measurement samples is 3.  Proposal 2: CSI-RS based L1-RSRP measurement accuracy for Rel-15 NR can be reused for NR HST and the number of measurement samples is 3.  Proposal 3: SSB-based L1-RSRP measurement delay TL1-RSRP\_Measurement\_Period\_SSB for Rel-15 NR can be reused for NR HST.  Proposal 4: CSI-RS based L1-RSRP measurement delay TL1-RSRP\_Measurement\_Period\_CSI-RS for Rel-15 NR can be reused for NR HST. |
| R4-2001346 | Nokia, Nokia shanghai Bell | 1. Beam management requirements seems not to need changes for HST. 2. RAN4 also need to remove the 1.5 scaling used for BFD L1 indication (TIndication\_interval) when DRX ≤ 320ms is used.   with the observation:  Although the simulations do include non-ideal beam management not all BM aspects are simulated. |

## Open issues summary

### Sub topic 4-1: CBD based on SSB/CSI-RS

**Agreements in RAN4#93 meeting:**

* CBD based on SSB/CSI-RS
  + FFS on whether Rel-15 CBD requirements based on SSB/CSI-RS can be reused for NR HST

**Issue 4-1: Whether Rel-15 CBD requirements (including delay and accuracy) based on SSB/CSI-RS can be reused for NR HST**

* Proposals
  + Option 1 (HW, Ericsson): reuse Rel-15 CBD requirements for NR HST.
* Recommended WF
  + Rel-15 CBD requirements (including delay and accuracy) based on SSB/CSI-RS can be reused for NR HST.

### Sub topic 4-2: BFD based on SSB/CSI-RS

**Agreements in RAN4#93 meeting:**

* BFD based on SSB/CSI-RS
  + Rel-15 BFD requirements based on SSB/CSI-RS can be reused for NR HST
    - FFS whether 1.5x relaxation factor shall be used

**Issue 4-2: Whether 1.5x relaxation factor shall be kept**

* Proposals
  + Option 1 (HW): keep the 1.5x scaling factor
  + Option 2 (QC): 1.5x relaxation factor is kept if SMTC >= 40ms, otherwise, 1.5x relaxation factor can be removed
  + Option 3 (NOKIA, Ericsson): remove the 1.5x scaling factor
* Recommended WF
  + 4 companies discuss issue 4-2, 3 options are proposed.
  + Moderator feels it is difficult to move forward due to the current situation, and would like to suggest more companies provide comments and possible compromise in order to move forward.

**Issue 4-3: Whether to keep the 1.5x scaling factor used for L1 indication (TIndication\_interval) for DRX ≤ 320ms**

* Proposals
  + Option 1 (NOKIA): remove the 1.5x scaling factor
* Recommended WF
  + Moderator would like to suggest more companies provide comments and possible compromise in order to move forward.

### Sub topic 4-3: L1-RSRP based on SSB/CSI-RS

**Agreements in RAN4#93 meeting:**

* L1-RSRP based on SSB
  + FFS on whether Rel-15 requirements (measurement delay, measurement accuracy) can be reused for NR HST
* L1-RSRP based on CSI-RS
  + FFS on whether Rel-15 requirements (measurement delay, measurement accuracy) can be reused for NR HST

**Issue 4-4: Whether Rel-15 L1-RSRP requirements (including delay and accuracy) based on SSB can be reused for NR HST**

* Proposals
  + Option 1 (HW, NOKIA): reuse Rel-15 requirements
  + Option 2 (QC): 1.5x relaxation factor is kept if SMTC >= 40ms, otherwise, 1.5x relaxation factor can be removed
  + Option 3 (Ericsson): Rel-15 SSB based L1-RSRP measurement/accuracy requirements can be reused for Rel-16 NR HST, but the 1.5x relaxation factor for DRX cycle <= 320ms is not kept for L1-RSRP measurement period in HST
* Recommended WF
  + 4 companies discuss issue 4-4, according to the proposals, all the companies share the similar view that the measurement accuracy and the number of samples for delay requirements in Rel-15 L1-RSRP based on SSB can be reused for NR HST. However, companies have different views on whether to keep the 1.5x relaxation factor.
  + Moderator would like to suggest company to check whether following suggestion is acceptable:
    - Measurement accuracy and the number of samples for delay requirements in Rel-15 L1-RSRP based on SSB can be reused for NR HST
  + Moderator would like to suggest more companies provide comments and possible compromise on whether to keep the 1.5x relaxation factor.

**Issue 4-5: Whether Rel-15 L1-RSRP requirements (including delay and accuracy) based on CSI-RS can be reused for NR HST**

* Proposals
  + Option 1 (HW, NOKIA): reuse Rel-15 requirements
  + Option 2 (QC): 1.5x relaxation factor is kept if SMTC >= 40ms, otherwise, 1.5x relaxation factor can be removed
  + Option 3 (Ericsson): Rel-15 CSI based L1-RSRP measurement requirements can be reused for Rel-16 NR HST, but 1.5x relaxation factor for DRX cycle <= 320ms is not kept for L1-RSRP measurement period
* Recommended WF
  + 4 companies discuss issue 4-5, according to the proposals, all the companies share the similar view that the measurement accuracy and the number of samples for delay requirements in Rel-15 L1-RSRP based on CSI-RS can be reused for NR HST. However, companies have different views on whether to keep the 1.5x relaxation factor.
  + Moderator would like to suggest company to check whether following suggestion is acceptable:
    - Measurement accuracy and the number of samples for delay requirements in Rel-15 L1-RSRP based on CSI-RS can be reused for NR HST
  + Moderator would like to suggest more companies provide comments and possible compromise on whether to keep the 1.5x relaxation factor.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | **Issue 4-1: Whether Rel-15 CBD requirements (including delay and accuracy) based on SSB/CSI-RS can be reused for NR HST**  WF agreeable to us  **Issue 4-2: Whether 1.5x relaxation factor shall be kept**  **Issue 4-3: Whether to keep the 1.5x scaling factor used for L1 indication (TIndication\_interval) for DRX ≤ 320ms**  **Issue 4-4: Whether Rel-15 L1-RSRP requirements (including delay and accuracy) based on SSB can be reused for NR HST**  **Issue 4-5: Whether Rel-15 L1-RSRP requirements (including delay and accuracy) based on CSI-RS can be reused for NR HST**  For issue 4-2 to 4-5, we suggest to come back to this issue after issue 2-5 is resolved. It makes more sense to have uniform 1.5 relaxation factor usage across all the requirement as SMTC would not change too often. |
| Huawei, HiSilicon | **Issue 4-1: Whether Rel-15 CBD requirements (including delay and accuracy) based on SSB/CSI-RS can be reused for NR HST**  Agree with moderator’s suggestion  **Sub topic 4-2: BFD**  **Issue 4-2: Whether 1.5x relaxation factor shall be kept**  **Issue 4-3: Whether to keep the 1.5x scaling factor used for L1 indication (TIndication\_interval) for DRX ≤ 320ms**  Same view as RLM (not remove 1.5x)  **Issue 4-4: Whether Rel-15 L1-RSRP requirements (including delay and accuracy) based on SSB can be reused for NR HST**  **Issue 4-5: Whether Rel-15 L1-RSRP requirements (including delay and accuracy) based on CSI-RS can be reused for NR HST**  For Issue 4-4 and 4-5: SSB and CSI-RS based L1-RSRP shall reuse R15 requirement. Removing 1.5 factor or not can refer to the conclusion of L3 measurement. |
| Ericsson | Issue 4-1: Support the recommended WF  Issue 4-3 : Similar issue as RLM and RRM and we should have a common outcome for BFD as well.  Issue 4-3 Similar issue as RLM and RRM, BFD and we should have a common outcome for L1 indication as well.  Issue 4-4 : For SSB based L1-RSRP we are OK for reuse of rel15 delay and accuracy requirements with the exception of 1.5x scaling factor. Again, a common outcome with other discussions on 1.5x scaling factor is necessary  Issue 4-5 : For CSI-RS based L1-RSRP, similar to Issue 4-4, we are OK for reuse of rel15 delay and accuracy requirements with the exception of 1.5x scaling factor. Again, a common outcome with other discussions on 1.5x scaling factor is necessary |
| Nokia | Issue 4-1: Can agree with the recommended WF  Issue 4-2: Option 3 or further discussion is needed.  Issue 4-3: Likely needs more discussion  Issue 4-4: It should be noted that our view here should be collected from both our contributions (R4-2000136 and R4-2001721). One aspect here is actual measurement and accuracy on LL and then latency on SL. As for the accuracy we agree that Rel-15 requirements can apply. Meanwhile for the latency we see that it is necessary to not apply the 1.5 scaling factor in HST conditions. Hence Option 1 and Option 3 are supported.  Issue 4-5: It should be noted that our view here should be collected from both our contributions (R4-2000136 and R4-2001721). One aspect here is actual measurement and accuracy on LL and then latency on SL. As for the accuracy we agree that Rel-15 requirements can apply. Meanwhile for the latency we see that it is necessary to not apply the 1.5 scaling factor in HST conditions. Hence Option 1 and Option 3 are supported. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #5: Inter-RAT measurement

*Agenda 8.17.1.5*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000160**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000160.zip) | vivo | Proposal 1: For connected UE non-DRX case, reuse R15 inter-RAT measurement requirement in TS 38.133 and both Tinter1 = 60ms and Tinter1 = 30ms should be supported in NR HST.  Proposal 2: For connected UE DRX case, specify inter-RAT cell identification requirement as Table 1.  Proposal 3: For idle/inactive UE, support option 1, i.e. reuse the R16 LTE HST cell re-selection requirements.  Proposal 4: The EUTRA-NR inter-RAT measurement requirement for connected UE in NR HST can be defined after intra-frequency measurement requirement is defined, by using the same methodology as intra-frequency requirements.  Proposal 5: The EUTRA-NR inter-RAT measurement requirement for idle UE in NR HST reuse the R16 NR HST cell re-selection requirements, i.e. option 1 is adopted. |
| [**R4-2000631**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000631.zip) | CMCC | Proposal 1: it is proposed to enhance the inter-RAT measurement requirements to support high speed, including EUTRA-NR inter-RAT measurement before EN-DC, and NR-EUTRA inter-RAT measurement for SA scenario.  EUTRA-NR inter-RAT measurement delay requirements before EN-DC  Proposal 2: it is proposed to specify EUTRA-NR inter-RAT measurement delay requirements before EN-DC following the Rel-16 HST NR measurement requirements.  Proposal 2.1: for high speed scenario, the EUTRA-NR inter-RAT cell re-selection requirements before EN-DC are proposed as following:  Table: Tdetect,NR, Tmeasure,NR and Tevaluate,NR   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle length [s] | Tdetect,EUTRAN\_Intra [s] (number of DRX cycles) | Tmeasure,EUTRAN\_Intra [s] (number of DRX cycles) | Tevaluate,E-UTRAN\_intra  [s] (number of DRX cycles) | | 0.32 | 2.56 x 1.5 (8 x 1.5) | 0.32 x 1.5 (1 x 1.5) | 0.96 x 1.5 (3 x 1.5) | | 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) | | 1.28 | 8.96(7) | 1.28 (1) | 3.84 (3) | | 2.56 Note1 | 58.88 (23) | 2.56 (1) | 7.68 (3) |   Observation 1: for no DRX case, all the candidate SMTC periods can be applied to the NR HST scenario.  Proposal 2.2: for no DRX case, the current PSS/SSS detection delay requirements, measurement delay requirements and SSB index acquiring delay requirements are applicable to high speed scenario, and all the candidate SMTC periods and all the candidate MGRP can be applied.  Proposal 2.3: For the case of DRX cycle < 320ms, it is proposed to reuse Rel-15 cell identification requirements. And all the candidate SMTC period can be considered.  Proposal 2.4: For the case of DRX cycle >= 320ms, it is proposed to reduce the number of samples for measurement and PSS/SSS detection. And the applied SMTC periodicity can be further discussed.  NR-EUTRA inter-RAT measurement requirements for SA  Proposal 3: it is proposed to specify NR-EUTRA inter-RAT measurement requirements for SA following the Rel-16 HST EUTRA measurement requirements.  Proposal 3.1: for high speed scenario, the cell re-selection requirements on NR-EUTRA inter-RAT measurement for SA are proposed as following:   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle length [s] | Tdetect,EUTRAN\_Intra [s] (number of DRX cycles) | Tmeasure,EUTRAN\_Intra [s] (number of DRX cycles) | Tevaluate,E-UTRAN\_intra  [s] (number of DRX cycles) | | 0.32 | 2.56 (8) | 0.32(1) | 0.96(3) | | 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) | | 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) | | 2.56 Note1 | 58.88 (23) | 2.56 (1) | 7.68 (3) |   Observation 2: for the no DRX case with Tinter1 of 60ms, the current requirements of TIdentify,E-UTRAN can be applied to the high speed scenario, while for the no DRX case with Tinter1 of 30ms, enhancement is necessary.  Proposal 4: for NR-EUTRA inter-RAT measurement requirements in SA connected mode with no DRX, the current requirements TIdentify,E-UTRAN with Tinter1 of 60ms can be reused for high speed scenario.  Proposal 5: for NR-EUTRA inter-RAT measurement requirements in SA connected mode with no DRX, the current requirements TIdentify,E-UTRAN with Tinter1 of 30ms may need to be enhanced to support high speed scenario.  Proposal 6: for NR-EUTRA inter-RAT measurement requirements in SA connected mode with DRX, the TIdentify,E-UTRAN are proposed as following:   |  |  |  | | --- | --- | --- | | DRX cycle length (s) | TIdentify, E-UTRAN (s) (DRX cycles) | | |  | Gap period = 40 ms, 20 ms | Gap period = 80 ms | | ≤0.16 | Non-DRX requirements in clause 9.4.2.2 apply | Non-DRX requirements in clause 9.4.2.2 apply | | 0.16 < DRX-cycle<1.28 | Note1 (10) | Note1 (10) | | 1.28 | Note1 (8) | Note1 (8) | | 1.28< DRX-cycle ≤10.24 | Note1 (20) | Note1 (20) | | NOTE 1: The time depends on the DRX cycle length. | | | |
| [**R4-2001392**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001392.zip) | Ericsson | TP: interRAT NR high speed updates in 36.133 |

## Open issues summary

### Sub topic 5-1: NR- EUTRA Inter-RAT measurement

**Agreements in RAN4#93 meeting:**

* NR-EUTRA Inter-RAT measurement (NR SA)
  + Cell re-selection
    - Option 1: reuse the R16 LTE HST cell re-selection requirements, and details are:

|  |  |  |  |
| --- | --- | --- | --- |
| **DRX cycle length [s]** | **Tdetect,EUTRAN\_Intra [s] (number of DRX cycles)** | **Tmeasure,EUTRAN\_Intra [s] (number of DRX cycles)** | **Tevaluate,E-UTRAN\_intra**  **[s] (number of DRX cycles)** |
| 0.32 | 2.56 (8) | 0.32(1) | 0.96(3) |
| 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) |
| 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |

* + - Other option is not precluded
  + Cell identification without DRX in connected mode
    - Option 1:
      * The Rel-15 requirements TIdentify,E-UTRAN with Tinter1 of 60ms can be reused for high speed scenario.
      * FFS whether the current requirements TIdentify,E-UTRAN with Tinter1 of 30ms can be reused for high speed scenario
    - Other options are not precluded
* NR-EUTRA Inter-RAT measurement (NR SA)
  + Cell identification with DRX in connected mode
    - Option 1

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.2.2 apply | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.16 < DRX-cycle<1.28 | Note1, 2 (10) | Note1, 2 (10) |
| 1.28 | Note1, 2 (8) | Note1, 2 (8) |
| 1.28< DRX-cycle ≤10.24 | Note1, 2 (20) | Note1, 2 (20) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: Intra-frequency deployed is assumed for LTE HST and intra-frequency without gap is assumed for NR HST,  So CSSFinterRAT = 1. | | |

* + - Option 2

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN TDD (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.256 | 3.84\*CSSFinterRAT (15\*CSSFinterRAT) | 3.84\*CSSFinterRAT (15\*CSSFinterRAT) |
| 0.32 | 4.8\*CSSFinterRAT (15\*CSSFinterRAT) | 4.8\*CSSFinterRAT (15\*CSSFinterRAT) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT) | Note1 (20\*CSSFinterRAT) |
| NOTE 1: The time depends on the DRX cycle length. | | |

* + - Other options are not precluded

**Issue 5-1: Whether to enhance the NR- EUTRA inter-RAT measurement (SA) to support HST**

* Proposals
  + Option 1 (CMCC, HW, Ericsson, vivo, QC): enhancement is necessary
* Recommended WF
  + NR-EUTRA inter-RAT measurement requirements need to be enhanced

**Issue 5-2: Cell re-selection requirements on NR- EUTRA inter-RAT measurement in idle mode**

* Proposals
  + Option 1 (CMCC, HW, Ericsson, vivo): The principle is that NR to EUTRA inter-RAT measurements follows the R16 EUTRA HST enhanced measurement requirements. And the details are shown in the following Table:

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN\_Intra [s] (number of DRX cycles) | Tmeasure,EUTRAN\_Intra [s] (number of DRX cycles) | Tevaluate,E-UTRAN\_intra  [s] (number of DRX cycles) |
| 0.32 | 2.56 (8) | 0.32(1) | 0.96(3) |
| 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) |
| 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) |
| 2.56 Note1 | 58.88 (23) | 2.56 (1) | 7.68 (3) |

* + Option 2 (QC):

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | TdetectEUTRA\_FDD [s] (number of DRX cycles) | TmeasureEUTRA\_FDD [s] (number of DRX cycles) | TevaluateEUTRA\_FDD  [s] (number of DRX cycles) |
| 0.32 | 7.68 (24) | 1.28 (4) | 1.6(5) |
| 0.64 | 12.8 (16) | 1.28 (2) | 1.92 (3) |
| 1.28 | 12.8(10) | 1.28 (1) | 3.84 (3) |
| 2.56 Note1 | 58.88 (23) | 2.56 (1) | 7.68 (3) |

* Recommended WF
  + Moderator would like to suggest company to check whether following suggestion is acceptable:
    - NR to EUTRA inter-RAT measurements requirements follows the R16 EUTRA HST measurement requirements

**Issue 5-3: Cell identification requirements on NR- EUTRA inter-RAT measurement in connected mode for non-DRX case**

* Proposals
  + Option 1 (CMCC): The current requirements TIdentify,E-UTRAN with Tinter1 of 60ms can be reused for high speed scenario. The current requirements TIdentify,E-UTRAN with Tinter1 of 30ms may need to be enhanced to support high speed scenario
  + Option 2 (QC): Inter-RAT measurement on LTE in NR SA mode only applicable to HST when Tinter1=60ms (gap pattern 0) is used
  + Option 3 (HW): NR to EUTRA inter-RAT measurements (in NR SA) follows the R16 EUTRA enhanced measurement requirements
  + Option 4 (vivo): For connected UE non-DRX case, reuse R15 inter-RAT measurement requirement in TS 38.133 and both Tinter1 = 60ms and Tinter1 = 30ms should be supported in NR HST
* Recommended WF
  + Moderator would like to suggest company to check whether following suggestion is acceptable:
    - For connected mode with non-DRX, R15 inter-RAT measurement requirement in TS 38.133 can be reused for NR HST

**Issue 5-4: Cell identification requirements on NR- EUTRA inter-RAT measurement in connected mode for DRX case**

* Proposals
  + Option 1 (CMCC):

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.2.2 apply | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.16 < DRX-cycle<1.28 | Note1 (10) | Note1 (10) |
| 1.28 | Note1 (8) | Note1 (8) |
| 1.28< DRX-cycle ≤10.24 | Note1 (20) | Note1 (20) |
| NOTE 1: The time depends on the DRX cycle length. | | |

* + Option 2 (QC):

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN TDD (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.256 | 3.84\*K (15\*CSSFinterRAT) | 3.84\*K (15\*CSSFinterRAT) |
| 0.32 | 4.8\*K (15\*CSSFinterRAT) | 4.8\*K (15\*CSSFinterRAT) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT) | Note1 (20\*CSSFinterRAT) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2. | | |

* + Option 3 (vivo):

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN TDD (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.16< DRX-cycle ≤0.32 | Note1 (15\*CSSFinterRAT) | Note1 (15\*CSSFinterRAT) |
| 0.64 | 5.12\*CSSFinterRAT (8\*CSSFinterRAT) | 5.12\*CSSFinterRAT (8\*CSSFinterRAT) |
| 1.28 | 8.96\*CSSFinterRAT (7\*CSSFinterRAT) | 8.96\*CSSFinterRAT (7\*CSSFinterRAT) |
| 1.28< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT) | Note1 (20\*CSSFinterRAT) |
| NOTE 1: The time depends on the DRX cycle length. | | |

* Recommended WF
  + Moderator would like to suggest more companies provide comments and possible compromise on the NR- EUTRA inter-RAT in connected mode for DRX case

### Sub topic 5-2: EUTRA-NR Inter-RAT measurement

**Agreements in RAN4#93 meeting:**

* EUTRA-NR Inter-RAT measurement (before EN-DC)
  + Cell re-selection
    - Option 1: reuse the R16 NR HST cell re-selection requirements, the details are:
    - Other option is not precluded
  + Cell identification without DRX in connected mode
    - Option 1: reuse Rel-15 NR PSS/SSS detection delay requirements, measurement delay requirements and SSB index acquiring delay
    - Other option is not precluded
  + Cell identification with DRX in connected mode
    - Option 1: Reduce the number of measurement samples
    - Option 2: Reuse the Rel-15 NR cell identification requirements and the feasible DRX cycles can be further discussed
    - Other option is not precluded

**Issue 5-5: Whether to enhance the EUTRA-NR inter-RAT measurement (before EN-DC) to support HST**

* Proposals
  + Option 1 (CMCC, HW, Ericsson, vivo): enhancement is necessary
  + Option 2 (QC): no enhancement
* Recommended WF
  + 5 companies discuss Issue 4-1, 4 companies prefer to enhance the EUTRA-NR inter-RAT measurement requirements and 1 company suggest no enhancement.
  + Moderator would like to suggest companies to check whether following suggestion is acceptable:
    - EUTRA-NR inter-RAT measurement requirements need to be enhanced

**Issue 5-6: Cell re-selection requirements on EUTRA-NR inter-RAT in idle mode**

* Proposals
  + Option 1 (CMCC, HW, vivo): The principle is that EUTRA-NR inter-RAT measurement (before ENDC) follows the R16 HST NR measurement requirements. And the details are shown in following table:

|  |  |  |  |
| --- | --- | --- | --- |
| **DRX cycle length [s]** | **Tdetect,EUTRAN\_Intra [s] (number of DRX cycles)** | **Tmeasure,EUTRAN\_Intra [s] (number of DRX cycles)** | **Tevaluate,E-UTRAN\_intra**  **[s] (number of DRX cycles)** |
| 0.32 | 2.56 x 1.5 (8 x M2) | 0.32 x 2 (M3) | 0.96 x 2 (3 x M4) |
| 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) |
| 1.28 | 8.96(7) | 1.28 (1) | 3.84 (3) |
| 2.56 Note1 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note: M2 = 1.5 and M3=M4= 2 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=M3=1. | | | |

* + Option 2 (Ericsson): Reuse the same reselection requirements as for enhanced NR intrafrequency reselection. M2, M3 and M4 are not kept and at least 160ms MGRP periodicity is excluded
* Recommended WF
  + Except whether to keep the scaling factor, the baseline among the companies are the same, which is following the R16 HST NR measurement requirements
  + Moderator would like to suggest companies to check whether following suggestion is acceptable:
    - There issue is related to the conclusion of Issue 5-5, if it is agreed to enhance the EUTRA-NR inter-RAT measurement requirements, the cell re-selection requirements on EUTRA-NR inter-RAT measurement follow R16 HST NR cell re-selection requirements

**Issue 5-7: Cell identification requirements on EUTRA-NR inter-RAT measurement in connected mode for non-DRX case**

* Proposals
  + Option 1 (CMCC): the current PSS/SSS detection delay requirements, measurement delay requirements and SSB index acquiring delay requirements can be reused to the high speed scenario, and all the candidate SMTC periods and all the candidate MGRP can be applied.
  + Option 2 (HW, vivo): EUTRA-NR inter-RAT measurement (before ENDC) follows the R16 HST NR measurement requirements
  + Option 3 (Ericsson):
    - Time period for PSS/SSS detection is max( 600ms, ceil( 5 x Kp) x max(MRGP,SMTC period ))
    - Time period for time index detection is max(120ms, ceil( 3 x Kp ) x max(MGRP,SMTC period))
    - Measurement period is max(200ms, ceil( 3 x Kp) x max(MGRP,SMTC period))
* Recommended WF
  + Although the detail proposal is different from companies, the baseline among the companies are the same, which is following the R16 HST NR measurement requirements
  + Moderator would like to suggest companies to check whether following suggestion is acceptable:
    - There issue is related to the conclusion of Issue 5-5, if it is agreed to enhance the EUTRA-NR inter-RAT measurement requirements, cell identification requirements on EUTRA-NR inter-RAT measurement in connected mode for non-DRX case follow R16 HST NR requirements

**Issue 5-8: Cell identification requirements on EUTRA-NR inter-RAT measurement in connected mode for DRX case**

* Proposals
  + Option 1 (CMCC):
    - For the case of DRX cycle < 320ms, it is proposed to reuse Rel-15 cell identification requirements. And all the candidate SMTC period can be considered.
    - For the case of DRX cycle >= 320ms, it is proposed to reduce the number of samples for measurement and PSS/SSS detection. And the applied SMTC periodicity can be further discussed.
  + Option 2 (HW, vivo): EUTRA-NR inter-RAT measurement (before ENDC) follows the R16 HST NR measurement requirements
  + Option 3 (Ericsson):
    - Time period for PSS/SSS detection is max( 600ms, ceil( 5 x Kp) x max(MRGP,SMTC period, DRX period ))
    - Time period for time index detection is max(120ms, ceil( 3 x Kp ) x max(MGRP,SMTC period, DRX period))
    - Measurement period is max(200ms, ceil( 3 x Kp) x max(MGRP,SMTC period))
* Recommended WF
  + Although the detail proposal is different from companies, the baseline among the companies are the same, which is following the R16 HST NR measurement requirements
  + Moderator would like to suggest companies to check whether following suggestion is acceptable:
    - There issue is related to the conclusion of Issue 5-5, if it is agreed to enhance the EUTRA-NR inter-RAT measurement requirements, cell identification requirements on EUTRA-NR inter-RAT measurement in connected mode for DRX case follow R16 HST NR requirements

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | **Issue 5-1: Whether to enhance the NR- EUTRA inter-RAT measurement (SA) to support HST**  Suggested WF is good for us.  **Issue 5-2: Cell re-selection requirements on NR- EUTRA inter-RAT measurement in idle mode**  As we explained in our paper, high speed train is a long-distance transportation system, inter-RAT handover most likely happens when train enters different regions, and this event to happen much less frequent than intra-frequency neighboring cell handover. Also note that inter-RAT measurement consumes more power than intra-frequency measurement. Therefore, we don’t agree with reusing intra-frequency requirement, but compromise can be made as long as UE power consumption and system performance trade-off is considered.  **Issue 5-3: Cell identification requirements on NR- EUTRA inter-RAT measurement in connected mode for non-DRX case**  Suggested WF is good for us.  **Issue 5-4: Cell identification requirements on NR- EUTRA inter-RAT measurement in connected mode for DRX case**  We have the following observations:   1. As explained in 5-2, inter-RAT measurement should be slower than intra-frequency measurement. 2. Below 0.32s DRx cycle, QC and Vivo are aligned. 3. Between 0.32 and 1.28, CMCC and vivo proposals are close.   Based on the observations, we propose a compromised proposal in the table pasted below.  **Issue 5-5: Whether to enhance the EUTRA-NR inter-RAT measurement (before EN-DC) to support HST**  We can compromise to accept enhancement, but we suggest to take our argument into consideration when discussing the enhancement:   1. In idle mode, UE is not transmitting, discover NR cell faster before EN-DC doesn’t provide significant performance improvement. Connection is still maintained by LTE. 2. Inter-RAT handover is less frequent than intra-frequency handover   **Issue 5-6: Cell re-selection requirements on EUTRA-NR inter-RAT in idle mode**  We suggest to discuss possible options between non-HST inter-RAT requirement and HST intra-frequency measurement requirement.  **Issue 5-7: Cell identification requirements on EUTRA-NR inter-RAT measurement in connected mode for non-DRX case**  **Issue 5-8: Cell identification requirements on EUTRA-NR inter-RAT measurement in connected mode for DRX case**  For issue 5-7 and 5-8, as we explained in issue 5-5, inter-RAT should be slower than intra-frequency measurement. We can compromise to enhance the inter-RAT measurement, but hope that we can find compromised requirement between no enhancement and intra-frequency HST requirement. |
| Huawei, HiSilicon | **Issue 5-1: Whether to enhance the NR- EUTRA inter-RAT measurement (SA) to support HST**  Agree with moderator’s suggestion  **Issue 5-2: Cell re-selection requirements on NR- EUTRA inter-RAT measurement in idle mode**  It is straight forward to support Option 1.  **Issue 5-3: Cell identification requirements on NR- EUTRA inter-RAT measurement in connected mode for non-DRX case**  Agree with moderator’s suggestion.  **Issue 5-4: Cell identification requirements on NR- EUTRA inter-RAT measurement in connected mode for DRX case**  Since the inter-RAT measurement shall share gap with NR measurement, the CSSF shall be considered. If the issue 5-3 is agreeable for non-DRX case, it is straight forward to agree that no enhancement for DRX case, so option 2 is more preferred ( there is typo in option2’s table, i.e, K shall be CSSF).  **Issue 5-5: Whether to enhance the EUTRA-NR inter-RAT measurement (before EN-DC) to support HST**  Agree with moderator’s suggestion. |
| vivo | **Issue 5-1:**  **Support moderator’s WF.**  **Issue 5-3:**  **Support moderator’s WF.**  **Issue 5-4:**  **Support QC’s compromised proposal.**  **Issue 5-5:**  **Support moderator’s WF.**  **Issue 5-7 and 5-8:**  **To clarify, our intention is to follow R16 NR HST methodology, but not to reuse the requirement directly.**  **Since for non-HST the measurement period requirement of an inter-RAT NR carrier in LTE is same as that of inter-frequency requirement in NR, our proposal is follow the same enhancement methodology, but the baseline should be inter-frequency requirement.**  **For example, if measurement sample is reduce from 5 to 3 for some DRX cycle and SMTC period configuration, according to intra-frequency measurement discussion, the same enhancement can be done based on the following table, e.g. the number of samples for measurement can be enhanced from 8 to 6.**   |  |  | | --- | --- | | **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** | | No DRX | Max(200ms, 8 × Max(MGRP, SMTC period)) × CSSFinter | | DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter | | DRX cycle > 320ms | 8 × DRX cycle × CSSFinter | | NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | | |
| Ericsson | Issue 5-1: We support the moderator proposal  Issue 5-2: We support the moderator proposal  Issue 5-3 : We can agree to the moderator proposal  Issue 5-4 : We have a preference for option 1, and we expect that DRX cycles of 160ms or 320ms are the most important to consider, since NR intrafrequency performance will become the limiting factor with larger DRX.  Issue 5-5 : We support the moderator proposal.  Issue 5-6 : The moderator suggestion to follow the outcome from issue 5-5 and the outcome of the discussion on NR-NR HST reselections seems a good oneIssue 5-7: Again we agree with the proposed approach, we should resolve NR HS requirements for non DRX then reuse the outcome in E-UTRA -> NR requirements  Issue 5-8: Again we agree with the proposed approach, we should resolve NR HS requirements for DRX then reuse the outcome in E-UTRA -> NR requirements |
| Nokia | Issue 5-1: We support the recommended WF.  Issue 5-2: Based on pure calculations it should be feasible to use Option 1. However, for Option 2 the UE would have moved about 1000m during the cell detection time of 7.68 seconds. Then additionally comes a round of measurements of 1.28 seconds leading to a total delay of 8.96 second. And with inter-site distance of 1000m assumed option 2 does seems to bring too long latencies. Based on this we support the recommended WF and NR to EUTRA inter-RAT measurements requirements follows the R16 EUTRA HST measurement requirements.  Issue 5-3: Again, looking at the numbers it seems that GP#0 is the most suitable GP in order to enable timely mobility. However, this is a network configuration issue and nothing would need to be captured as a requirement in RAN4.  Issue 5-4: Agree with recommended WF.  Issue 5-5: we would likely need to consider the overall system delay in connected mode.  Issue 5-6: Agree that RAN4 should follow the R16 HST NR measurement requirements. However, we have concerns related to the scaling factors.  Issue 5-7: Same as for issue 5-5, RAN4 should consider the overall system delay and consider whether the existing requirements are sufficient or whether R16 HST NE measurement requirements would need to be applied.  Issue 5-8: Same as for issue 5-7. |

|  |  |  |
| --- | --- | --- |
| **QC compromised proposal for NR- EUTRA inter-RAT measurement in connected mode for DRX case** | | |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN TDD (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.16<DRx cycle<=0.32 | Note1 (15) | Note1 (15) |
| 0.32< DRx cycle <= 0.64 | Note1 (10) | Note1 (10) |
| 0.64 < DRx cycle <= 1.28 | Note1 (8) | Note1 (8) |
| 1.28< DRX-cycle ≤10.24 | Note1 (20) | Note1 (20) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: The requirement only applicable to CSSFinterRAT = 1 case | | |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2001392**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001392.zip) |  |
|  |  |
|  |  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |