**3GPP TSG RAN WG1 #115 R1-23nnnnn**

**Chicago, USA, November 13th – November 17th, 2023**

**Source: Ad-Hoc Chair (AT&T)**

**Title: Session Notes of AI 8.16.7**

**Agenda Item:** **8.16.7**

**Document for:** **Endorsement**

### 8.16.7 UE features for NR mobility enhancements

**Agreement:**

* **Include in the LS to RAN4 that RAN1 kindly asks RAN4 to discuss the following UE capabilities** 
  + **Maximum number of measured candidate cells for all periodic reports, activated semi-persistent reports, and triggered aperiodic reports at a given time**
  + **For RTD <= CP**
    - **The max number of SSB resources configured to measure L1-RSRP within a slot across candidate cells**
    - **The max number of SSB resources configured for L1-RSRP across all the candidate cells**
  + **RTD > CP**
    - **The max number of SSB resources configured to measure L1-RSRP within a slot across candidate cells**
    - **The max number of SSB resources configured for L1-RSRP across all the candidate cells**
* **Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 45. NR\_Mob\_enh2 | 45-1 | Intra-frequency L1 measurement and reports for L1-L2 Triggered Mobility (LTM) procedure~~[—processing capability]~~ | 1. Support of ~~[RTD > CP and RTD <= CP]~~ intra-frequency L1- RSRP measurement and reporting based on SSB(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra-frequency L1-RSRP measurement  ~~[3. Maximum number of measured candidate cells for all periodic reports, activated semi-persistent reports, and triggered aperiodic reports at a given time]~~  4. Support of up to L candidate cells and M beams in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  5. Maximum number of LTM CSI report configs  ~~[5. The max number of SSB resources configured to measure L1-RSRP within a slot with across all CC candidate cells and serving cell across all CC]~~ | 2-21 or 2-22 or 2-23 or 2-23a | Yes | No | UE does not support intra-frequency L1 measurement and reports for Rel-18 LTM operation | [Per band/BC] | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  ~~[Component 3 candidate values: {1,2,3,4,5,6,7, 8}]~~  Component 4 candidate values:  L: {1, 2,3,4}  M: {1, 2,3,4}  M × L: {1,2,3,4~~[~~,6,8,9,12, 16~~]~~}  Component 5 candidate values:  Aperiodic: [{0,1,2,3,4}]  Periodic: [{1,2,3,4}]  Semi-persistent: [{0,1,2,3,4}]  ~~[Component 5 candidate values: {1,2,~~ | Optional with capability signalling |

**Agreement:**

* **Include in the LS to RAN4 that RAN1 kindly asks RAN4 to discuss the following UE capabilities** 
  + **Maximum number of measured candidate cells for all periodic reports, activated semi-persistent reports, and triggered aperiodic reports at a given time**
  + **With gap**
    - **The max number of SSB resources configured to measure L1-RSRP within a slot across candidate cells for intra- and inter-frequency L1-RSRP measurement**
    - **The max number of SSB resources configured across all the candidate cells for intra- and inter-frequency L1-RSRP measurement**
  + **Without gap**
    - **The max number of SSB resources configured to measure L1-RSRP within a slot across candidate cells for intra- and inter-frequency L1-RSRP measurement**
    - **The max number of SSB resources configured across all the candidate cells for intra- and inter-frequency L1-RSRP measurement**
* **Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 45. NR\_Mob\_enh2 | 45-1a | Inter-frequency L1 measurement and reports for L1-L2 Triggered Mobility (LTM) procedure~~[—processing capability]~~ | 1. Support of inter- frequency L1- RSRP measurement ~~[with and/or without gap]~~ and reporting based on SSB(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra- and inter-frequency L1-RSRP measurement  ~~[3. Maximum number of measured candidate cells for all periodic reports, activated semi-persistent reports, and triggered aperiodic reports at a given time for intra- and inter-frequency L1-RSRP measurement]~~  4. Support of up to L candidate cells and M beams in one report where a SSBRI-RSRP pair is used for each beam report for intra- and inter-frequency L1-RSRP measurement  ~~[5. The max number of SSB resources configured to measure L1-RSRP within a slot with candidate cells and serving cells across all CC for intra- and inter-frequency L1-RSRP measurement~~  ~~6. The max number of SSB resources configured to measure L1-RSRP across all the candidate cells and serving cells for intra- and inter-frequency L1-RSRP measurement]~~ | 2-21 or 2-22 or 2-23 or 2-23a, 45-1 | Yes | No | UE does not support inter-frequency L1 measurement and reports for Rel-18 LTM operation | [Per band/BC] | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  ~~[Component 3 candidate values: {1,2,3,4,5,6,7,8}]~~  Component 4 candidate values:  L: {1,2,3,4}  M: {1,2,3,4}  M × L: {1,2,3, 4~~[~~,6,8,9,12,16~~]~~}  ~~Component 5 candidate values: {1,2,4,8,16}~~  ~~Component 86~~  ~~candidate values:~~  ~~{2,4,8,12,16,32,64}~~  ~~Note: The component 5/6 are also counted in component 1 and component 2 of FG16-1g/16-1g-1~~ | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-3 | ~~LTM~~ Beam indication with joint DL/UL LTM TCI states | 1. Support of unified TCI with joint DL/UL LTM TCI-state indication for LTM procedure  2. Maximum number of configured joint LTM TCI state(s) ~~[across/~~per~~]~~ candidate cell~~s~~ ~~[and serving cells]~~ ~~[in a band]~~  3. Support of indicating and activating a single joint LTM TCI state in a cell switch command.  ~~[~~4. Supported QCL source RS in the LTM TCI-state configuration ~~using SSB as QCL source RS~~ ~~for PDCCH and PDSCH reception]~~  ~~[5. Support LTM TCI-state configuration using SSB TRS as QCL source RS for PDCCH and PDSCH reception]~~  ~~[6 Support of joint DL/UL TCI state indication in cell switch command MAC-CE based cell switch operation]~~  5. Maximum number of configured joint LTM TCI state(s) across candidate cells | 23-1-1, RAN2 FG for LTM | Yes | No | UE does not support Beam indication with joint DL/UL LTM TCI states ~~Rel-18 LTM operation~~ | [Per band/BC] | No | No | n/a | Component 2 candidate values: ~~FFS~~ {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {SSB, TRS, both}  Component 5 candidate values: FFS  ~~FFS: how to count total number of joint TCI states~~ | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-4 | ~~LTM~~ Beam indication with separate DL/UL LTM TCI states | 1. Support of unified TCI with separate DL/UL TCI-state indication for LTM procedure  2. Maximum number of configured DL TCI state(s) ~~[across/~~per~~]~~ candidate cell~~s~~ ~~[and serving cells]~~ ~~[in a band]~~  3. Maximum number of configured UL TCI state(s) ~~[across/~~per~~]~~ candidate cell~~s~~ ~~[and serving cells]~~ ~~[in a band]~~  4. Support of indicating and activating a pair of UL/DL TCI-state in a cell switch command.  ~~[~~5. Supported QCL source RS in the LTM TCI-state configuration ~~using SSB as QCL source RS for PDCCH and PDSCH reception~~  ~~[5. Support TCI-state using TRS as QCL source RS for PDCCH and PDSCH reception]~~  ~~[6 Support of joint DL/UL TCI state indication in cell switch command MAC-CE based cell switch operation]~~  7. Maximum number of configured separate DL LTM TCI state(s) across candidate cells  8. Maximum number of configured separate UL LTM TCI state(s) across candidate cells | 23-10-1, RAN2 FG for LTM | Yes | No | UE does not support Rel-18 LTM operation with separate DL/UL TCI states | [Per band/BC] | No | No | n/a | Component 2 candidate values: ~~FFS~~ {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component ~~2~~3 candidate values: ~~FFS~~ {4, 8, 12, 16, 24, 32, 48, 64}  Component 5 candidate values: {SSB, TRS, both}  Component 7 candidate values: FFS  Component 8 candidate values: FFS | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-3a | MAC-CE activated joint LTM TCI states | 1. Supported QCL source RS for MAC-CE activated joint LTM TCI states  2~~1~~. Maximum number of MAC-CE activated joint LTM TCI states ~~[across/~~per~~]~~ candidate cell~~s~~ ~~[and serving cells]~~ ~~[in a band]~~  3. Maximum number of MAC-CE activated joint LTM TCI states across candidate cells and serving cells | 45-3 | Yes | No | UE does not support MAC-CE activated joint LTM TCI states | [Per band/BC] | No | No | n/a | Component 1 candidate values: {SSB, TRS, both}  Component ~~1~~2 candidate values ~~for K~~: ~~FFS~~ {1,2,3,4,…,15,16}  Component 3 candidate values: {1,2,3,4,8,16,32}  The maximum number of MAC-CE activated joint TCI states across all servings cells is limited by component [x] in FG 23-1-1 | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-4a | MAC-CE activated DL/UL LTM TCI states | 1. Supported QCL source RS for MAC-CE activated DL/UL LTM TCI states  2~~1~~. Maximum number K1 of MAC-CE activated DL TCI states ~~[across/~~per~~]~~ candidate cell~~s~~ ~~[and serving cells]~~ ~~[in a band]~~ ~~before cell-switch command~~  3~~2~~. Maximum number K2 of MAC-CE activated UL TCI states ~~[across/~~per~~]~~ candidate cell~~s~~ ~~[and serving cells]~~ ~~[in a band]~~ ~~before cell-switch command~~  4. Maximum number of MAC-CE activated DL TCI states across all candidate cells and serving cells  5. Maximum number of MAC-CE activated UL TCI states across all candidate cells and serving cells | 45-4 | Yes | No | UE does not support MAC-CE activated DL/UL TCI states | [Per band/BC] | No | No | n/a | Component 1 candidate values: {SSB, TRS, both}  Component 2~~1~~ candidate values: ~~FFS~~ {1, 2,3,4,5,6,7,8}  Component 3~~2~~ candidate values: ~~FFS~~ {1, 2,3,4,5,6,7,8}  Component 4 candidate values: {1,2,4,8,16}  Component 5 candidate values: {1,2,4,8,16}  The maximum number of MAC-CE activated DL/UL TCI states across all servings cells is limited by component [x] in FG 23-10-1 | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition ~~of candidate cell(s)~~ based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE ~~[for serving and non-serving cell]~~  2. Power ramping for PRACH retransmission based on PDCCH order indication  ~~[~~3. Support of dropping the serving cell UL to handle~~ing~~ the overlap between UL transmission on serving cell(s) and PRACH on ~~intra- or inter-frequency~~ candidate cell(s)~~]~~ | FFS | Yes | No | ~~FFS~~ RACH-based early TA acquisition is not supported | ~~[~~Per band~~/BC]~~ | No | No | n/a | ~~[~~Component 1 candidate values: {1,2,3,4,5,6,7,8 ~~FFS~~}~~]~~ | Optional with capability signalling |
| 45. NR\_Mob\_enh2 | 45-5a | RACH-based early TA acquisition with simultaneous transmission | Support of simultaneous transmission to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | FFS | Yes | No | Support of RACH-based early TA acquisition with simultaneous transmission is not supported | [Per band] | No | No | n/a |  | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-6 | UE-based TA measurement | 1. Support of UE-based TA measurement  2. Maximum number of candidate cells that the UE maintains the TA for |  | Yes | No | UE-based TA measurement is not supported | ~~[~~Per band~~/BC]~~ | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 45. NR\_Mob\_enh2 | 45-7 | TA indication in cell switch command ~~with and~~ ~~without RACH~~ | Support of TA indication in cell switch command ~~with and without RACH~~ |  | Yes | No | TA indication in cell switch command ~~with and without RACH~~ is not supported | ~~[~~Per band~~/BC]~~ | No | No | n/a |  | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-1 | Intra-frequency L1 measurement and reports for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of intra-frequency L1- RSRP measurement and reporting based on SSB(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra-frequency L1-RSRP measurement  4. Support of up to L candidate cells and M beams in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  5. Maximum number of LTM CSI report configs | 2-21 or 2-22 or 2-23 or 2-23a | Yes | No | UE does not support intra-frequency L1 measurement and reports for Rel-18 LTM operation | [Per band/BC] | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 4 candidate values:  L: {1, 2,3,4}  M: {1, 2,3,4}  M × L: {1,2,3,4, 6, 8, 9, 12, 16}  Component 5 candidate values:  Aperiodic: ~~[~~{0,1,2,3,4}~~]~~  Periodic: ~~[~~{1,2,3,4}~~]~~  Semi-persistent: ~~[~~{0,1,2,3,4}~~]~~ | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-3 | Beam indication with joint DL/UL LTM TCI states | 1. Support of unified TCI with joint DL/UL LTM TCI-state indication for LTM procedure.  2. Maximum number of configured joint LTM TCI state(s) per candidate cell  3. Support of indicating and activating a single joint LTM TCI state in a cell switch command.  4. Supported QCL source RS in the LTM TCI-stateconfiguration  5. Maximum number of configured joint LTM TCI state(s) across candidate cells | 23-1-1, RAN2 FG for LTM | Yes | No | UE does not support Beam indication with joint DL/UL LTM TCI states | [Per band/BC] | No | No | n/a | Component 2 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {SSB, TRS, both}  Component 5 candidate values: {8, 16, 24, 32, …, 1024} ~~FFS~~ | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-4 | Beam indication with separate DL/UL LTM TCI states | 1. Support of unified TCI with separate DL/UL TCI-state indication for LTM procedure.  2. Maximum number of configured DL TCI state(s) per candidate cell  3. Maximum number of configured UL TCI state(s) per candidate cell  4. Support of indicating and activating a pair of UL/DL TCI-state in a cell switch command.  5. Supported QCL source RS in the LTM TCI-state configuration  7. Maximum number of configured separate DL LTM TCI state(s) across candidate cells  8. Maximum number of configured separate UL LTM TCI state(s) across candidate cells | 23-10-1, RAN2 FG for LTM | Yes | No | UE does not support Rel-18 LTM operation with separate DL/UL TCI states | [Per band/BC] | No | No | n/a | Component 2 candidate values: {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate values: {4, 8, 12, 16, 24, 32, 48, 64}  Component 5 candidate values: {SSB, TRS, both}  Component 7 candidate values: {8, 16, 24, 32, …, 1024} ~~FFS~~  Component 8 candidate values: FFS | Optional with capability signalling |

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| 45. NR\_Mob\_enh2 | 45-4 | Beam indication with separate DL/UL LTM TCI states | 1. Support of unified TCI with separate DL/UL TCI-state indication for LTM procedure.  2. Maximum number of configured DL TCI state(s) per candidate cell  3. Maximum number of configured UL TCI state(s) per candidate cell  4. Support of indicating and activating a pair of UL/DL TCI-state in a cell switch command.  5. Supported QCL source RS in the LTM TCI-state configuration  7. Maximum number of configured separate DL LTM TCI state(s) across candidate cells  8. Maximum number of configured separate UL LTM TCI state(s) across candidate cells  9. Maximum number of configured cells for separate DL/UL LTM TCI states | 23-10-1, RAN2 FG for LTM | Yes | No | UE does not support Rel-18 LTM operation with separate DL/UL TCI states | [Per band/BC] | No | No | n/a | Component 2 candidate values: {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate values: {4, 8, 12, 16, 24, 32, 48, 64}  Component 5 candidate values: {SSB, TRS, both}  Component 7 candidate values: {8, 16, 24, 32, …, 1024}  Component 8 candidate values: {4, 8, 12, 16, …, 512} ~~FFS~~  Component 9 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling |
| 45. NR\_Mob\_enh2 | 45-3 | Beam indication with joint DL/UL LTM TCI states | 1. Support of unified TCI with joint DL/UL LTM TCI-state indication for LTM procedure.  2. Maximum number of configured joint LTM TCI state(s) per candidate cell  3. Support of indicating and activating a single joint LTM TCI state in a cell switch command.  4. Supported QCL source RS in the LTM TCI-stateconfiguration  5. Maximum number of configured joint LTM TCI state(s) across candidate cells  6. Maximum number of configured cells for joint LTM TCI states | 23-1-1, RAN2 FG for LTM | Yes | No | UE does not support Beam indication with joint DL/UL LTM TCI states | [Per band/BC] | No | No | n/a | Component 2 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {SSB, TRS, both}  Component 5 candidate values: {8, 16, 24, 32, …, 1024}  Component 6 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling |

R1-2310850 UE features on R18 Mobility Enhancement Huawei, HiSilicon

R1-2310895 On UE features for NR mobility enhancements Nokia, Nokia Shanghai Bell

R1-2310957 Discussion on UE features for NR mobility enhancements ZTE

R1-2311033 UE-features for NR mobility enhancements Ericsson

R1-2311123 Discussion on UE features for L1/L2-triggered Mobility vivo

R1-2311188 Discussion on UE features for mobility Spreadtrum Communications

R1-2311232 Discussion on UE features for NR mobility enhancements OPPO

R1-2311504 Discussion on the UE features for NR Mobility CMCC

R1-2311648 Discussion on UE features for NR mobility enhancements NTT DOCOMO, INC.

R1-2311712 UE features for NR mobility enhancements Apple

R1-2311873 UE features for mobility Samsung

R1-2311985 Views on UE features for NR mobility enhancements MediaTek Inc.

R1-2312067 UE features for NR mobility enhancements Qualcomm Incorporated

R1-2312084 Summary of UE features for NR mobility enhancements Moderator (AT&T)