**3GPP TSG-RAN WG2 Meeting #123 *R2-23XXX***

**Toulouse, France, August 21 – 25, 2023**

Agenda Item: 7.4.2.3

Source: Huawei, HiSilicon

**Title:** **Summary of [Post122][058][Mob18] Contents of Cell Switch MAC CE**

Document for: Discussion and Decision

# Introduction

* [Post122][058][Mob18] Contents of Cell Switch MAC CE (Huawei)

Scope: Starting from proposals to R2 122 viewed in the light of agreements taken so far. Determine potentially agreeable points and points for discussion at R2 123 (open points)

Intended Outcome: Report

Deadline: Long

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**Related proposals @RAN2#122 meeting**

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| **Tdoc** | **Proposal** |
| [R2-2304688](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2304688%20Discussions%20on%20cell%20switch.docx) CATT | Proposal 1: The LTM triggering MAC CE can include the following information,   * TCI state indication information; * TA information for target cell; * Value of LTM supervisor timer; * Preamble index for intra-DU CFRA-based LTM, FFS for inter-DU.   Proposal 2: The BWP indication information is not included in the LTM triggering MAC CE.  Proposal 3: Do not support SCell activation/deactivation via the LTM triggering MAC CE. |
| [R2-2304720](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2304720_Remaining%20issues%20for%20Cell%20Switching.doc) Samsung Electronics Co., Ltd | Proposal 1: RAN2 to discuss and agree on one of the following options  Option 1: BWP IDs of BWPs to activate upon receiving cell change command are always signaled in MAC CE used for cell change.  Option 2: For LTM, the fields’ firstActiveUplinkBWP and firstActiveDownlinkBWP are signaled in L1/L2 inter-cell mobility candidate (target) configuration. If BWP IDs of BWPs to activate are not included in MAC CE used for cell change, UE activates and uses BWPs indicated by these fields upon receiving cell change command.  Proposal 7: RAN2 to discuss and agree on one of the following for RA resources for RA upon cell switch command   * Approach 1: UE is configured with CFRA resources (list of one or more [preamble index/PO index/SSB index]) in candidate cell configuration in same manner as configured during the legacy handover/reconfiguration with sync i.e. by signaling rach-ConfigDedicated in candidate cell configuration. Common RACH configuration/parameters from RACH-ConfigCommon/ RACH-ConfigCommonTwoStepRA of BWP selected are used during RA procedure.   + Principles of RA type selection, carrier selection as in legacy handover/reconfiguration with sync are applied. * Approach 2: UE is configured with CFRA resources (list of one or more [preamble index/PO index/SSB index]) in cell switch command. Common RACH configuration/parameters from RACH-ConfigCommon/ RACH-ConfigCommonTwoStepRA of BWP selected are used during RA procedure. The advantage of this is that UE can be configured with CFRA resources for SSB (s) based on latest measurement results. * Approach 3: UE is not configured with CFRA resources. Common RACH configuration/parameters from RACH-ConfigCommon/ RACH-ConfigCommonTwoStepRA of BWP selected are used during RA procedure.   Proposal 8: Value indicating that the UE shall apply the TA of one source cell is not signalled in cell switch command. |
| [R2-2304889](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2304889%20Open%20Issues%20for%20LTM%20Procedure.docx) MediaTek Inc. | Proposal 2: In RACH-less LTM, network should provide UL grant for the first UL message in target cell. RAN2 to discuss the method, e.g.,   * Configured grant in candidate RRC configuration, or * UL grant field in LTM command MAC CE. |
| [R2-2304891](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2304891%20Triggering%20MAC%20CE%20for%20LTM.docx) MediaTek Inc. | Proposal 1: The LTM command MAC CE should include at least the following fields:   * + Candidate configuration identity: [2] bits   + TCI state ID(s): [7] bits for joint/DL TCI state, [6] bits for UL TCI state   + Joint or separate TCI state indication: 1 bit   + DL/UL indication: 1 bit   + TA value: [12] bits   + BWP IDs: 2 bits for DL BWP and 2 bits for UL BWP   Proposal 2: Wait for RAN1 decision on the following fields in LTM command MAC CE:   * Triggering of aperiodic TRS transmitted from the target cell * Triggering the CSI acquisition of the target cell and reporting to the target cell * Triggering of aperiodic SRS transmission to the target cell * Additional TCI state activation   Proposal 3: RAN2 to decide the following fields in the LTM command MAC CE, after agreements on related discussions:   * Serving cell index * SCell activation/deactivation * CFRA resources availability * UL grant for the first message * C-RNTI |
| [R2-2304909](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2304909_Remaining%20issues%20on%20LTM%20procedures.docx) vivo | Proposal 6: A CFRA resource indication can be introduced in LTM cell switch command. Only when the indication indicates CFRA resource is available, UE applies the CFRA resource configured in the candidate cell configuration to access the target cell during LTM.  Proposal 7: Dedicated RACH resource can be included in LTM cell switch command. If LTM cell switch command indicates RACH resource (shared by multiple UE in S-DU, S-DU ensures no collision occurs), UE applies the RACH resource to access the target cell.  Proposal 8: For RACH-less LTM, a candidate cell can provide a UL resource poor to source DU. And source DU can dynamically allocate the UL resource of the pool to UE in LTM cell switch command. UE can use the indicated UL resource to send the first UL PDU in the target cell. |
| [R2-2304911](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2304911_RRC%20configuration%20for%20LTM.docx) vivo | Proposal 12: UE determines the BWPs (for DL and UL) to be activated upon the execution of LTM based on the firstActivateDownlinkBWP-Id and firstActivateUplinkBWP-Id within the configuration of target cell(s).  Proposal 13: Upon the reception of LTM cell switch command, UE performs target SCell activation/deactivation based on the indication (i.e. sCellState field) within the pre-configured RRC configuration of target SCells. |
| [R2-2304953](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2304953%20cell%20switch_v1.docx) Fujitsu | Proposal 1: At least the following information can be included in the LTM cell switch command MAC CE:   * Information to identify the target cell(s), FFS for the details, e.g. a set ID, a candidate configuration index and the indication of SpCell * TA related information * Unified TCI state index for the target cell, depending on RAN1 * Active DL and UL BWPs for the target cell, if it is different from the first active BWP signaled by RRC configuration   Proposal 2: In addition to existing SCell activation/deactivation mechanisms, the SCell activation/ deactivation state can be included in the LTM cell switch command MAC CE for intra-DU case so that the SCell activation/deactivation will be performed simultaneously with SpCell change.  Proposal 4: RAN2 to discuss how to handle the activated SCells which are unchanged after the LTM cell switch. |
| [R2-2305167](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305167%20NR%20MOB%20MAC%20CE.docx) Interdigital, Inc. | Proposal 1: The content of the cell switch MAC CE at least consists of:   1. Candidate configuration ID (already agreed) 2. TA related information (agreed by RAN1) 3. 1 joint or 1 pair of UL and DL unified TCI State index for the target Cell (agreed by RAN1) 4. Active DL and UL BWPs for the target cell (agreed by RAN1) 5. FFS RAN1: Triggering of aperiodic TRS transmitted from the target cell 6. FFS RAN1: Triggering the CSI acquisition of the target cell and reporting to the target cell 7. FFS RAN1: Triggering of aperiodic SRS transmission to the target cell 8. FFS RAN1: C-RNTI   FFS: the presence of each field (i.e. always present or configurable)  Proposal 2: By default the initial SCell state on the target cell after LTM cell switch is based on RRC configuration sCellState. At least for the intra-DU case, NW may indicate a new SpCell candidate configuration index and perform SCell activation/deactivation simultaneously using MAC CE.  Proposal 3: BWP can be indicated in the RRC configuration of candidate cells, MAC CE indication in cell switch command is optional.  Proposal 4: RAN2 to discuss whether the cell switch MAC CE may contain an indication of RACH resource and/or UL grant for the target cell. |
| [R2-2305295](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305295%20-%20Discussion%20on%20MAC%20CE%20content%20and%20partial%20MAC%20reset%20for%20LTM.docx) OPPO | [Proposal 1 LTM cell switch MAC CE can indicate TCI state info, i.e., 1 joint or 1 pair of UL and DL unified TCI State index for the target cell.](#_Toc134795825)  [Proposal 2 LTM cell switch MAC CE can contain TA info, if any.](#_Toc134795826)  [Proposal 3 SCell activation/deactivation indication is not contained in LTM cell switch MAC CE.](#_Toc134795827)  [Proposal 4 BWP information is not contained in LTM cell switch MAC CE.](#_Toc134795828)  [Proposal 5 CFRA resource is not contained in LTM cell switch MAC CE.](#_Toc134795829) |
| [R2-2305541](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305541%20LTM%20command%20MAC%20CE%20content%20and%20RAN3%20LS%20reply.docx) Huawei, HiSilicon, CATT, ZTE Corporation, Sanechips, vivo, China Unicom | Proposal 1: To support SCell activation simultaneously with LTM execution, the network (target cell) can set the “sCellState-r16” in the candidate configuration by RRC as supported currently, i.e. no need to include the SCell activation/deactivation in LTM MAC CE.  Proposal 2: In inter-DU LTM, RAN2 excludes to include the active BWP ID in the LTM MAC CE. (FFS for intra-DU LTM) |
| [R2-2305576](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305576%20Contents%20of%20cell%20switch%20MAC%20CE.docx) Xiaomi | Proposal 1: The initial SCell state can be indicated by sCellState-r16 or the cell switch MAC CE.  Proposal 2: The dedicated PRACH resource can be indicated by the cell switch MAC CE. |
| [R2-2305641](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305641) CMCC | Proposal 1: RAN2 to confirm that TCI state is supported in an MAC CE carrying LTM switch command.  Proposal 2: RAN2 to confirm that TA value is supported in an MAC CE carrying LTM switch command.  Proposal 3: RAN2 to confirm that L2 reset indication is not included in an MAC CE carrying LTM switch command.  Proposal 4: RAN2 to confirm that CFRA resource are not included in the MAC CE carrying LTM switch command.  Proposal 5: RAN2 to confirm that CFRA indication (i.e., valid or invalid) is included in the MAC CE carrying LTM switch command. |
| [R2-2305649](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305649%20Cell%20switch.docx) NEC | Proposal 3: If RAN2 can agree that the network can send the SCell Activation/Deactivation MAC CE with the LTM cell switch command MAC CE, it is up to network whether to activate/deactivate SCell(s) at LTM cell switch for intra-DU LTM. |
| [R2-2305908](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305908%20_Discussion%20On%20RRC%20Reconfiguration%20Aspects.docx) Nokia, Nokia Shanghai Bell | Proposal 3: BWP to be used upon the LTM execution is either indicated directly within the candidate cell configuration for L1/L2 inter-cell mobility using RRC Configuration message or indicated in the LTM triggering using MAC CE.  Proposal 4: If Option 2 is followed, the notification from the source to the target about the BWP used before the LTM is FFS. |
| [R2-2305909](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2305909_On%20the%20cell%20switch%20in%20LTMmand.docx) Nokia, Nokia Shanghai Bell | For deciding the cell index three options exist:   1. Source DU determines the cell index: In this option, the Source DU associates the PCI of the prepared target cell with the cell index, and it provides the association between the cell index and PCI to CU which in turn send it to the UE (and the other DUs, in case of Dynamic Switching). 2. CU determines the cell index: In this option the CU associates the PCI of the prepared target cell with the cell index, and it provides the association between the cell index and PCI to Source DU (and the other DUs, in case of Dynamic Switching) and to the UE 3. UE uses the ID of the target cell configuration (i.e., RRC configuration for L1/2 mobility) as cell index: In this option the CU informs the (source) DU about the ID of the target cell configuration.   Proposal 7: RAN2 to decide which of the options 1, 2, and 3 should be followed for indicating the target cell index in the LTM MAC CE. |
| [R2-2306010](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2306010-%20Discussion%20on%20RRC%20aspects%20for%20LTM.docx) Ericsson | [Proposal 7 The BWP to be used by the UE upon the execution of the LTM cell switch procedure can be indicated directly within the LTM candidate cell configuration.](#_Toc134736810)  [Proposal 8 If UL/DL BWP IDs are included in the LTM cell switch command and are also present within the LTM candidate cell configuration, the UE shall consider as valid the one received in the LTM cell switch command (and ignore the ones in the LTM candidate cell configuration).](#_Toc134736811) |
| [R2-2306013](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2306013-%20LTM%20cell%20switch%20command%20and%20UE%20actions.docx) Ericsson | [Proposal 3 The BWP information in the LTM cell switch command MAC CE is indicated using BWP-ID referring to one of the configured BWPs within the LTM candidate cell configuration.](#_Toc134739287)  [Proposal 4 The BWP information in the LTM cell switch command MAC CE contains the BWP-ID the UE shall apply as firstActiveDownlinkBWP and firstActiveUplinkBWP.](#_Toc134739288)  [Proposal 5 As in legacy, the same BWP-ID is applied for both firstActiveDownlinkBWP and firstActiveUplinkBWP.](#_Toc134739289)  [Proposal 6 The TCI-state information in the LTM cell switch command MAC CE refers to a TCI-state configured within the LTM candidate cell configuration.](#_Toc134739290)  [Proposal 7 The initial state of an SCell upon an LTM cell switch is part of the LTM candidate cell configuration.](#_Toc134739291)  [Proposal 8 Existing MAC CEs for SCell activation/deactivation are supported to change the state of an SCell upon the execution of an LTM cell switch (the MAC CE for SCell activation/deactivation is sent after the LTM cell switch MAC CE).](#_Toc134739292) |
| [R2-2306479](file:///D:/Tdoc%20review/RAN2%23122/word/R2-2306479%20Discussion%20on%20LTM) China Unicom | Proposal 2: Candidate SCell activation/deactivation information can be included in RRCReconfiguration message at the LTM preparation phase. Candidate SCell activation/deactivation can be optionally included in LTM MAC CE for intra-DU case. |
| R2-2304883 Futurewei | Proposal 3: Consider using the cell switch command MAC CE to carry the target TA or the source TA adjustment with indication in the MAC CE showing which type of TA is carried. |

**Issue collection for [Post122][058]**

Following information is to be discussed in the long email [Post122][058][Mob18] Contents of Cell Switch MAC CE, on whether it can be included in the cell switch MAC CE (also about its format).

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| **Information** | | **Clarification** | |
| TA related information | TA value | It can be included. | The discussion point may be on the format design in MAC CE.  (pending on running CR discussion) |
| TA as zero | The need is confirmed by RAN1, and details on the format is up to RAN2.  *”From RAN 1 perspective, without performing PDCCH-ordered RACH for candidate cell(s), RACH-less mechanism can be supported by indicating TA value of target cell as TA=0 or keeping the same value as source cell in cell switch command.*” |
| TA same as source TAG/cell |
| UE-based TA measurement | We may need to postpone the discussion, until RAN4 confirms the feasibility and RAN1 concludes on the detailed solution. |
| Beam indication/TCI state ID | | It can be included. |
| Active BWP ID | | RAN2 to discuss the need of active BWP ID in LTM cell switch MAC CE, in addtion to the legacy *firstActiveUplinkBWP* and *firstActiveDownlinkBWP* in RRC configuration.  Also to clarify the applicable scenario:   * intra-DU or inter-DU; * RACH-less or RACH-based cell switch; | |
| SCell activation/deactivation indication | | RAN2 to discuss the need of SCell activation/deactivation in LTM cell switch MAC CE, in addtion to the legacy “*sCellState-r16*” in RRC configuration.  Also to clarify the applicable scenario: intra-DU or inter-DU. | |
| CFRA resource | CF CFRA preamble index | Motivation is to reduce the RACH resource reservation.  Source cell can select the CFRA resource among the RACH resource shared by mulitple served UEs, by indicating the dedicated preable in LTM cell switch MAC CE.  Also, it may indicate whether the CFRA resource in candidate configuration is available/valid or not (e.g. if the pre-configured RA resource is release/reallocated by target cell).  Also to clarify the applicable scenario: intra-DU or inter-DU. | |
| CFRA resources availability/validity indication |
| UL grant (to be used by target cell) | | This is considered as the optimizaiton to the CG configured in RRC, which is related to the FFS in RAN2 agreement: ”*Configured grant can be used for RACH-less LTM, for the first UL data transmission to the target cell, the UE selects the configured grant occasion, which is associated with the beam indicated in the LTM MAC CE (as set by source cell). FFS further optimization*”  Is it dynamic grant like the UL grant in RAR? Is it still type1 like configured grant? Is it a index of some shared CG pool? | |
| C-RNTI (to be used by target cell) | | RAN2 to discuss the need of C-RNTI in LTM cell switch MAC CE, in addition to the legacy *newUE-Identity* in *ReconfigurationWithSync* in RRC configuration.  See the RAN1#113 meeting agreement  ”*Whether C-RNTI that is to be used by target cell needs to be included within the MAC-CE containing cell switch command will be left to RAN2 decision.*” | |
| Value of LTM supervisor timer | | This is related to whether LTM reuses the same timer for both RACH-less and RACH-based cell switch.  Even if the RACH-less specific timer is agreed, it is still the baseline to consider using RRC to configure the timer value. | |

**Question A: Do you see the need of any other information to be included in the LTM cell switch MAC CE?**

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| **Companies** | **Other more content to be discussed** | **Motivation/Clarification** |
| Futurewei | Indication of TA type and usage | In last RAN1 meeting, the following agreements have been reached:  “*From RAN 1 perspective, UE-based TA measurement (UE derives TA based on Rx timing difference between current serving cell and candidate cell as well as TA value for the current serving cell) is supported.”*  “*From RAN 1 perspective, without performing PDCCH-ordered RACH for candidate cell(s), RACH-less mechanism can be supported by indicating TA value of target cell as TA=0 or keeping the same value as source cell in cell switch command.”*  RAN2 needs to support the above RAN1 agreements and ensure the accuracy of the current serving cell TA used for the case that the target cell TA is the same as current serving cell TA, or the case that target TA is derived from current serving cell TA and the RSTD of the serving and target cells. A 2-bit field can be added to indicate the following four cases of TA type and usage of the content of the TA field, e.g.:  00: The TA field contains the TA of the target cell. When the TA  field is set to ‘0’, it is the case of target cell TA=0.  01: The TA field contains the most recent dynamic change over the  TA of current serving cell, and the target cell TA = source cell  TA.  10: The TA field contains the most recent dynamic change over the  TA of current serving cell, and the target cell TA is derived  based on the current source cell TA and RSTD of the source and  target cells.  11: The TA field is absent and the UE needs to perform random  access to the target cell. |
| Fujitsu | UL carrier | In case of RACH-based LTM, for example, this field is used to indicate the UL carrier to perform RACH procedure. In case of RACH-less LTM, this field is used to indicate the UL carrier for CGs to transmit the first UL data. |
| Nokia, Nokia Shanghai Bell | See comments | * In our view, the discussion on the TA should focus on its value. We think that it is fine to give the TA value in the MAC CE. Then, the special cases of the TA being zero or the same as that of the source TAG/cell, could be included in the RRC Reconfiguration message. Regarding the fourth option, could you please clarify what the intention is. In our view, there might not be time at cell switch for the UE to compute the TA value itself. |
| Vodafone | See comments | UE-based TA measurement: this option is pending the investigation in RAN4 and RAN1. In any case, the time taken by the UE in computing TA measurement should be taken into account as the MAC CE based cell switch is to support fast cell switch with much delay. |
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Some outstanding open issues in the Editor’s Notes of MAC running CR are also to be discussed in the long email [Post122][058][Mob18] Contents of Cell Switch MAC CE:

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| **Open issue** | **Description/clarification** |
| #1 | For LTM completion, how UE to determine the successful reception of its first UL data by the network (left over issue which may need a new MAC CE in MAC):  -Option 1: RLC ACK of RRCReconfigurationComplete message  -Option 2: C-RNTI addressed PDCCH  -Option 3: UE Contention Resolution identify MAC CE |
| #2 | The fields size in MAC CEs:   * “Target Configuration ID” field in the LTM Command MAC CE, i.e. the maximum number of candiate cells in RRC configured LTM * 8/16/? * Considering the MAC CE format to be OCT aligned; * The maximum number for CHO candidate is 8; * “Candidate Cell ID” field in the Candidate Cell TCI States Activation/Deactivation MAC CE, i.e. the maximum number of candiate cells in RRC configured TCI state * 4/8/? * Note the maximum number of reported cell in L1 measurement report is 4, as agreed by RAN1. * “Cell indicator” in PDCCH order for early RACH, i.e. the maximum number of candiate cells in RRC configured early RACH resource * 4/8/? * Note the maximum number of reported cell in L1 measurement report is 4 at one time, as agreed by RAN1. |
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**Question B: Do you see any other critical issue that can be discussed in this email discussion [Post122][058][Mob18] Contents of Cell Switch MAC CE?**

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| **Companies** | **Issue?** | **Motivation/Clarification** |
| Nokia, Nokia Shanghai Bell | See comments | For open issue #2, we think this can follow the CHO paradigm (i.e., 8 candidate cells configured in the RRC). We note that this requires a discussion also for the case of Dual Connectivity. For the other points, we think it is fine to follow the RAN1 agreements. |
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# Discussion

**2.1 TA information in LTM MAC CE**

RAN1 agreement and LS to RAN4 (R1-2306259):

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| RAN1 has confirmed the following working assumption, which was made in RAN1#112:  **Working Assumption**  From RAN 1 perspective, UE-based TA measurement (UE derives TA based on Rx timing difference between current serving cell and candidate cell as well as TA value for the current serving cell) is supported.   * Corresponding UE capability is to be introduced to support UE-based TA measurement * For a UE reports support of this capability, configuration of UE-based TA measurement is supported * FFS: other impacts on RAN1 spec   RAN1 respectfully asks RAN4 to analyze the feasibility of supporting this mechanism. |

On top of the endorsed MAC running CR R2-2306924, we will continue following discussion.

If RAN4 confirms the feasibility and RAN1 completes the design of this UE based TA measurement in August meeting, the LTM MAC CE needs to address the following cases: (If it is not eventually concluded by RAN4/RAN1, then there is no such case 2)

* **Case 1**: RACH-based (actual TA value not needed in the MAC CE)
* **Case 2**: RACH-less with UE based TA measurement (actual TA value not needed in the MAC CE)
* **Case 3**: RACH-less with actual TA value provided (including the zero or same value)

Rapporteur has following way forward as starting point:

**WF1: Postpone the design/discussion to October meeting for more RAN1/4 progress on UE based TA measurement** (since the MAC CE design could be simpler without case 2).

**WF2: Use 2-bits filed to directly indicate the case 1/2/3. The TA field is included in case 3.**

* If RAN1/4 does not complete the supporting of UE based TA measurement, use only 1-bit to indicate case 1 or 3.The TA field is included in case 3. [i.e. fallback to the above highlight behavior]
* Note that the TA field is already 12 bits. If this is optional field, it means the optional TA field itself causes two octets (12bits TA + 4bits R).

**WF3: Use 1-bit field to indicate whether it is case 2 or not. If it is not case 2 (e.g. when this filed is set to 0), one specific value (e.g. FFF) of the TA field indicates the case 1; otherwise, it is case 3.**

* If RAN1/4 does not complete the supporting of UE based TA measurement, one specific value (e.g. FFF) of TA field indicates the case 1; otherwise, it is case 3. [i.e. fallback to the above highlight behavior]
* Note that the TA field is already 12 bits. If this is mandatory field, it can be combined with some R and the Target Configuration ID field as the first two mandatory octets (e.g. 1bit R+ 3bits Target ID+ 12bits TA).

**Q1: Which WF do you prefer on the format of the TA information in LTM MAC CE?**

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| **Companies** | **WF 1/2/3?** | **Comments** |
| Samsung | None | In our view, there is no need to indicate the three cases. It is sufficient to indicate whether TA is included or not in MAC CE. One bit is sufficient for this. |
| MediaTek | 1 | Our understanding is that RAN4 has concern on the timing difference between sites (“synchronous” network only means the timing difference is below some threshold), which may make UE-based TA measurement infeasible. Although we support this method, we may wait for RAN4 conclusion before working on RAN2 MAC CE details. |
| Futurewei | WF 2 with modification | As indicated in our answer to question A, we would suggest using 2-bit field to indicate:  00: The TA field contains the TA of the target cell. When the TA  field is set to ‘0’, it is the case of target cell TA=0.  01: The TA field contains the most recent dynamic change over the  TA of current serving cell, and the target cell TA = the most updated  source cell TA.  10: The TA field contains the most recent dynamic change over the  TA of current serving cell, and the target cell TA is derived based on  the current source cell TA and RSTD of the source and target cells.  11: The TA field is absent and the UE needs to perform random  access to the target cell.  The case ‘00’ of target TA is available covers the special value of target TA=0.  The cases, ‘01’: target TA the same as serving cell TA, and ‘10’: UE based TA measurement, depend on the accuracy of the source cell TA, in these cases the most recent delta source cell TA should be delivered to the UE via the cell switch command MAC CE.  If the network thinks the UE must perform random access, the indication should be set to ‘11’.  In our view, “**Case 3**: RACH-less with actual TA value provided” cannot include the case that the target TA value is same as the source cell TA value since the network/source cell does not maintain the absolute source cell TA of the UE. The source cell only updates the delta source TA to the UE and the UE maintains the most updated absolute TA for UL TX. Therefore, “the target TA value is same as the source cell TA value” has to be a separate case, and anyway 2-bit indication is required. Even for the target TA = source TA case, to ensure the accuracy of the target TA, the most recent source TA should be used. It is desirable to use the cell switch command MAC CE to carry the current source TA-change over the previously determined source TA to let the UE getting the most updated source serving cell TA.  In our view, for inter-DU mobility, we cannot assume source and target DUs are precisely synchronized. The network should compensate the inaccuracy caused by the asynchronization between the DUs. With network compensation, the UE measured TA should be accurate enough. |
| Qualcomm | None | RAN1 agreed that “configuration” of UE-based TA measurement is supported. It is not clear why this configuration has to be an indication in the LTM MAC CE. Configuration typically refers to RRC configuration. If that’s the case, case 2 is dropped as it will not impact the MAC CE design. All what remains is whether the LTM MAC CE carries a TA value or not. |
| CATT | None | Similar understanding as Samsung. The TA information is optionally included in the LTM command MAC CE, and one bit is sufficient to indicate whether this field is present or not. As for if UE-based TA is supported, when TA is not included, whether RACH or RACH-Less should be performed, it can be further discussed after RAN4 conclusion. |
| ZTE | None | UE can automatically obtain the TA value of the candidate cell when UE based TA acquisition is configured via RRC, it is irrelevant with the TA field provided in MAC CE. Therefore, in our understanding, only 1-bit indication is enough: If the 1-bit indication is set to 1 which means TA value of the target cell is present in the LTM Cell switch MAC CE; if the 1-bit indication is set to 0 which means TA value of the target cell is not present in the LTM Cell switch MAC CE. |
| Apple | None | We do not want MAC CE to indicate about the UE based TA derivation (can be configured with RRC) |
| Ericsson | 1 | We in principle agree with Samsung proposal, but since the discussion in RAN1 and RAN4 is still ongoing it makes sense to wait and then implement the necessary signalling. |
| OPPO | None | We see no need to indicate all the three cases, for RACH-based LTM and RACH-less LTM, one-bit is sufficient for UE to differentiate the cases.  And for UE-based TA acquisition, we understand RRC can be used for indicating. |
| LGE | None | One bit to indicate whether TA value is included or not should be sufficient, i.e., if the NW knows TA of the target cell, the NW will give TA value in the LTM cell switch command, but if the NW doesn’t know TA of the target cell, TA value is not included in the LTM cell switch command. We think that’s all what RAN2 consider for LTM MAC CE design for TA value and it is not sure that case 2 should be considered for MAC CE design. |
| Huawei, HiSilicon | WF1 | It seems above companies with “none” answer think the RACH-less LTM cell switch of “UE based TA measurement” is configured by RRC (based on UE capability) rather than indicated by MAC CE. (we can try that.)  Please note the fact that RACH-less LTM cell switch in “UE based TA measurement” still requires NW to indicate the beam information in LTM MAC CE (since no RACH to select the beam). This is the relationship with MAC CE.   * **Case 1**: no TA value, no beam information. * **Case 2**: no TA value, include beam information * **Case 3**: includes TA value and includes beam information   So, anyway it is MAC CE to indicate one case among those 3 cases, for the presence of TA value and/or beam information. |
| CMCC | WF1 | RAN1 already confirm the UE-based TA measurement and RAN4 will discuss the feasibility in the next meeting. We think the configuration is more of allowing the UE to perform “UE based TA measurement”. But we can keep this open and wait for the progress from RAN4. |
| vivo | 1 | Considering the decision on whether the case 2 is supported in LTM has not be concluded, and it will impact whether 0 bit or 1 bit or 2 bits are needed in LTM cell switch command MAC CE to indicate the different cases, we think it is better to postpone it to wait for more progress in RAN1/4. |
| Xiaomi | WF1 | We think it is safer to wait for more inputs from RAN1/RAN4. |
| Fujitsu | None | We think that Case 2 can be configured by RRC rather than LTM MAC CE. It means that 1 bit is included in the MAC CE to indicate whether TA value is included or not.  In addition, for TA with zero or same value as serving cell, we can further discuss it should be considered case 3 or separate case(s). If it is considered as case 3, the design of MAC CE is simple; if it is considered as separate case, TA bits (12-bits) can be saved by e.g. one addition bit to indicate the separate cases and serving cell index in case TA value is same as serving cell. |
| InterDigital | 1 |  |
| NTT Docomo | WF1 | We want to wait for progress on RAN1/RAN4. |
| Nokia, Nokia Shanghai Bell | WF1 | We can discuss after the RAN4 agreement and decide after further input from them. |
| DENSO | WF1 | In the next meeting, the RAN4 will discuss the feasibility of UE-based TA measurement.  Whether the case 2 is supported or not has the impact for size of the bits field to indicate the different cases. Therefore, we need to wait for RAN4 agreement and more detail of UE-based TA measurement. |
| KDDI | None | We think there is no need to indicate three cases. When UE based TA measurement is configured by RRC, UE can obtain TA value. |
| Sharp | WF1 | RAN4 will discuss the feasibility of UE based TA measurement, and we can wait for the outcome from RAN4. |
| Vodafone | None or 1 | As the discussion in RAN1 and 4 ongoing, we should take the outcome of RAN1/RAN2 discussion into account. |

**Summary: TBD**

**2.2 Active BWP ID in LTM MAC CE**

RAN1 achieved some consideration on the content of the LTM MAC CE, including the active DL and UL BWPs for the target cell.

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| --- |
| From RAN1 point of view, at least the following information can be included in the cell switch command, which is conveyed by MAC CE   * + Information to identify the target cell(s)     - The details including bit number are designed by RAN2   + TA related information (details up to the discussion in A.I. 9.10.2)   + 1 joint or 1 pair of UL and DL unified TCI State index for the target Cell     - Note: discussion on target SpCell is not precluded   + Active DL and UL BWPs for the target cell   + FFS: Triggering of aperiodic TRS transmitted from the target cell   + FFS: Triggering the CSI acquisition of the target cell and reporting to the target cell   + FFS: Triggering of aperiodic SRS transmission to the target cell   + FFS: C-RNTI * FFS: the presence of each field (i.e. always present or configurable)   **Conclusion**   * Whether active DL and UL BWP of the target Cell/SpCell field, within the cell switch command, is always present or not is left to RAN2 decision. |

It should be RAN2 final discussion on how to indicate the active BWP ID (RRC vs. MAC CE), by considering the corresponding network side coordination and other aspects which may be agnostic to other WGs.

This “active BWP ID” in LTM MAC CE introduces the **dynamic change** of active BWP of the target cell, which may be different with the *firstActiveUplinkBWP-Id* and *firstActiveDownlinkBWP-Id* as in RRC pre-configuration.

The **motivation should be first clarified** on: 1) why target cell wants to change its decision upon trigger LTM, compared to the one provided in the pre-configuration phase; 2) why source cell needs to be involved in the decision of active BWP ID (BWP switch) of target configuration, which is supposed to be target cell strategy.

Note that the RP#100 conclusion has exclude the CSI-RS based L1 measurement for LTM candidate, which means the source cell has no measurement result on the BWP level for its judgment to dynamically change the active BWP ID.

**Q2a: Which option do you prefer on how to determine the active BWP ID of target cell?**

* **Option 1: Only based on the legacy *firstActiveUplinkBWP-Id* and *firstActiveDownlinkBWP-Id* in RRC (pre)configuration corresponding to the target cell.**
* **Option 2: Using optional fields of “active UL/DL BWP ID” in LTM cell switch MAC CE. When included in the LTM MAC CE, it overrides the legacy *firstActiveUplinkBWP-Id* and *firstActiveDownlinkBWP-Id* in RRC (pre)configuration of the target cell.**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Option?** | **Comments** (Please clarify the technical motivation) |
| Huawei, HiSilicon | Option 1 | Source cell should always follow the target cell decision on the first BWP, which is the target cell strategy based on e.g. traffic load on different BWPs. |
| Samsung | Option 2 | RAN1 has agreed to include BWP ID(s) in MAC CE. As per RAN1 conclusion, whether BWP IDs are always present or not is up to RAN2.   * Whether active DL and UL BWP of the target Cell/SpCell field, within the cell switch command, is always present or not is left to RAN2 decision.   Unless there is feasibility issue we prefer to follow RAN1 agreement. |
| MediaTek | Option 1 | BWP assignment is based on long-term factors (e.g., traffic load) and needs not to be very flexible. Assignment in candidate RRC configuration should be feasible. |
| Futurewei | Option 1 | This BWP is used at the target cell and has to be determined by the target cell. The initial BWP at the target cell for mobility is not a fast change configuration and need not to be determined at the cell switch. If the BWP is notified by the MAC CE, the source cell needs to negotiate with the target cell to get the BWP from the target cell before issuing the cell switch command MAC CE. This activity will delay the cell switch. Unless we see benefit for doing this from a use case. |
| Qualcomm | Option 1 at least for inter-DU | We think Option 1 is sufficient for inter-DU scenario for the reasons listed by the rapporteur.  For intra-DU scenario, dynamically modifying the active BWP may provide scheduling flexibility, but we don’t have a strong view on this. |
| CATT | Option 1 |  |
| ZTE | Option 1 for both inter-DU intra-DU,cases, option 2 is only for intra-DU LTM | Option 1 can be supported as the baseline. Option 2 is somewhat an enhancement, the main benefits from this enhancement is that UE can be directly put into the suitable BWP of the target cell so that the time gap due to BWP switch after LTM can be saved. However, we do not think such time gap due to BWP switch is a big issue, but for containing the BWP Id in the LTM Cell switch MAC CE must cause the extra interaction between two DUs in the case of inter-DU LTM, this kind of delay is LTM delay which shall be reduced as much as possible from our point of view. So based on above discussion, we support option 2 as optional which is only for intra-DU case. |
| Apple | Option 2 | We already have dynamic BWP changes with DCI… and since LTM cell switch is considered generally as lower layer procedure, why limit to RRC configured BWP (esp when subsequent LTM is being designed for).  *[HW]: “dynamic BWP changes with DCI” is really different with source dynamically change the decision from target.* |
| Ericsson | Option 2 | Relying on the BWP IDs within the LTM candidate cell configuration is too limiting. If the network wants to switch the UE among BWPs (e.g., a “normal” BWP and a “power saving” BWP) depending on the UE traffic, this would not be possible. Also, this imply that after an LTM cell switch the network would need to send an RRCReconfiguration to the UE thus breaking the principle of subsequent LTM.  We prefer to honor the RAN1 agreement, unless there is a feasibility concern (also in line of what Samsung has clarified).  *[HW]: the flexibility can be done by target cell when generating the target configuration. After cell switch, DCI can always be used.* |
| OPPO | Option 1 |  |
| LGE | Option 1 | We think that the option 1 is sufficient and has no problem to support most cases.  Even though *firstActiveUplinkBWP-Id* or *firstActiveDownlinkBWP-Id* in RRC (pre)configuration is crowed and the target cell wants to use other BWP instead of this preconfigured first active BWP, the NW can change active BWP anytime using legacy BWP switching right after LTM cell change and this would not cause long delay. Considering that the NW can control traffic load on a specific BWP, we are not sure how frequently the concerned case occurs and dynamic change of active BWP of the target cell is beneficial.  In addition, if the option 2 is used to change active BWP, this may increase LTM cell change delay since the source cell should receive this BWP information from the target before sending LTM cell switch command. |
| CMCC | Option 1 |  |
| vivo | Option 1 | In our view, the first activate BWP ID of the candidate cell could be only decided/ updated by candidate cell itself, and source cell couldn’t be aware of the situation, e.g. the load of BWP in candidate cell. Hence, it is not reasonable for source cell to change the first active BWP of candidate cell blindly. |
| Xiaomi | Option 1 |  |
| Fujitsu | Option 2 | We think that it can be long time since BWP information is provided in the pre-configuration phase considering subsequent LTM without reconfiguration and thus the load situation can be changed.  To solve this, 1) different BWP id from RRC configuration can be indicated in LTM MAC CE, or 2) BWP switching is performed after LTM completion via RRC reconfiguration or DCI. 1) is needed if BWP indicated by RRC is already overloaded. |
| InterDigital | Option 1 for inter-DU  Option 2 can be considered for intra-DU | Agree with ZTE. |
| NTT Docomo | Option 1 | We have same view with QC. |
| Nokia, Nokia Shanghai Bell | Option 1 | Regarding the active BWP ID, we think that it is sufficient to re-use the legacy mechanisms and configure it via RRC. Further optimizations are not seen as necessary as the active BWP ID is anyway not expected to change much during the LTM procedure (which is designed to be fast). |
| DENSO | Option 2 | In subsequent LTM scenario, network may need change *firstActiveDownlinkBWP-Id* based on load balancing.  Therefore, We think it is useful to change the *firstActiveDownlinkBWP-Id* by indicating Cell Switch Command MAC CE from one indicated by RRC. |
| KDDI | Option 1 | We think it is sufficient to use BWP information configured by RRC. |
| Sharp | Option 2 | Unless there is a feasibility issue, we can follow the RAN1 agreement, but if we go with Option 1, we should inform RAN1 because this option might revert the RAN1 assumption. |
| Vodafone | Option 1 | we think that it is sufficient to re-use the legacy mechanisms and configure it via RRC. It doesn’t need to be very dynamic. |

**Q2b: If your answer to Q2a is option-2, please also clarify whether the applicable scenario of the active BWP ID in LTM MAC CE is only for intra-DU, or also for inter-DU. Otherwise, you may skip this question.**

If you consider this is also for inter-DU, please clarify the F1AP signaling on how can the target DU know the updated active BWP ID (if it is source DU decision), and on how the source DU knows the updated decision on active BWP ID (if it is target DU decision).

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| **Companies** | **Only intra-DU, or both intra-/inter-DU?** | **Comments** |
| Samsung | both | In our view the interaction between source DU and target DU is anyways needed e.g. for TCI state, if the source DU/target DU, decides TCI state to be included in LTM MAC CE, it needs to be informed to target DU/source DU. |
| Qualcomm | Only intra-DU or none | Scheduling decisions of separate DUs are independent. Therefore, the source DU should NOT include active BWP on behalf of the target DU. Introducing coordination among Dus defers LTM triggering and may cause UE RLF. |
| ZTE | Only intra-DU or none. |  |
| Apple | Both |  |
| Ericsson | Both |  |
| Fujitsu | Both | At last meeting, considering dynamic grant for the first UL data in target cell, RAN2 assumes that the target DU is informed when LTM decision is made at source DU. So, we don't see addition latency due to BWP information in LTM MAC CE. |
| InterDigital | Intra-DU |  |
| DENSO | Both |  |
| Sharp | Both | The interaction for TCI state information between source DU and target DU is needed as Samsung comments, so the information of active BWP can also be transferred with TCI state information if multiple BWPs are configured for LTM target cell. |

As to the option-2, some details are still to be clarified:

* For RACH-based cell switch, the active UL BWP is supposed to be configured with RACH resource/configuration. If the active UL BWP can be dynamically changed, how to dynamically re-configure the RACH resource if the active UL BWP ID in LTM MAC CE is different with *firstActiveUplinkBWP-Id* in RRC, where the RACH should be configured. Or, do we assume all UL BWPs has to be configured with RACH?
* For RACH-less cell switch, if configured grant is used for the first UL data transmission, how to dynamically re-configure the CG resource on the updated active UL BWP, if it is different with RRC configured one. Or, do we assume all UL BWPs should be configured with CG resource?

**Q2c: If your answer to Q2a is option-2, please also clarify whether the applicable scenario of active BWP ID in LTM MAC CE is for RACH-based and/or RACH-less cell switch. Otherwise, you may skip this question.**

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| **Companies** | **RACH-based, or RACH-less, or both?** | **Comments** |
|  | both | For RACH based, indicated BWP should be one of the BWPs configured with RACH resource/configuration. UE will apply the configuration of indicated BWP.  For RACH less, CG configuration can be common and applied to the BWP indicated. |
| Apple | Both |  |
| Ericsson | Both |  |
| Fujitsu | Both |  |
| InterDigital | both |  |
| DENSO | Both |  |
| Sharp | Both |  |

**Summary: TBD**

**2.3 SCell activation/deactivation in LTM MAC CE**

In order to support the simultaneously SCell activation upon LTM trigger, some companies propose to include the SCell activation/deactivation in LTM MAC CE, in addition to the legacy “*sCellState-r16*” in RRC pre-configuration of the target cell.

This **dynamic update** of SCell state may come from following motivations: the L1 measurement result to a candidate SCell changes a lot upon LTM execution, compared to the previous L3 measurement result upon RRC pre-configuration.

The similar situation exists also in CHO. And, in RAN1, it is not clear yet on whether the L1 measurement report can explicitly indicate the candidate SCell and whether the source cell can differentiate if the reported RS is for candidate Pcell or candidate SCell.

Please note, for the SCell simultaneous activation upon LTM execution, there is no performance difference for LTM interruption time, between RRC pre-configured and MAC CE indicated manners.

**Q3a: Which option do you prefer to support the SCell activation simultaneously with LTM cell switch execution?**

* **Option 1: SCell state is based on the legacy *sCellState-r16* in RRC (pre)configuration corresponding to the target cell.**
* **Option 2: Using optional fields in LTM cell switch MAC CE to indicate the SCell activation/deactivation state. When included in the LTM MAC CE, it overrides the legacy *sCellState-r16* in RRC (pre)configuration of the target cell.**

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| **Companies** | **Option?** | **Comments** |
| Huawei, HiSilicon | Option 1 | It is the target cell strategy to decide the SCell activation/deactivation, based on the UE traffic amount (i.e. how many carrier is required for UE traffic load).  Even if the RSRP of some candidate SCell (with *sCellState-r16* set to “*activated*” in RRC) becomes weak at the time of LTM cell switch, the BFD and BFR can be used in the worst case with no critical issue (i.e. no need of dynamic control by the source cell). |
| Samsung | Option 1 | In our understanding, RAN2 has not yet agreed to support simultaneous SCell activation during LTM. L1 measurement report for candidate Scells may not be supported. It means NW has to blindly configure the SCell in the LTM candidate configuration.  However, if it will be introduced option 1 is better than option 2 i.e. NW preconfigure the SCell if it is required. |
| MediaTek | Option 1 | Agree with Huawei |
| Futurewei | Option 1 | Agree with Huawei. |
| Qualcomm | Option 1 at least for inter-DU |  |
| CATT | Option 1 |  |
| ZTE | Option 1 |  |
| Ericsson | Option 1 but | We just want to clarify that with Option 1 the network has to configure Scells blindly and this may be inefficient for performance point of view.  If L1 measurements on SCell of LTM candidate cells will be supported, with Option 1 these will be useless.  Therefore, if we go for Option 1, we should inform RAN1 about this since L1 measurements on Scells of LTM candidate cells will not be needed.  *[HW]: option 1, target cell can configure this based on L3 measurement when generating the candidate configuration.* |
| OPPO | Option 1 |  |
| LGE | Option 1 |  |
| CMCC | Option 1 |  |
| vivo | Option 1 |  |
| Xiaomi | Option 2 | We think that for the intra-DU case, the gNB can use LTM MAC CE to activate/deactivate the target SCell. We are also fine to follow the majority view. |
| Fujitsu | Option 2 | Similar comment as for Q2a |
| InterDigital | Option 1 for inter-DU, Option 2 can be considered for intra-DU | Similar to BWP, at least for intra-DU there is a benefit from more flexible/dynamic configuration |
| NTT Docomo | Option 1 |  |
| Nokia, Nokia Shanghai Bell | Option 1 |  |
| DENSO | Option 2 | Similar to BWP, see comment for Q2a |
| KDDI | Option 1 | We think it is sufficient to use Scell information configured by RRC. |
| Sharp | Option 2 | By considering the data volume when LTM cell switch is performed, SCell activation/deactivation state should be indicated by MAC CE rather than by RRC configuration. We assume there are at least two alternatives to indicate activation/deactivation state for SCells of LTM target by MAC CE as below:  Alt. 1: Using optional fields in LTM cell switch MAC CE (Option 2 above)  Alt. 2: Re-using the legacy SCell activation/deactivation MAC CE |
| Vodafone | Option 1 | Agree with Huawei that is the target cell strategy to decide the SCell activation/deactivation, based on the UE traffic amount |

**Q3b: If your answer to Q3a is option-2, please also clarify whether the applicable scenario of the SCell activation/deactivation in LTM MAC CE is only for intra-DU, or also for inter-DU. Otherwise, you may skip this question.**

If you consider this is also for inter-DU, please clarify the F1AP signaling efforts:

* on how can the target DU know the updated SCell state (if it is source DU decision);
* on how the source DU knows the updated decision on SCell state (if it is target DU decision);
* on how the target DU knows the latest L1 measurement result on SCell, just in case it may change the decision (if it is target DU decision);

|  |  |  |
| --- | --- | --- |
| **Companies** | **Only intra-DU, or both intra-/inter-DU?** | **Comments** |
| Xiaomi | Only intra-DU |  |
| Fujitsu | Both |  |
| InterDigital | Intra-DU |  |
| DENSO | Both |  |
| Sharp | Only intra-DU |  |
|  |  |  |
|  |  |  |

**Summary: TBD**

**2.4 CFRA resource in LTM MAC CE**

There are some proposals to include the CFRA resource related information in LTM MAC CE, like following:

* Understanding 1: CFRA preamble index;
* Understanding 2: CFRA resources availability/validity indication;
* Other?

The motivation seems to save some reserved CFRA resource at LTM candidate cell side. The opponent view may be that NW can also choose to use CBRA for LTM cell switch, if the RACH resource is considered as limited at candidate cell.

Understanding 1 seems similar to the PDCCH order indicated preamble index, which makes the RRC configured shared/contention-based resource as dedicated for this UE.

Understanding 2 seems to withdraw/confirm the CFRA resource configured in RRC.

**Q4a: Do you agree the need of CFRA resource related information in LTM cell switch MAC CE?**

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| --- | --- | --- | --- | --- |
| **Companies** | **Yes** (include) or **No** (not include)? | | **Comments** (please clarify the detailed format (e.g. which understanding) of this kind of CFRA information, if you prefer to include) | |
| Samsung | Yes | | CFRA resource configured by RRC may not be valid at the time cell switch. So, validity timer or validity indication in LTM MAC CE can be useful.  CFRA resource (SSB index/Preamble index) in LTM MAC CE is also useful at least for FR2. Based on latest measurement, network can indicate CFRA resource for best beam in the LTM MAC CE. | |
| MediaTek | No | | CFRA configuration is not small (not just preamble index) and should be provided in candidate RRC configuration.  Availability of CFRA resources upon LTM execution may be an issue. However, having availability bit in MAC CE means that source cell needs to check with target cell before sending the MAC CE, which introduces extra delay. A simpler way would be that the target cell ensures that CFRA resources are available upon LTM execution. Note that we do not expect a large number of candidates, so no need to worry that many CFRA resources are reserved for UEs eventually do not come. | |
| Futurewei | No | | In our understanding, the option other than source/target CFRA resource negotiation indicated by MTK is to pre-maintain a small pool of preambles of a candidate cell at the source cell with a smaller number of preambles shared by a larger number of UEs such that preamble resources may be saved by different UEs reusing the same preamble at different time. However, it is difficult to determine the size of the pool of preambles at different time to be maintained at the source cell. If large number of UEs are switching to a target cell in short period of time, smaller number of preambles cannot prevent collision. If time spread for UEs to perform cell switch is long enough, locking a pool of multiple preambles of a candidate cell at the source cell wastes resources. Configuring the dedicated preamble at RRC pre-configuration is sufficient and more efficient. It appears to us for CFRA, maintaining a pool of target cell preambles at the source cell and using cell switch command to indicate a preamble from the pool to the UE may not save preamble resources in some cases and may cause collision in some other scenarios. The complexity is also increased a lot. | |
| Qualcomm | No | | This should be RRC-configuration. In LTM, we optimize for RACH-less LTM execution. RACH-based LTM execution is not main mode of operation. We do not expect limitation on CFRA resources if network chooses to do RACH-based execution. | |
| CATT | Yes | | The LTM command MAC CE can indicate the preamble index, and by this way not much dedicated RACH resource will be reserved by each candidate cell for possible UE access. Like the RACH resource reserved for early TA acquisition, the same RACH resource or separate RACH resource can also be reserved for LTM execution. The candidate cell can provide a RACH resource pool for multiple UEs. | |
| ZTE | No | | LTM support both RACH-less and RACH based cell switch. From NW perspective, for reducing the LTM delay, in the case of intra-DU LTM, RACH-less LTM is preferable as there is no additional inter-DU interaction for the TA obtained from early TA acquisition. While in the case of inter-DU LTM, RACH based LTM is preferable with a same reason. With above logics, assuming that RACH dedicated resource are carried in the LTM Cell switch MAC CE, the preferable scenario is inter-DU LTM, however, it needs extra interaction between two DUs for allocating RACH resources before transferring the LTM Cell switch MAC CE which may cause extra LTM delay, the gain is not absolute with a certain price to pay.. so we do not see any need to have this kind of enhancement. | |
| Apple | No | | An index to RRC config is enough. | |
| Ericsson | No | | We can rely on CFRA provided within the LTM candidate cell configuration. | |
| OPPO | No | |  | |
| LGE | No | | Same view with QC and Ericsson. | |
| Huawei, HiSilicon | No | |  | |
| CMCC | Yes | | We think the configuration of CFRA resource is not essential. But validity indication in LTM MAC CE can be useful. We think the validity indication doesn’t mean that the source should check with target before sending the MAC CE. Although the NW could update the configuration if the reserved resource is not available, the source could indicate the invalidity in the MAC CE and trigger the cell switch first to reduce the interruption caused by falling back from CFRA to CBRA. | |
| vivo | Yes | | Since the subsequent LTM is supported, the CFRA resource of a candidate may be reserved for a certain UE and couldn’t be used by other UEs for a long time. Hence, the wastage of resources will occur for a candidate cell. In our view, both understanding 1 and understanding 2 could be helpful, and both two solutions require the CFRA resource related information in LTM cell switch MAC CE. | |
| Xiaomi | Yes | | We think that CFRA resource are quite precious for the network. It is reasonable not to always reserve the CFRA resource via the candidate cell configuration of RRC. | |
| Fujitsu | No | RRC configuration only. | |
| InterDigital | Yes | | To enable more flexible sharing of CFRA resource between multiple UEs it can be beneficial to indicate in the cell switch command, however acknowledge that this is an optimisation. | |
| NTT Docomo | No | |  | |
| Nokia, Nokia Shanghai Bell | See comments | | Regarding the CFRA resources, we agree that the CFRA preamble index can be given in the MAC CE. However, if the CFRA preamble index is given, we do not see the need for the additional information given in the second field. In our view, for LTM cell switch purposes, it is sufficient is sufficient ot give the preamble index in the MAC CE. Any other information would simply increase the size of the messaging and cause unnecessary overhead. | |
| DENSO | Yes | | We think that including CFRA resource in cell switch MAC CE can be useful. | |
| KDDI | No | | We think it is sufficient to use an index configured by RRC reconfiguration. | |
| Sharp | No | | CFRA resources in RRC pre-configuration are enough. | |
| Vodafone | No | | Agree with MediaTek explanation. CFRA configuration is not small (not just preamble index) and should be provided in candidate RRC configuration. | |

**Q4b: If the answer to Q4a is yes, clarify the applicable scenario of CFRA resource related information in LTM MAC CE is only intra-DU or also or inter-DU. Otherwise, you may skip this question.**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Only intra-DU, or both intra-/inter-DU?** | **Comments** (If you consider this is also for inter-DU, please clarify the F1AP signaling efforts) |
| CATT | both | When source make the LTM execution decision, and choose the CFRA resource for the UE, the source DU indicate the UE ID and associated CFRA resource to the target DU via CU. |
| vivo | Both | For inter-DU LTM case:  With understanding 1, candidate cell can provide a shared CFRA resource pool to source DU. Then the source cell can select a CFRA preamble index from the pool and indicate it to UE in LTM cell switch command. The impact to F1AP is similar like CFRA resource allocation for early TA acquisition.  With understanding 2, candidate cell may withdraw the CFRA resource previously configured in RRC to UE. If a candidate cell wants to withdraw the CFRA resource, the candidate DU needs to inform CU and then CU will indicate the source DU that the CFRA resource has been withdrawn. After the candidate DU get response from the source DU, the candidate DU can reallocate the concerned CFRA resource to other UEs. |
| Xiaomi | Slightly prefer Only intra-DU | We understand that supporting inter-DU may require extra standard efforts. Considering the limited remaining time in this release, we can focus on only intra-DU. |
| InterDigital | Intra-DU |  |
| DENSO | Both | When LTM execution is decided by source DU, and CFRA for UE is selected, the source DU indicate UE associated information to target DU via CU. |
|  |  |  |
|  |  |  |

**Summary: TBD**

**2.5 UL grant in LTM MAC CE**

There are some proposals to include the UL grant related information to be used at target cell in the LTM cell switch MAC CE, which is supposed to be the enhancement, in addition to the CG configured in RRC and PDCCH monitoring of DG at target cell. However, it is not clear on the detailed format and how it is supposed to work, like:

* Is it kind of dynamic grant like the UL grant in RAR?
* Is it an index of some shared CG pool configured by RRC?

**Q5: Do you agree need of UL grant related information in LTM cell switch MAC CE?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes** (include) or **No** (not include)? | **Comments** (please clarify the details if you are supportive to this enhancement) |
| Samsung | Yes | UL grant as in RAR can be included |
| MediaTek | No | We believe that it is enough to have UL grant using CG in candidate RRC configuration and PDCCH monitoring. Also, we don’t think source can provide the info in MAC CE because it depends on target. |
| Futurewei | No | We have similar view as MediaTek. Legacy RAR is from the target cell while LTM cell switch MAC CE is from the source cell. If the source cell gets the target cell grant via negotiation at cell switch, it is even worse than DG with more delay. Otherwise, it the MAC CE carries the target cell grant, the grant has to be notified to the source cell at the preparation phase, then using MAC CE to deliver the grant to the UE. It is not clear why don’t we directly using RRC pre-configuration to carry the grant to the UE at the preparation phase. |
| Qualcomm | No | The UE determines what UL grant to use based on RRC configuration:   * If target cell configuration provides PDCCH search space, the UE waits for PDCCH from the target cell. * If target cell configuration provides CG configuration, the UE uses the latter.   We do not see the need to yet another solution where the grant for transmission to the target cell comes from the source cell. Such solutions anyway do not work for inter-DU. Their benefit for intra-DU is questionable. |
| CATT | No | Agree with MediaTek that the agreed UL grant methods are sufficient.  For CG manner, From the UE side, it is clear which CG resource should be used according to the selected beam, no more information is needed. |
| ZTE | No | If we support this, the extra interaction between two DUs before transferring LTM Cell switch MAC CE are needed for inter-DU LTM which must cause the extra LTM delay. |
| Apple | No | No need for this optimization. |
| Ericsson | No | Agree with MediaTek |
| OPPO | No | UL grant indicated in cell switch command may introduce additional inter-DU interaction. |
| LGE | No | We think that current solutions, i.e., the CG configured in RRC and PDCCH monitoring of DG at target cell, are sufficient and further optimization is not needed to get UL grant. |
| Huawei, HiSilicon | No |  |
| CMCC | No |  |
| vivo | Yes | Like the question 4, the same resource wastage will occur if candidate cell allocates and reserves dedicated CG resources for each UE. Hence a shared CG resource pool for all LTM Ues of one candidate cell could be considered. In this case, the UL grant related information should be included in LTM cell switch MAC CE. |
| Xiaomi | No | Agree with MediaTek. |
| Fujitsu | No | We don’t see the need to include UL grant related information in LTM cell switch MAC CE. |
| InterDigital | No | If type 2 CG is to be supported we may consider it, otherwise RRC configuration is sufficient. |
| NTT Docomo | No |  |
| Nokia, Nokia Shanghai Bell | No | We prefer the UL grant to be configured in the RRC as it would require less signaling between the DUs (thus less delay in configuring/enabling the LTM procedure). |
| DENSO | No | We think that it is enough to have UL grant using CG in candidate RRC configuration and PDCCH monitoring. |
| KDDI | Yes | We think it is efficient to indicate UL grant as in RAR by cell switch command in least intra-DU case. |
| Sharp | No | Agree with MTK |
| Vodafone | No | Agree with MediaTek |

**Summary: TBD**

**2.6 C-RNTI in LTM MAC CE**

RAN1#113 meeting agreement “*Whether C-RNTI that is to be used by target cell needs to be included within the MAC-CE containing cell switch command will be left to RAN2 decision*”.

**Q6: Do you agree need of C-RNTI in LTM cell switch MAC CE, in addition to the legacy *newUE-Identity* in *ReconfigurationWithSync* in RRC configuration?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes** (include) or **No** (not include)? | **Comments** |
| Samsung | No | Do not see need to dynamically update C-RNTI |
| MediaTek | No | C-RNTI can be provided in candidate RRC configuration |
| Futurewei |  | Has some sympathy on the motivation. Consider C-RNTI also a resource at each cell since the number of C-RNTI per cell is limited. If C-RNTI is pre-configured by RRC for candidate cells, the C-RNTI is locked at a candidate cell before the candidate cell becomes the serving cell of the UE. More C-RNTI resources are consumed. If the delay introduced by source/target negotiation during a cell switch is acceptable, the source cell can negotiate C-RNTI with the target cell first, then send it to the UE via cell switch command. C-RNTI is only assigned to the UE when cell switch occurs. In this case, C-RNTI resource is saved at the cost of increased delay of the cell switch. For delay sensitive LTM, RRC pre-configuring C-RNTI (no in MAC CE) is preferred. |
| Qualcomm | No | This is *historically* an RRC configuration during handovers, including CHO. No reason for it to be carried in a MAC CE? |
| CATT | No |  |
| ZTE | No | For inter-DU LTM case, the extra interaction between 2 DUs are needed if the C-RNTI is carried in the LTM MAC CE, given that the C-RNTI is sufficient for each cell, we do not think there is any necessary include C-RNTI in the MAC CE. |
| Apple | No | Not needed in DL (in MAC CE) |
| Ericsson | No |  |
| OPPO | No |  |
| LGE | No | We don’t see need of C-RNTI in LTM cell switch MAC CE. |
| Huawei, HiSilicon | No |  |
| CMCC | No |  |
| vivo | No |  |
| Xiaomi | No |  |
| Fujitsu | No |  |
| InterDigital | No |  |
| NTT Docomo | No |  |
| Nokia, Nokia Shanghai Bell | No | We think that the C-RNTI to be used by the target cell can be given in the RRC Reconfiguration message and do not see the need for further optimization. The space for C-RNTI is quite large, so there is no need to allocate it dynamically as the CU can simply compute more values in case there are more UEs that need a C-RNTI configured. Moreover, the MAC CE is an unprotected message, thus including C-RNTI in the MAC CE command would create security issues and have a high spec impact. |
| DENSO | No |  |
| KDDI | No |  |
| Sharp | No |  |
| Vodafone | No | Not see the need for dynamically update of C-RNTI |

**Summary: TBD**

**2.7 LTM supervisor timer in LTM MAC CE**

This is somehow related to whether LTM uses the same supervisor timer for both RACH-less and RACH-based cell switch.

Even if the RACH-less specific timer is agreed, it still should be the baseline to consider using RRC to configure a RRC layer timer value.

**Q7: Do you agree need of the LTM supervisor timer value in LTM cell switch MAC CE?**

Please clarify your views on the motivation to have different configured value of LTM supervisor timer for RACH-less and RACH-based cell switch. And, also to clarify why RRC configured value is not sufficient.

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes** (include) or **No** (not include)? | **Comments** |
| Samsung | No |  |
| MediaTek | No | Note that in legacy handover, t304 is generated by target. In current RRC running CR, t3xx is outside candidate config, meaning that it’s generated by source. We may need to clarify which node generates the timer. |
| Futurewei | No | RRC configuring the supervisor timer value is sufficient. |
| Qualcomm | No | It is sufficient to use the RRC configured parameter as in legacy. |
| CATT | see comments | Two separate supervisor timer values can be used for RACH based LTM case and RACH-less based LTM case. RACH-Less based LTM procedure should have less latency requirment than RACH based LTM procedure. Shorter timer value should be applied for RACH-less case. |
| ZTE | No | It is not clear to us the motivation to indicate the supervisor timer in LTM MAC CE. |
| Apple | No |  |
| Ericsson | No | We already agree that the supervision timer is an RRC timer. |
| OPPO | No |  |
| LGE | No |  |
| Huawei, HiSilicon | No |  |
| CMCC | No |  |
| vivo | No |  |
| Xiaomi | No |  |
| Fujitsu | No |  |
| InterDigital | No |  |
| NTT Docomo | No |  |
| Nokia, Nokia Shanghai Bell | No | In our view, the reception of the MAC CE command could trigger the timer, however its value can be given in the RRC message same as in legacy. We see no need for further optimizations of this procedure. |
| DENSO | No |  |
| KDDI | No |  |
| Sharp | No |  |
| Vodafone | No |  |

**Summary: TBD**

**2.8 LTM completion determination**

For LTM completion, how UE to determine the successful reception of its first UL data by the network (leftover issue which may need a new MAC CE in MAC running CR):

* Option 1: RLC ACK of *RRCReconfigurationComplete* message
* Option 2: C-RNTI addressed PDCCH
* Option 3: UE Contention Resolution identify MAC CE (new MAC CE, FFS on the naming)

Some agreement from NTN WI RACH-less handover discussion: ”*LTE approach (of confirming the HO completion) is reused for both pre-allocated grant and dynamic grant. FFS any enhancement to the confirmation of RACH-less HO completion, e.g. the NW does not send the UE Contention Resolution Identity MAC CE, and sends PDCCH/PDSCH addressed to C-RNTI*”

**Q8: Do you agree to use UE Contention Resolution Identity MAC CE (option 3) for UE to determine the successful reception of its first UL data by the network, in RACH-less cell switch?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes** or **No** (which option)? | **Comments** (Please clarify the critical issue why not to go with the approach considered by NTN and LTE RACH-less) |
| Samsung | Option 2 | In our understanding UL grant used by UE to send first UL data is dedicated to UE. So, option 2 seems sufficient. |
| MediaTek | Option 2 | We prefer Opt.2 and think it is sufficient. If network must send a MAC CE (e.g., due to robustness concern), we suggest defining a new MAC CE. UE Contention Resolution Identity MAC CE is for RACH procedure, and it’s a bit strange to use it in RACH-less LTM. |
| Futurewei | Option 2 with clarification | We think C-RNTI addressed PDCCH scheduled further DL/UL transmission would be sufficient. If there is no immediate follow up data transmission, a new DL cell switch completion MAC CE can be transmitted. Agree with MTK, the contention resolution MAC CE does not fit in LTM cell switch case. |
| Qualcomm | Option 2 (do not copy LTE or NTN) | In LTE, the CRC for PDCCH was 16 bits, so the false alarm rate is of concern. This was one of the justifications for using MAC CE in LTE RACH-less design.  In NR, the CRC for PDCCH is 24 bits, so the false alarm rate is very low. That’s why any PDCCH addressing the UE’s C-RNTI (for UL scheduling or for DL scheduling) is sufficient.  If NR RACH-less NTN copied the LTE solution, we do not have to do so since it is unjustifiable to send a 48-bit MAC CE whose content the UE will ignore anyway.  Option 1 incurs high latency. |
| CATT | Yes | No issue found by going with the approach considered by NTN and LTE RACH-less |
| ZTE | Option 2 | Option 2 is easier and sufficient |
| Apple | Op2 | Similar reasons that we discussed in earlier question. |
| Ericsson | Option 2 (ok also with Option 1) |  |
| OPPO | Option 3 | We see no need to introduce separate solutions for same issue. Option 3 is preferred since we can have common solution as LTE RACH-less HO as well as NTN. |
| LGE | Option 2 | Agree with above comments for option 2. |
| Huawei, HiSilicon | Option 3 | Issue for option 2: what if UE has no new DL data for transmission (in which case NW may not schedule the UE timely with C-RNTI)? What if UE is configured with CG in RACH-less?  For sure, option 3 means new MAC CE, FFS on the naming. |
| CMCC | Option 3 | Option 3 is already applied in the LTM RACH-less HO. We think it is sufficient to reuse the legacy solution. |
| vivo | Option 3 | Since the delay of RLC ACK may be long, which would lead handover failure in case it is longer than T304, then, option 1 is not preferred.  For option 2, as Huawei clarified it could work with some restriction. In our view, option 2 could work only in the following scenarios:   * Scenario 1: UE receives the C-RNTI addressed PDCCH which schedules a new UL transmission (i.e., the NDI provided in the associated HARQ information has been toggled) and the identified HARQ process is the same as the HARQ process used for the transmission of previous RRCReconfigurationComplete message. * Scenario 2: UE receives the C-RNTI addressed PDCCH which schedules a new DL transmission.   The scenario that UE receives C-RNTI addressed PDCCH which is used for the schedule of RRCReconfiguration message couldn’t work well as it cannot ensure network confirm the success of cell switch for the UE. However, as rapporteur summarized, if UE has no UL data to be transmitted/scheduled, this may be inefficient.  Option 3 is the same as LTE in which the network is forced to send an explicit MAC CE at every LTM cell switch procedure. Hence, there is no delay and the supervision timer will be easy to be configured. Thus, we think option 3 is more reasonable, and it should be supported. |
| Xiaomi | Slightly prefer Option 2 | The reason for LTE to use the contention resolution MAC CE for RACH-less is because the target node may have blind scheduling (i.e. sending C-RNTI PDCCH) before receiving the RACH-less UL transmission from the UE. However, the LTM MAC CE is sent by the source node, and the target node is not able to know when the source node will choose which candidate configuration. Thus, the blind scheduling is not possible for LTM. Then Option 2 is simpler for the implementation. |
| Fujitsu | Option 2 | Option 2 is baseline, i.e. upon PDCCH reception which is used to schedule the PDSCH (Option 1/Option 3) rather than PDSCH reception.  To support Option 2, a new MAC CE can be introduced to indicate the successful reception at gNB to handle the case where there is no available DL/UL data for transmission. |
| InterDigital | Option 1 or 2 |  |
| NTT Docomo | Option 2 or 3 | We think both Option 2 and Option 3 are effective. |
| Nokia, Nokia Shanghai Bell | Option 1 | We think that option 1 is sufficient for both RACH and RACH-less HO. This is also aligned with legacy and the agreements on Model 1 that were done in RAN2. Going through the other options would simply incur more overhead (e.g., in option 3, we would still need to receive the UL grant). |
| DENSO | Option 2 | Agree with above comments for option 2. |
| KDDI | Option 3 | We think it is enough to reuse legacy LTE RACH-less HO. |
| Sharp | Option 3 | For Option 1, delay of RLC ACK reception might cause LTM supervisor timer expiry and unnecessary RRC re-establishment because UE determination of the successful reception might be used to stop this timer.  For Option 2, C-RNTI addressed PDCCH might not be sufficient to determine the successful reception because there is a case that target cell does not receive the first UL data scheduled by this PDCCH successfully. |
| Vodafone | Option 1 or option 2 |  |

**Summary: TBD**

**2.9 Fields size in MAC CEs**

Following fields are somehow related and may impact the design of the new MAC Ces in MAC running CR (mainly on how many octets are required in the format).

* **A:** “Target Configuration ID” field in the LTM Cell Switch Command MAC CE, i.e. the maximum number of LTM candidate cells in RRC configuration;
* **B:** “Candidate Cell ID” field in the Candidate Cell TCI States Activation/Deactivation MAC CE, i.e. the maximum number of candidate cells with RRC configured TCI state;
* **C:** “Cell indicator” field in PDCCH order for early RACH, i.e. the maximum number of candidate cells with RRC configured early RACH resource;

Some observations:

The maximum number for CHO candidate is 8;

The maximum number of reported cell in L1 measurement report is 4, as agreed by RAN1.

**Q9: Do you agree following proposal:**

* **A:** The size of “Target Configuration ID” field in the LTM Command MAC CE is 3-bits, i.e. the maximum number of LTM candidate cells in RRC configuration is 8.
* **B:** The size of “Candidate Cell ID” field in the Candidate Cell TCI States Activation/Deactivation MAC CE is 2-bits, i.e. the maximum number of candidate cells with RRC configured TCI state is 4.
* **C:** The size “Cell indicator” field in PDCCH order for early RACH is 2-bits, i.e. the maximum number of candidate cells with RRC configured early RACH resource is 4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Companies** | **Yes** or **No** (other value)? | | | **Comments** (if no, any other suggestion?) |
| Field A | Field B | Field C |
| Samsung |  |  |  | We can wait for RRC discussion |
| MediaTek |  |  |  | Wait for RRC discussion |
| Futurewei |  |  |  | The rapporteur suggested number sounds reasonable. Can be further discussed. |
| Qualcomm | Yes | No | No | The three numbers should be the same. Any candidate cell may be RRC-configured with TCI states to be activated/deactivated by the MAC CE (though that won’t happen for all cells concurrently). Early RACH can be triggered towards any of the candidate cells. |
| CATT | Yes | No | No | Agree with Qualcomm |
| ZTE |  |  |  | Wait for RRC discussion |
| Apple |  |  |  | Defer to RRC. |
| Ericsson |  |  |  | We in principle agree with Qualcomm, but we can wait this to be discussed in RRC first. |
| OPPO | Yes | No | No | Agree with Qualcomm. |
| LGE |  |  |  | Rapporteur’s proposals seem reasonable, but there is no reason to be hurry and we can wait for RRC discussion at this point. |
| Huawei, HiSilicon |  |  |  | From MAC running CR, at least the number of candidate cell is a little bit urgent. 8 should be easy to converge. |
| CMCC |  |  |  | Wait for RRC discussion. |
| vivo |  |  |  | Wait for RRC discussion. |
| Xiaomi |  |  |  | Wait for RRC discussion, but agree with the intention of the options. |
| Fujitsu | Yes |  |  | Wait for RRC discussion. |
| InterDigital | Yes | No | No | Agree with QC |
| NTT Docomo |  |  |  | Wait for RRC discussion. |
| Nokia, Nokia Shanghai Bell | Yes | Yes | Yes | Ok to follow the RAN1 agreement |
| DENSO |  |  |  | Wait for RRC discussion. |
| KDDI |  |  |  | Wait for RRC discussion. |
| Sharp |  |  |  | Wait for RRC discussion |
| Vodafone |  |  |  | Can wait for this discussion |

**Summary: TBD**

# Conclusion and proposals

TBD

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