

**3GPP TSG RAN WG1 #115**

**R1-2311034**

**Chicago, USA, November 13<sup>th</sup> – November 17<sup>th</sup>, 2023**

**FUJITSU**

# **FL plan on L1 enhancements for LTM at RAN1#115**

**Document For:**

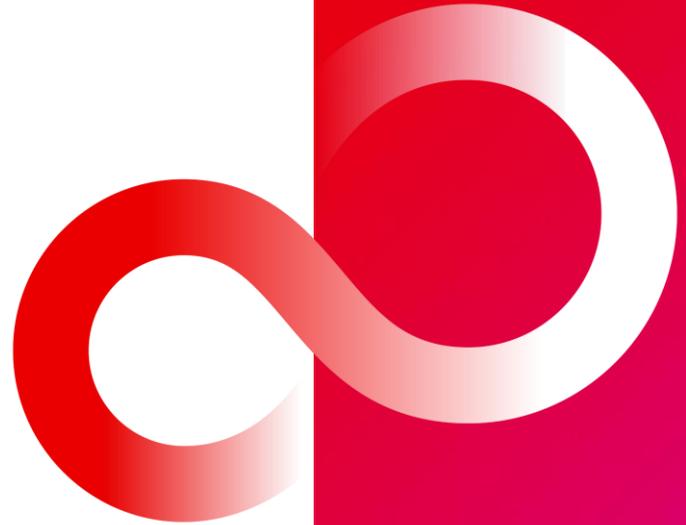
**Information**

**Agenda item**

**8.7.1**

**Source:**

**Moderator (Fujitsu)**



# Discussion plan

# Summary of Q3 2023(April and May meeting) FUJITSU

## ● RAN1#114 (August)

- All the critical issues are finalized in August meeting
- RAN1 declared that RAN1 work for this WI can be closed

## ● RAN#101 (September)

- No concern was raised during this meeting, i.e. RAN confirmed that RAN1 work for this WI can be closed

## ● RAN1#114bis (October)

- An essential issue was found (though at least one company doesn't think so) for TCI state indication, and this issue was not resolved in RAN1#114bis
- It was confirmed that companies have different understanding / preference on the handling of TC states

It is expected that all essential issues (i.e. impacting MAC CE/RRC parameters) are resolved in RAN1#115

The TCI state indicated in the cell switch command is associated with:

- Option A: LTM TCI state pool of the target cell, i.e. configured under LTM-Candidate-r18
- Option B: TCI state pool of the target cell, i.e. target cell's ServingCellConfig

### 6.1.3.xy LTM Cell Switch Command MAC CE

The LTM Cell Switch Command MAC CE is identified by MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a variable size with following fields (Figure 6.1.3.xy-1):

- R: Reserved bit, set to 0: **[FFS]**
- Target Configuration ID: This field indicates the index of candidate target configuration to apply for LTM cell switch, corresponding to **[ltm-CandidateId]** as specified in TS 38.331 [5]. The length of the field is 3 bits;
- Timing Advance Command: This field indicates whether the TA is valid for the LTM target cell (i.e. the SpCell corresponding to the target configuration indicated by Target Configuration ID field). If the value of this field is set to FFF, this field indicates that no valid timing adjustment is available for the PTAG of the LTM target cell (and UE shall perform Random Access to the LTM target cell); Otherwise, this field indicates the index value  $T_d$  used to control the amount of timing adjustment that the MAC entity has to apply in TS 38.213 [6], and that the UE can skip the Random Access procedure for this LTM cell switch. The length of the field is 12 bits;
- TCI state ID: This field indicates and activates the TCI state for the LTM target cell (i.e. the SpCell of the target configuration indicated by the Target Configuration ID field). The TCI state is identified by **TCI-StateId** as specified in TS 38.331 [5]. If the value of **unifiedTCI-StateType** in the SpCell of the target configuration indicated by Target Configuration ID field is **joint**, this field is for joint TCI state, otherwise, this field is for downlink TCI state. The length of the field is 7 bits;
- UL TCI state ID: This field indicates and activates the uplink TCI state for the LTM target cell (i.e. the SpCell of the target configuration indicated by the Target Configuration ID field). The most significant bits of UL TCI state ID are considered as reserved bits and the remainder 6 bits indicate the **TCI-UL-StateId** as specified in TS 38.331 [5]. This field is included if the value of **unifiedTCI-StateType** in the SpCell corresponding to the target configuration indicated by Target Configuration ID field is **separate**. The length of the field is [8] bits;

## ● RAN1 CRs (For RAN#101)

TS	CR	Re v	Rel	Title	Cat	Vsn	@ Mtg	TD#	Source to WG	Work Item	Clauses affected	Other Aff Specs
38.212	0146	-	Rel-18	Introduction of Rel-18 Further NR mobility enhancements	B	17.5.0	RAN1#114	R1-2308711	Huawei	NR_Mob_en h2-Core	6.3.1.1.2, 6.3.2.1.2, 7.3.1.2.1	TS 38.213, TS 38. 214
38.213	0505	-	Rel-18	Introduction of further mobility enhancements	B	17.6.0	RAN1#114	R1-2308699	Samsung	NR_Mob_en h2-Core	4.2, 7.4, 7.5, 8.1, 21 (new)	
38.214	0439	-	Rel-18	Introduction of specification support for mobility enhancements	B	17.6.0	RAN1#114	R1-2308718	Nokia	NR_Mob_en h2-Core	5.2.1, 5.2.1.1, 5.2.1.2, 5.2.1.4.1, 5.2.1.4.2,	TS 38.212, TS 38.213

## ● RAN1 CRs (After RAN1#114bis)

- TS38.212 – [R1-2310747](#)
- TS38.213 – [R1-2310731](#)
- TS38.214 – [R1-2310762](#)



- R2-2311333 (RAN2)
  - 1. For the model of CSI report configuration, RAN2 to implement Option2 (i.e., introduce ltm-CSI-ReportConfig and not reuse CSI-ReportConfig) as in current RRC running CR.
  - 2. For the model of RS configuration, RAN2 to follow what is indicated by RAN1 in the parameter list.
  - 3. The LTM CSI resource configuration is generated by the CU.
  - 4. The list of LTM CSI resource configuration is common for all the LTM candidate cells (as in current RRC running CR).
  - 5. RAN2 assumes that network can include the field spCellInclusion only if the SpCell is an LTM candidate cell.
  - Question: Does the UE need to know the SMTC of LTM candidate cells in order to perform L1 measurements (so that it needs to be included in the RS configuration)?
- R4-2317331(RAN4) : Reply LS on beam application time
  - RAN4 do not define beam application time. If the definition of beam application time is needed from RAN1's perspective, RAN4 understands that it would be only specified by RAN1. Current cell switch delay defined in RAN4 can cover the TCI state application time, and there is no need to include additional beam application time component in the cell switch delay requirements.
- R4-2317428(RAN4): LS on Improvement of SCell/SCG setup delay
  - NO RAN1 action

# Open issues for RAN1#115

- **Issue 1-1: Reply to RAN2 LS (High priority at least for providing our answer to RAN2)**
  - Does the UE need to know the SMTC of LTM candidate cells in order to perform L1 measurements (so that it needs to be included in the RS configuration)?
  - FL view: RAN4 is more appropriate to answer this question
- **Issue 1-2: Introduction of SSB-based L1 SINR (Low priority)**
  - FL view: this issues is too big for the maintenance phase
  - FL suggestion is to discuss in RAN plenary for Rel-19
- **Issue 1-3: Number of CPU occupied by an LTM CSI report (Mid priority)**
  - common understanding is 1 CPU, but it was confirmed that companies want to clarify

- **Issue 2-1: A MAC CE is introduced to activate/deactivate the SSB(s)/cell(s) configured in the L1 measurement report (Low priority)**
  - FL view: this issue is too big for the maintenance phase: the system will work without this mechanism
  - Companies are encouraged to take the following conclusion (i.e. outcome of offline offline discussion during RAN1#114bis):
    - *the intention of this proposal is achieved by the existing mechanism, i.e. semi-persistent reporting with different resource set. No new MAC CE will be defined in Rel-18.*
- **Issue 2-2: Necessity to define a new priority rule for LTM CSI report (Mid Priority)**
  - FL view: RAN2 decided to take option 2 for LTM report configuration. Then, we need to consider the case where CSI report for LTM and legacy have the same priority based on the current rule.
  - It is also pointed out that CSI report for LTM should have higher priority than legacy CSI report, which need more discussion at RAN1#115
  - Unless a configurability is introduced, this issue can be handled as a RAN1 maintenance issue.

## ● Issue 3-1: Beam indication when Rel-17 Unified TCI framework is not applicable (Mid priority)

- The following proposal has been open

- For beam indication of target cell based on Rel-17 unified TCI framework applied to at least CORESET#0 and CORESETs (other than CORESET#0) associated with Type 0A/1/2-PDCCH CSS sets where followUnifiedTCI-state is not enabled or not provided:
  - Alt.1: Follow the indicated TCI state until a new TCI state is configured or activated by the target cell
  - Alt.1': use the QCL assumption of the SSB configured as the root QCL reference of the indicated TCI until a TCI activation/indication is given in the target cell
  - Alt.4: No new behaviour is introduced on top of Rel-17 unified TCI

- This proposal tries to address the missing part of the specification. Should be solved at RAN1#114
- We need further assessment on “at least” in the proposal: applicability to other PDCCH CSS type (0B: multi/broadcast, 1A: SDT, 2A: PEI)
- Consequence if no consensus is achieved: Alt 4 is automatically taken and gNB scheduler is required to avoid the occurrence of such cases.
- After concluding this issue, we can also discuss the additional issue on monitoring occasions for Type 0A/1/2-PDCCH CSS

## ● Issue 3-2: Beam application time (Mid priority)

- RAN4 LS is received after October meeting: *RAN4 do not define beam application time. If the definition of beam application time is needed from RAN1's perspective, RAN4 understands that it would be only specified by RAN1. Current cell switch delay defined in RAN4 can cover the TCI state application time, and there is no need to include additional beam application time component in the cell switch delay requirements.*
- From the RAN4 description, there might be no necessity of further RAN1 discussion for this issue.
- However, according to the discussion so far, beam application time in RAN1 may require RRC signaling (depending on our decision). Final decision will be made at RAN1#115 based on companies' contribution.

- **Issue 3-3: Simultaneous operation of Rel-17 ICBM and Rel-18 LTM (Low priority at least under this AI)**
  - FL observation: majority of the companies see no necessity to introduce any new features to support this operation in Rel-18
  - FL suggestion is to discuss this issue under UE capability session

- **Issue 3-4: Beam indication for multiple cells for CA (Mid Priority)**
  - The common understanding is that the existing mechanism, i.e. the use of SimultaneousU-TCI-statelist is applicable for LTM case.
  - However, there are two different views where this RRC parameter is provided: FL thinks Alt.1 is the easier way and relevant for maintenance phase
    - Alt 1. Under ServingCellConfig for the target cell.
    - Alt 2. Under LTM-Candidate-r18
  - After that, we can discuss when the TCI states for the candidate cells in the list (i.e. potential Scells) are activated.
  - It was also pointed that this mechanism doesn't work for the case where beam configuration is different for each cell, i.e. FR1-FR2 CA
    - More discussion is necessary whether/how to address this case in Rel-18
  - If no consensus achieved, Alt.1 would be the interpretation and TCI state activation can be discussed as a maintenance issue

# 3. Beam indication

- **Issue 3-5: TCI states used during and after cell switch command for RACH-based LTM (High priority)**
  - This issue was postponed because RAN2 had the same discussion
  - RAN2 conclusion:
    - *Session chair: We wait for R1 discussion. If not converged at next meeting RAN2 can decide.*
  - Therefore, RAN1 can make the final decision on this issue, while some coordination between RAN1 and RAN2 would also be helpful
  - The point of the discussion is:
    - Just following indicated TCI state is helpful to unify the operation regardless of RACH
    - During RACH procedure, just reusing legacy procedure would be useful not to change the UE behavior. On the other hand, UE is required to further perform the SSB measurement to detect the best SSB to perform RACH for this case.
    - What is the applicable physical channels implied by "during RACH procedure"
    - Whether TRS should be used during RACH procedure, when configured.
  - This is an essential correction for RACH based LTM, and should be concluded at RAN1#115

In Rel-18 LTM and when **TCI-state field** is included in the cell switch command, for the scenario where the UE needs to perform RACH-based LTM after receiving cell switch command,

- Opt.1: During and after RACH procedure until a new TCI state is indicated by the target cell, **a UE follows the indicated TCI-state in the cell switch command.**
- Opt.2: During and after RACH procedure until a new TCI state is indicated by the target cell, a **UE follows the SSB identified during a recent RACH procedure.**
- Opt.3:
  - During RACH procedure, **a UE follows the SSB identified during a recent RACH procedure.**
  - After RACH procedure until a new TCI state is indicated by the target cell, **a UE follows the indicated TCI-state in the cell switch command**
- Opt.4: CFRA with Opt.1 and CBRA with Opt.2.
- Opt.5:
  - During RACH procedure, **a UE follows the SSB of the indicated TCI-state in the cell switch command.**
  - After RACH procedure until a new TCI state is indicated by the target cell, **a UE follows the indicated TCI-state in the cell switch command**
- Opt.6:
  - Channels associate with RACH procedure, **a UE follows the SSB identified during a recent RACH procedure.**
  - Channel following indicated TCI states until a new TCI state is indicated by the target cell, **a UE follows the indicated TCI-state in the cell switch command**

# 3. Beam indication

- Issue 3-6: Association of TCI state indication in the cell switch command (High priority)

- The TCI state indicated in the cell switch command is associated with
  - LTM TCI state pool of the target cell, i.e. configured under LTM-Candidate-r18
- UE uses the TCI state provided in the cell switch command after receiving cell switch command until a TCI state [in the new serving cell] is indicated
  - Note: after TCI in the new serving cell is indicated, legacy BM is used.
- FFS: whether and how retain LTM activated TCI states for candidate cell

- FL would like to decouple this issue from others, e.g. 5-3
  - However, it should be noted that “separate TCI state pool management for LTM and legacy BM” is the baseline assumption here
- The cyan part above could be the common understanding of the group considering the current agreement in RAN3
- The controversial part is how to reduce the UE complexity to manage these two TCI state pools:
  - One solution is to associate these two TCI state pool: for a candidate cell, the TCI state list should be the same for LTM-candidate-r18 and ServingCellConfig, and the indicated TCI state index can point the same TCI state.
  - Another solution is to relax the UE capability, i.e. to introduce a very limited number of activated TCI states (for LTM and BM)

## ● Other proposals

- FL will not re-open the following discussions in Rel-18
  - Beam indication timing scenario 1
  - Beam indication mechanism applicable to gNBs not supporting Rel-17 TCI framework
  - Beam indication for mTRP

- No major issues for cell switch command
- Other proposals
  - Provision of BWP information (DL/UL) in cell switch command for the activated TCI states
    - Majority companies saw no need for this proposal at RAN1#114bis.
    - We may come back based on companies' contributions
  - UE behavior for legacy beam switch after receiving cell switch command
    - Majority companies saw no issue
    - We may come back based on companies' contributions

- Issue 5-1: Deactivation of activated TCI states for LTM (Mid priority)
  - The following issue was identified during RAN1#115, but no time to come-back was available
    - *RAN1 to discuss how to activate/deactivate LTM TCI states for multiple cells based on the running CR 38.321, which allows LTM TCI state activation for single cell at one time*
  - RAN1 spirit is to solve this issue without impacting MAC specifications

# 5. TCI state activation

- Issue 5-2: UE behavior when TRS configuration is provided under LTM-Candidate-r18 for candidate cells (High priority)
  - TRS configuration for candidate cell(s) can be provided, and UE capability is also introduced.
  - However, the corresponding UE behavior hasn't been clear yet.

gNB behavior for TRS		UE behavior for candidate cell tracking			
Provision of candidate cell TRS config.	Whether candidate cell TRS is transmitted before cell switch takes effect	UE capability	Before cell switch command	During cell switch command (until the completion of cell switch)	After cell switch (until receiving new MAC CE for TCI state activation)
Yes	Yes	Yes (UE can track TRS for candidate cell before cell switch)	Alt 1. Track TRS Alt 2. Track SSB Alt 3. Up to UE	Alt 1. Track TRS Alt 2. Track SSB Alt 3. Up to UE	Alt 1. Track TRS Alt 2. Track SSB Alt 3. Up to UE
	No		Alt 1. Track TRS Alt 2. Track SSB(Q. How does the UE know that TRS is not transmitted) Alt 3. Up to UE(Q. How does the UE know that TRS is not transmitted) Alt 4. This operation is not allowed (i.e. UE can assume the presence of TRS if configured)	Alt 1. Track TRS (It should be clarified when the UE can assume the presence of TRS) Alt 2. Track SSB(Q. How does the UE know that TRS is not transmitted) Alt 3. Up to UE(Q. How does the UE know that TRS is not transmitted) Alt 4. This operation is not allowed (i.e. UE can assume the presence of TRS if configured)	Alt 1. Track TRS (It should be clarified when the UE can assume the presence of TRS) Alt 2. Track SSB Alt 3. Up to UE
No	Yes		No	Track SSB	Track SSB
	No	Alt 1. Track SSB Alt 2. This operation is not allowed (i.e. misconfiguration)		Alt 1. Track TRS (It should be clarified when the UE can assume the presence of TRS) Alt 2. Track SSB Alt 3. This operation is not allowed (i.e. misconfiguration)	Alt 1. Track TRS (It should be clarified when the UE can assume the presence of TRS) Alt 2. Track SSB [Only DL scheduled by CSS (other than type 3 CSS) is allowed ??] Alt 3. This operation is not allowed (i.e. misconfiguration)
No	Yes	No	Track SSB	Track SSB	Track SSB [Only DL scheduled by CSS (other than type 3 CSS) is allowed ??]
	No				

RAN1 can look at the spec change (if any) after achieving our common understanding

- **Issue 5-3: Retain or deactivate TCI states after cell switch (Mid priority)**
  - Baseline assumption: UE management for TCI state pool is independent for LTM and legacy BM
  - The potential benefit to retain TCI states other than target cell is to be ready for the immediate handover (LTM) right after cell switch
  - The potential benefit to retain TCI states for target cell is to be ready beam switch (i.e. legacy beam management) right after cell switch
    - It was pointed out that his concept contradicts with the baseline assumption above
    - However, the benefit may remain if the association between two pools are defined
  - FL understands that option 4 is the simplest solution: if necessary, the new serving cell can always send a MAC CE to activate the necessary TCI states for LTM and legacy BM
  - FL recommendation is to discuss this issue after issue 3-6 is concluded.

After cell switch, for the activated LTM TCI states,

- Option 1: UE retains the activated LTM TCI states only for the target cell
- Option 2: UE retains the activated LTM TCI states for all candidate cells other than target cell
- Option 3: UE retains the activated LTM TCI states for all candidate cells (may need RRC configuration / MAC CE to deactivate— FFS condition)
- Option 4: UE deactivates all activated LTM TCI states other than indicated TCI state
- Option 5: configurable between 1, 2,3,4,5 depending on UE capability
- Support:

Thank you

