

FL plan on L1 enhancements for LTM at RAN1#112bis-e

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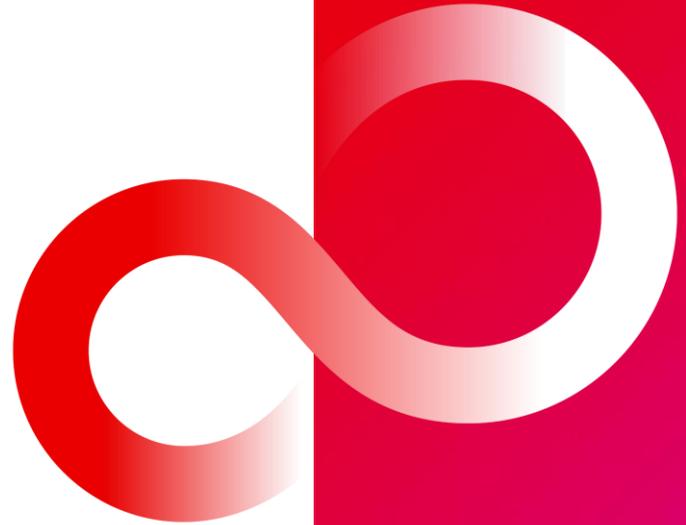
Information

Agenda item

9.10.1

Source:

Moderator (Fujitsu, MediaTek)



Discussion plan

● RAN1#112 (Feb)

- In RAN1#112, most of discussion time was spent on L1 measurement configuration, and hence sufficient time cannot be given to other important topics such as reporting, beam indication etc.
 - In short, the overall progress was not so good
- However, FL believes the technical discussions were good enough to reach a lot of important agreements in April meeting.

● RAN1#112b-e (April)

- Considering the remaining time for Rel-18 competition (1 e-meeting and 2 F2F meetings), FL sees the strong necessity to focus on the essential issues.
 - The list of essential issues are provided in the next slide
- Non-essential/optimization issues will be treated on best-effort basis

● RAN1#113 (May)

- Follow-up discussions on the essential issues will be performed
- Based on the agreements in RAN1#112b-e, discussion on RRC parameters needs to be commenced.

Detailed plan for each meeting

Meeting No	Key issues
RAN1#112b-e (April)	<p>Essential issues</p> <ul style="list-style-type: none">• [Update of RAN1 assumptions on L1 intra- and inter frequency measurement – <i>no strong need for RAN1 discussion in #112b-e</i>]• Configurations for L1 measurement – necessary configuration parameters, including time domain information• Contents of gNB scheduled L1 measurement reporting (how to choose the beams for reporting [followed by how many, how/whether to configure/activate the beams of the cells etc.])• Preparation for cell switch and beam indication: Details on DL synchronization• Beam indication for scenario 2 based on Rel-17 unified TCI framework (beam indication applies to signals/channels that <u>does not</u> follow Rel-17 unified TCI, and beam indication for multiple target cells [followed by beam application time])• [Simultaneous operation of Rel-17 ICBM and Rel-18 LTM – maybe UE capability discussion: <i>can be treated in RAN1#113</i>]• Information included in cell switch command <p>Low priority issues</p> <ul style="list-style-type: none">• CSI-RS based L1 measurement• L1-SINR• Filtering for L1 measurement results• Additional container for gNB scheduled L1 measurement reporting (PUCCH, MAC CE)• UE/event triggered reporting• Preparation for cell switch and beam indication: TRS tracking and CSI acquisition• Beam indication for scenario 1• Beam indication applicable to gNBs supporting only Rel-15 TCI framework
RAN1#113 (May)	<ul style="list-style-type: none">• Continuation of essential issues• RRC parameters
RAN#100 (June)	TBD

red part: handled by Fujitsu

blue part: handled by MediaTek

RAN1 agreements and FL plans for RAN1#112b-e

[Conclusion at RAN1#110b-e]

Agreement

- For Rel-18 L1/L2 mobility, L1 intra-frequency measurement for candidate cell is supported
 - At least the following aspects are for RAN1 further study:
 - RAN1 assumes Rel-17 ICBM CSI measurement as starting point.
 - Whether and how to apply relaxation for the restrictions imposed on the Rel-17 intra-frequency L1 non-serving cell measurement defined in 9.13.2 of TS38.133, where RAN4 impact is foreseen, e.g.
 - SFN offset alignment compared with serving cell
 - BWP setting, i.e. non-serving cell SSB should be covered by serving cell active BWP
 - Introduction of symbol level gap or SMTC for larger Rx timing difference (i.e. larger than CP length)
 - Commonality with intra-frequency L3 measurement
 - Commonality with L1 inter-frequency measurement for measurement configuration
- Send an LS to RAN4 (CC RAN2)
 - RAN1 to ask RAN4 if the restriction on e.g., SFN offset alignment, BWP setting and Rx timing difference, etc, described in 9.13.2 of TS38.133 for intra-frequency L1 non-serving measurement can be relaxed or not.
 - RAN1 assumes Rel-17 ICBM CSI measurement as starting point.

[Conclusion at RAN1#111, #112]

No discussion, wait for RAN4 LS

L1 measurement: L1 Inter-freq measurement

[Conclusion at RAN1#110b-e]

Agreement

- For Rel-18 L1/L2 mobility, further study the potential RAN1 spec impact of L1 inter-frequency measurement
 - The definition and scenarios of L1 inter-frequency measurement is determined by RAN4, and RAN1 assumes at least the following until receiving their confirmation
 - The scenarios not included in intra-frequency are regarded as inter-frequency, which includes at least the following scenarios:
 - The frequency of the measured RS not covered by any of the active BWPs of SpCell and Scells configured for a UE, but covered by some of the configured BWPs of SpCell and Scells configured for a UE.
 - The frequency of the measured RS not covered by any of the configured BWPs of SpCell and Scells configured for a UE
 - At least the following aspect is studied:
 - Commonality with L1 intra-frequency measurement for measurement configuration
- Send an LS to RAN4 (CC RAN2)
 - RAN1 would like to confirm our understanding that the supported scenarios not included in intra-frequency are regarded as inter-frequency, which includes at least the following scenarios:
 - The frequency of the measured RS not covered by any of the active BWPs of SpCell and Scells configured for a UE, but covered by some of the configured BWPs of SpCell and Scells configured for a UE.
 - The frequency of the measured RS not covered by any of the configured BWPs of SpCell and Scells configured for a UE
 - It is RAN1 understanding that the introduction of measurement gap and SMTC for L1 inter-frequency measurement, if any, is expected to be a RAN4 issue
 - Note: this content is included in the LS agreed for intra-frequency L1 measurement

[Conclusion at RAN1#111]

Agreement

- For Rel-18 LTM, L1 inter-frequency measurement is supported from RAN1 point of view.

[Conclusion at RAN1#111]

No discussion, wait for RAN4 LS

Definition of L1 measurement based on the RAN4 LSs:

- SSB-based Intra-frequency L1 measurement:
 - Center frequency and SCS of the SSB of the candidate cell are the same as those for serving cells, which is indicated in ServingCellConfigCommon
 - For the time offset,
 - The SFN offset alignment can be relaxed if UE performs L3 measurement before L1 measurement *(FL note: it is not clear if this has any RAN1 spec impact – and maybe none)*
 - The scenario that RTD between the SSBs of serving cell and candidate cell on the same carrier is larger than CP length of the corresponding SCS is supported with additional UE capability.
 - The UE capability is discussed and defined in RAN4
 - For the BWP setting,
 - The SSB for intra-frequency L1 measurement may not be covered by serving cell active BWP at least in some scenario.
 - The definition of the scenario is determined by RAN4
- SSB-based Inter-frequency L1 measurement:
 - The supported scenarios not included in intra-frequency L1 measurement are regarded as inter-frequency L1 measurement.

Because RAN4 agreements for the definition of intra-frequency L1 measurement include many FFS, FL sees no strong necessity to update the RAN1 agreements at RAN1#112b-e.

[Conclusion at RAN1#110b-e]

Agreement

- For Rel-18 L1/L2 mobility,
 - SSB is supported for L1 intra-frequency measurement
 - SSB is supported for L1 inter-frequency measurement if inter-frequency L1 measurements are supported
- Further study the following L1 measurement RS for candidate cell
 - CSI-RS for tracking, beam management, CSI and mobility, CSI-IM, which is for L1 intra-frequency and L1 inter-frequency (if supported)

[Conclusion at RAN1#111]

The FL proposal 1-4-v3 was not due to the lack of time during RAN1#111. Companies are encouraged to perform their analysis based on the latest proposal below:

- For Rel-18 LTM,
 - L1 measurement based on CSI-RS for beam management for candidate cells is supported for L1 intra-frequency measurement and L1 inter-frequency measurement if supported in RAN4
 - The definition of intra- and inter- frequency for CSI-RS is defined in RAN4
 - The CSI-RS is explicitly linked to a candidate cell
 - Applicability to L1-RSRP and/or L1-SINR is separately discussed.
 - FFS for the support of other CSI-RS types (i.e. tracking, CSI, mobility and CSI-IM).

[Conclusion at RAN1#112]

No consensus on the following proposal (No time to come back), postpone to the next meeting.

- **[Working assumption]:** CSI-RS is introduced for L1-RSRP measurement from RAN1 point of view
 - Intra- and inter- frequency is supported
 - At least CSI-RS for BM [mobility] is supported
 - Send an LS to RAN4 to explicitly ask their feasibility to finalize their work in Rel-18]

- Given the controversy in RAN#112, FL is afraid that the discussion on CSI-RS requires long online/GTW time in RAN1#112b-e
 - Spec impact and RAN4 workload
 - Necessity and benefit on top of SSB based L1 measurement
- Rel-18 LTM functionality can be completed without CSI-RS based L1 measurement: SSB-based measurement is anyway available

FL is not so positive to handle this issue in RAN1#112b-e, but the final decision (on treat or not) will be made based on the companies' contributions

[Conclusion at RAN1#110b-e]

- **Agreement**

For candidate cell measurement for Rel-18 L1/L2 mobility,

- L1-RSRP is supported for intra-frequency candidate cell measurement.
- Further study the following measurement quantities for candidate cell measurement
 - L1-RSRP for inter-frequency (if supported)
 - L1-SINR for intra-frequency and inter-frequency (if supported)

FFS: to assess the use case and the benefit of UL measurement instead of/in addition to DL L1 measurement, which includes:

- How the UL measurement result is used, e.g. handover decision
- Signals/channels used for UL measurement, e.g. SRS
- Spec impact including other WGs, e.g. definition of gNB measurement, interface to transfer RS configuration or measurement results
- Note: The next discussion will take place based on companies' contribution in future meeting.

[Conclusion at RAN1#111]

- **Agreement**

- For candidate cell measurement for Rel-18 LTM,

- SSB based L1-RSRP is supported for intra-frequency measurement
- SSB based L1-RSRP is supported for inter-frequency measurement from RAN1 point of view
- FFS: L1-SINR, CSI-RS based L1-RSRP

[Conclusion at RAN1#112]

No consensus on the following proposal

- [CSI-RS based L1-SINR (with channel measurement and interference measurement using CSI-RS) is introduced from RAN1 point of view
 - If supported, both intra- and inter-frequency L1-SINR is supported
 - Send an LS to RAN4 to explicitly ask their availability in Rel-18]

- It is pointed out that the benefit of L1-SINR cannot be achieved by SSB, but CSI-RS
- However, the introduction of CSI-RS has not been agreed yet
- Also, companies have a different understanding on the benefit of L1-SINR

**FL plan is to deprioritize this discussion in RAN1#112b-e.
This topic may be discussed depending on the result on CSI-RS based L1 measurement.**

[Conclusion at RAN1#110b-e]

Postponed (FL proposal 1-6)

- For Rel-18 L1/L2 mobility, [study the importance of mitigating the ping-pong issue for L1/L2 mobility, which is expected to align with RAN2. If important yes,] further study at least the following mitigation aspects:
 - UE-based filtering to the L1 measurement results, where the definition of filtering includes:
 - Time domain filtering: e.g. exact definition of time domain filtering, and/or
 - Cell-level (spatial domain) filtering: e.g. how many beams are averaged, and/or how the beams are chosen.
 - Applicability to L1-RSRP and L1-SINR (if supported)
 - Applicability to intra-frequency and inter-frequency (if supported)
 - Necessity to be specified in standard considering the presence of alternative implementation-based solutions, e.g. gNB-based filtering and/or L3 measurement (when involved)

[Conclusion at RAN1#111]

Given the comments from companies, FL believes no positive result can be obtained on this topic even when we discuss the discussion in this meeting. Therefore, FL would like to take approach 1 this meeting and to encourages to have offline discussions for the next meeting.

With this analysis, the discussion on this section is closed. If companies have any comments, the following table can be used or further input.

[Conclusion at RAN1#111]

No discussion

FL plan is to deprioritize this discussion in RAN1#112b-e

[Conclusion at RAN1#112]

Agreement

- For L1-RSRP measurement RS configuration
 - For SSB based L1-RSRP measurement:
 - ◇ As a starting point, at least the following information needs to be provided to a UE, e.g.
 - For intra- and inter- frequency: PCI or logical ID (e.g., as being defined in R17 ICBM), time domain (e.g. SMTC or periodicity and SSB position in burst)
 - For inter-frequency: frequency domain location (e.g. center frequency), SCS
 - FFS: transmission power (for pathloss calculation)
 - ◇ Note: other parameters included in the configuration can be further discussed
 - ◇ Including above agreement into the LS
 - The detailed design of RRC structure is up to RAN2, and send an LS to RAN2 to request to work on the RRC structure design on the measurement configuration.
 - ◇ Following RAN1 understanding will be provided in the LS
 - RAN1 has discussed the following configuration options for L1 measurement configurations for SSB till RAN1#112:
 - Option 1) Configurations for L1 measurement RS is provided under ServingCellConfig for the serving cells
 - ◇ is useful to reuse the mechanism for Rel-17 ICBM and necessary information to support inter-frequency measurement will be added there.
 - Option 2) Configurations for L1 measurement RS is provided separately from ServingCellConfig for the serving cells and CellGroupConfig for the candidate cells
 - ◇ is useful to avoid the duplicated configurations for L1 measurement RSs, [and avoid UE to process configurations for L1 measurement RS provided under CellGroupConfig for the candidate cells]
 - Option 3) Configurations for L1 measurement RS is provided under CellGroupConfig for the candidate cells
 - ◇ can achieve the similar benefit as Option 2) by directly referring to the candidate cell configurations.
 - Note RAN2 has a full flexibility to design the whole RRC structure design.
 - RAN1 believes this is RAN2 expert region, and respectfully asks RAN2 to finalize the RRC structure design after RAN1 finalizes the discussion on RRC parameters.
 - It is noted that RAN1 foresees the necessity of similar discussions on TCI state pool for candidate cells and L1 measurement report configurations.
- While RRC structure will be handled by RAN2, RAN1 still need to complete the necessary RRC parameters for L1 intra- and inter- frequency measurement, e.g.

- Time domain information (yellow part above)
- Resolution of FFS (i.e. transmission power) , etc

To prepare an initial RRC list in May, further discussion on the RRC parameter list (especially time domain discussion) is necessary in RAN1#112b-e

Agreement

- Send an LS to RAN2/RAN3 asking the clarification on intra-/inter-DU scenario:
 - RAN1 has started the discussion on the configuration for L1 measurement and TCI states for candidate cells. Regarding the following RAN2 agreements captured in RAN2 LS (R1-2208331/R2-2209257), it is not clear for RAN1 which kind of information/configuration for candidate cell(s) are available at a serving cell for inter-DU case for Rel-18 L1/L2 mobility. Thus, companies have different understanding on the implication of the sentence “as much commonality as reasonable” in the LS.
 - *The design for intra-DU and inter-DU L1/L2-based mobility should share as much commonality as reasonable. FFS which aspects need to be different.*
 - RAN1 respectfully asks RAN2 and RAN3 if the serving DU knows the measurement RS configuration and TCI state configuration of cells served by another DU

● Reply from RAN2 (R2-2212988) available

- *RAN2 assumes that LTM (intra DU and inter DU) is network-controlled mobility where the control is from the source, i.e., measurements (L1 measurements) are configured in the UE from the source Cell, and the decision to switch cell is by the source cell, and enhancements considered for LTM before cell switch, e.g. pre-synchronization, TA handling, target beam management (to the extent it is supported) may be made by the source cell. RAN2 understands that this may require cooperation among source DU, CU, target DU, and/or OAM. RAN2 don't see any blocking issue to share information between DUs but the support of this is in RAN3 domain. RAN2 see no necessity for a direct inter-DU-interface to support this.*

● Reply from RAN3 (R3-226829) available

- *Regarding Q3 about L1 measurement and TCI state configurations in the LS, RAN3 agreed that based on the current specification, the serving DU cannot know the measurement RS configuration and TCI state configuration of cells served by another DU.*
- *Any possible consideration for Rel-18 on the coordination over F1 among serving DU, target DU, and CU would need clearly identified requirements from other groups.*

**RAN1 needs to define a clear requirement to RAN3 to move forward.
The necessity of further LS on this matter depends on the agreement in RAN1#112b-e.**

L1 measurement reporting – Contents of gNB scheduled L1 measurement reporting

[Conclusion at RAN1#110b-e]

Agreement (FL proposal 2-1-1)

- For L1 measurement report for Rel-18 L1/L2 mobility, further study the following mechanisms:
 - Report as UCI on PUCCH or PUSCH
 - Periodic report on PUCCH, semi-persistent report on PUCCH/PUSCH, and aperiodic report on PUSCH
 - Further study potential enhancements to Rel-17 ICBM report format to accommodate Rel-18 scenarios, e.g.
 - Inter-frequency measurement, if supported
 - Increasing the maximum number of reported beams, which is 4 for Rel-17 ICBM
 - Flexible size beam report, e.g. two-part UCI (e.g., the 1st part contains the best beam/cell and the number (e.g., N) of reported beams/cells, the 2nd part contains the rest (N-1) beams/cells
 - Reducing the reporting overhead by e.g. choosing beams/cells per frequency or across frequencies to report (FFS how)
 - Report on MAC CE
 - Both gNB scheduled and/or UE initiated (if supported) report are studied

[Conclusion at RAN1#112]

No consensus on the following proposal, but common understanding is that the blue part is the key issue in RAN1#113

- For L1 measurement reporting for LTM,
 - **At maximum [4] beams** (4 is a starting point, FFS: the values and UE capabilities) from candidate cell(s) **and serving cells** configured for measurement & reporting can be reported in a single report instance
 - **FFS whether the configured candidate cell(s) can be activated**
 - **FFS how to choose the beams to be reported from multiple candidate cells, e.g. from all configured/activated candidate cells, from each candidate cell, from each group of candidate cells, from selected candidate cells**
 - **Additionally/At least** 1 beam from the serving cell is included in the report instance
 - FFS: always included or depending on the gNB configuration

- It was confirmed in RAN1#112 that the blue part in the conclusion is the most important to move forward
- This needs to be concluded in RAN1#112 as so many follow-up discussions can be foreseen
 - Number of cells/beams to be configured, necessity of activation etc

Discussion on report contents, i.e. how to choose the beams for reporting, is prioritized in RAN1#112b-e

L1 measurement reporting - Container of gNB scheduled L1 measurement reporting

[Conclusion at RAN1#110b-e]

Agreement (FL proposal 2-1-1)

- For L1 measurement report for Rel-18 L1/L2 mobility, further study the following mechanisms:
 - Report as UCI on PUCCH or PUSCH
 - Periodic report on PUCCH, semi-persistent report on PUCCH/PUSCH, and aperiodic report on PUSCH
 - Further study potential enhancements to Rel-17 ICBM report format to accommodate Rel-18 scenarios, e.g.
 - Inter-frequency measurement, if supported
 - Increasing the maximum number of reported beams, which is 4 for Rel-17 ICBM
 - Flexible size beam report, e.g. two-part UCI (e.g., the 1st part contains the best beam/cell and the number (e.g., N) of reported beams/cells, the 2nd part contains the rest (N-1) beams/cells
 - Reducing the reporting overhead by e.g. choosing beams/cells per frequency or across frequencies to report (FFS how)
 - Report on MAC CE
 - Both gNB scheduled and/or UE initiated (if supported) report are studied

[Conclusion at RAN1#111]

Agreement

- For gNB scheduled L1 measurement report for Rel-18 LTM, report as UCI is supported
 - Semi-persistent report on PUSCH, and aperiodic report on PUSCH are supported
 - FFS: periodic and semi-persistent PUCCH
 - In a single report instance, report for serving cell and candidate cell(s) for intra-frequency and/or inter-frequency can be included.

[Conclusion at RAN1#112]

The following proposal was postponed.

- Periodic and semi-persistent PUCCH are also supported for gNB scheduled L1-measurement reporting.

- While majority supports PUCCH as a container for gNB scheduled L1 measurement reporting, this wouldn't be an essential feature because report on PUSCH is available
- The final decision can be made after seeing the feedback contents

Discussion on PUCCH can be deprioritized at least in RAN1#112b-e, then come back after deciding the details of report contents

[Conclusion at RAN1#111]

Agreement

- For L1 measurement report for Rel-18 L1/L2 mobility, if UE event triggered report for L1 measurement is supported based on further study
 - At least the following aspects may be considered
 - How to define UE event and exact definition of events,
 - Report container
 - Resource allocation/assignment for UE event triggered report
 - Necessity of indication to gNB when the condition UE event is met, and how
 - Necessity to define the condition to start/stop the reporting,
 - Contents of the report/reporting format, PCI, RS ID, measurement result etc.
 - The interaction with filtered L1 measurement results (if supported)
 - Support of simultaneous configuration of both UE event triggered and any of periodic/semi-persistence/aperiodic reporting, and solutions when both of them are configured.
 - Report destination, whether the report is sent to serving cell only or can be sent to one or more candidate cell(s).
 - Benefit when L3 measurement is involved

[Conclusion at RAN1#112]

The following proposal was not discussed due to the lack of time

Alt 1

- UE event triggered report for L1 measurement is supported with the following design principle: Alt 2. (if Alt 1 is not agreeable)
 - Supported the following trigger events (FFS on the necessity of modification) where the threshold and offset value (if needed) is configured by RRC
 - ~~A2 based/ Serving becomes worse than absolute threshold;~~

- A3 based/Neighbor becomes amount of offset better than PCell/PSCell;
- ~~A4 based/ Neighbor becomes better than absolute threshold;~~
- A5 based/PCell/PSCell becomes worse than absolute threshold1 and neighbor/Scell becomes better than another absolute threshold2;
- ~~Scell BFR framework~~
- As for Start/Stop condition:
 - Time To Trigger (TTT) is introduced and time duration is configured by RRC, where UE event triggered report is performed when the configured event is continuously fulfilled within the configured time duration.
 - The report is performed only once after the fulfillment of the event, i.e. no stop condition is defined
- No indication to notify the fulfillment of the event condition to gNB is introduced
- MAC CE is used to convey the UE event triggered report
 - The scheduling of PUSCH is up to gNB
- Contents/format defined for gNB scheduled reporting is reused as much as possible (FFS the modifications)
- No filtering mechanism in time domain and cell level is introduced for L1 measurement results
- No specific enhancement on report destination is necessary, i.e. UE follow the gNB indication of Tx spatial filter and pathloss reference RS using the existing mechanism
- gNB scheduled reporting and UE event triggered reporting can be simultaneously configured
- No consensus to introduce UE event triggered report for L1 measurement results in Rel-18

- FL thinks this is an optimization given the support of gNB scheduled reporting
- Also, it will take long time to complete this functionality as proponents have different proposals

FL plan is to deprioritize this discussion in RAN#112b-e

Beam indication - Beam indication mechanism based on Rel-17 unified TCI framework

High Priority

[Conclusion at RAN1#110b-e]

Agreement(FL proposal 3-1)

- RAN1 to further study if the beam indication of candidate cell(s) L1/L2 mobility should be designed for a specific TCI framework below, and their potential RAN1 spec impact.
 - **Option A:** Beam indication for Rel-18 L1/L2 mobility is designed based on Rel-17 TCI framework mechanism
 - **Option B:** Beam indication for Rel-18 L1/L2 mobility is designed based on Rel-15 TCI framework mechanism
 - **Option C:** Beam indication for Rel-18 L1/L2 mobility is designed based on both Rel-15 and Rel-17 TCI framework mechanisms

[Conclusion at RAN1#111]

Agreement

- The beam indication of candidate cell(s) for Rel-18 LTM should be designed based on the following:
 - Beam indication for Rel-18 LTM is designed based on Rel-17 unified TCI framework, if both serving cell and candidate cell support Rel-17 unified TCI framework
 - FFS: whether/how to design mechanism for Beam indication for Rel-18 LTM when at least one from serving cell and candidate cell supports only Rel-15 TCI framework.
 - Note: How and whether to indicate the new serving cell(s) and timing for beam indication are separately discussed

[Conclusion at RAN1#112]

Agreement

- At least for Rel-17 unified TCI framework based beam indication included in cell switch command (i.e. scenario 2), beam indication applies to signals/channels that follow or are configured to follow Rel-17 unified TCI at the target cell(s)
 - FFS: beam indication for mTRP case
- The following proposals are postponed
- The existing mechanism, i.e. simultaneousTCI-UpdateList1 and simultaneousTCI-UpdateList2, is reused to indicate TCI states for multiple target cells
 - Beam application time may be different from that for Rel-17 ICBM, FFS the exact value(s)

- While there were intensive discussions on the necessity of beam indication for the signals/channels that doesn't follow Rel-17 unified TCI at the target cell, no details were captured in the chair's note
 - FL believes that further assessment by companies on this aspect is necessary to complete the design of beam indication based on Rel-17 unified TCI framework
- The mechanism of beam indication for multiple serving cells needs discussion, especially if the existing mechanism can be reused.
- Beam application time can be discussed after all the necessary procedure is clarified, i.e. no urgent discussion in RAN1#112b-e is foreseen

The following issues need to be discussed/assessed in RAN1#112b-e:

- the necessity of a mechanism for beam indication applies to signals/channels that does not follow Rel-17 unified TCI at the target cell(s)
- measures to apply beam indication for multiple serving cells
- [beam application time, especially whether the necessity of different value from Rel-17 ICBM – this can be discussed after the UE procedure is clarified]

Beam indication - Beam indication mechanism based on Rel-15 TCI framework

[Conclusion at RAN1#110b-e]

Agreement(FL proposal 3-1)

- RAN1 to further study if the beam indication of candidate cell(s) L1/L2 mobility should be designed for a specific TCI framework below, and their potential RAN1 spec impact.
 - **Option A:** Beam indication for Rel-18 L1/L2 mobility is designed based on Rel-17 TCI framework mechanism
 - **Option B:** Beam indication for Rel-18 L1/L2 mobility is designed based on Rel-15 TCI framework mechanism
 - **Option C:** Beam indication for Rel-18 L1/L2 mobility is designed based on both Rel-15 and Rel-17 TCI framework mechanisms

[Conclusion at RAN1#111]

Agreement

- The beam indication of candidate cell(s) for Rel-18 LTM should be designed based on the following:
 - Beam indication for Rel-18 LTM is designed based on Rel-17 unified TCI framework, if both serving cell and candidate cell support Rel-17 unified TCI framework
 - **FFS: whether/how to design mechanism for Beam indication for Rel-18 LTM when at least one from serving cell and candidate cell supports only Rel-15 TCI framework.**
 - Note: How and whether to indicate the new serving cell(s) and timing for beam indication are separately discussed

[Conclusion at RAN1#112]

FL proposal

- Interested companies are encouraged to check the proposal on by proponent companies, and to input their contribution to the future meeting as necessity.

- In RAN1#112, only a few companies were interested in FFS part (with cyan marker)
- The necessity to consider Rel-15 TCI framework depends on the possibility where such a situation happens in the real deployment
- Input from companies (especially operators) can trigger the further discussion on this aspect

Check companies' contribution at RAN1#112. This topic will be deprioritized unless a demand on this functionality is received.

[Conclusion at RAN1#110b-e]

Agreement(FL proposal 3-2)

- From RAN1 perspective, the following scenarios can be considered for Rel-18 L1/L2 mobility for beam indication timing. This will be updated depending on further RAN1-assessment and RAN2 decision on the time chart
 - Scenario 1: Beam indication before cell switch command
 - Scenario 2: Beam indication together with cell switch command
 - Scenario 3: Beam indication after cell switch command
- Interested companies are encouraged to further study the validity of the scenarios and the potential spec impact.

[Conclusion at RAN1#111]

Agreement

- For beam indication timing for Rel-18 LTM,
 - Support Scenario 2: Beam indication together with cell switch command,
 - For Rel-17 unified TCI framework,
 - Beam indication indicates TCI state for each target serving cell
 - FFS: Scenario 1: Beam indication before cell switch command
 - FFS: Scenario 3: Beam indication after cell switch command
 - FFS: Activation of TCI state(s) of target serving and/or candidate cell(s).

[Conclusion at RAN1#112]

Agreement

- RAN1 shares the same understanding as RAN2 on agreement:
 - The LTM mobility trigger information is conveyed in a MAC CE
 - The same MAC CE is used for the LTM triggering.

Agreement

- The agreement on scenario 2 (Beam indication together with cell switch command) at RAN1#111 is further clarified as the following:
 - Beam indication for the target cell(s) is conveyed in the MAC CE used for LTM triggering for scenario 2

The following proposal (based on Scenario 1) is postponed

- Simultaneous operation of Rel-17 ICBM and Rel-18 LTM is supported
- On scenario 1 for the timing of cell switch command, companies are encouraged to study further the following aspects:
 - which kind of enhancement is needed for scenario on top of the simultaneous operation of Rel-17 ICBM and Rel-18 LTM, and
 - the necessity of enhancements for scenario 1 when an activation procedure before cell switch command reception is introduced for scenario 2.

- Necessity of TCI activation is covered in [the other slide](#)
- Support of simultaneous operation of Rel-17 ICBM and Rel-18 LTM needs clarification at least from UE capability POV
 - If UE capability is the only issue, the discussion can be deferred to the later stage of Rel-18
- Motivation of scenario 1 and the spec impacts needs more RAN1 discussion (at least from FL POV, extension of Rel-17 ICBM scenario and the early use of new beam/early activation of TCI state can be the motivation), and this may imply that more discussion time in RAN1 is required.
 - However, FL thinks that scenario 2 would be sufficient to complete LTM functionality, and scenario 1 is an optimization

Check companies' view on simultaneous operation of Rel-17 ICBM and Rel-18 LTM at RAN1#112

[Conclusion at RAN1#110b-e]

Agreement(FL proposal 4-1)

- Interested companies are encouraged to perform technical analysis of the cell switch command from a RAN1 point of view, e.g.
 - Necessary information included in the command, which is relevant for RAN1 discussion
 - Necessary number of bits for the information
 - L1 impact or concern to use DCI or MAC CE for L1/L2 cell switch command

[Conclusion at RAN1#112]

The following proposal was postponed

- From RAN1 point of view, at least the following information needs to 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
 - FFS: TA related information (up to the discussion in A.I. 9.12.2)
 - **Beam Indication for the target SpCell**
 - ID of the active DL and UL BWPs for the target SpCell
- **Study further the necessity/effectuality and benefit of the following field and corresponding UE procedure]**
 - 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
- FFS: the presence of each field (i.e. always present or configurable)
- FFS: the bit size of each field, or can be felt to RAN2

FL note: yellow part can be removed if we can achieve the consensus during offline discussion

- FL proposal at RAN1#112 gives a good starting point of further RAN1 discussion. Further consolidation on this proposal is expected in RAN1#112b-e
- “Beam indication for the target SpCell” (in cyan) will be based on Rel-17 TCI framework, but the details were not discussed so far.
- The necessity of TRS and CSI-acquisition depends on the introduction of triggering for TRS and CSI-acquisition for candidate cells “before” cell switch command
- Triggering of A-SRS for target cell(s) can be discussed separately

FL thinks this is an essential discussion, and especially details of beam indication information included in cell switch command should be concluded in RAN1#112b-e

Preparation for LTM: TRS tracking and CSI acquisition

[Conclusion at RAN1#110b-e]

Agreement(FL proposal 5-1)

- RAN1 to further study the potential RAN1 enhancements and spec impact to perform **at least** the following procedures prior to the reception of L1/L2 cell switch command aiming at the reduction of handover delay / interruption
 - **DL synchronization** for candidate cell(s)
 - TRS tracking for candidate cell(s)
 - CSI acquisition for candidate cell(s)
 - **Activation/Selection** of TCI states for candidate cell(s), if feasible
 - Note: Uplink synchronization aspect will not be discussed under this A.I.

FFS: Whether the above procedures prior to the reception of L1/L2 cell switch command can be performed on candidate cell when it is deactivated SCell (if defined in RAN2)

[Conclusion at RAN1#111]

Agreement

- Regarding the potential RAN1 enhancements to reduce the handover delay / interruption for Rel-18 LTM
 - Support at least DL synchronization for candidate cell(s) based on at least SSB before cell switch command
 - Further study the necessary mechanism, e.g. signaling and UE capability

[Conclusion at RAN1#112]

The following proposal was postponed

- **TRS tracking for candidate cells before the reception of cell switch command is supported**
- **CSI acquisition for candidate before reception of cell switch command is supported**

- Key aspect is whether or not TRS tracking and CSI acquisition are essential features for LTM (to reduce the interruption time or handover delay)
- If not, FL suggestion is not to introduce both of them in Rel-17 because non-negligible spec impact is foreseen
 - For intra- and/or inter-frequency, necessity of gap, feedback priority for UCI etc.
- As an alternative, triggering for TRS and CSI acquisition for target cell(s) by cell switch command may be used (which may require less spec impact)

FL plan is to deprioritize TRS tracking and CSI acquisition in RAN1#112b-e, but triggering by cell switch command may be reasonable and can be potentially discussed

[Conclusion at RAN1#110b-e]

Agreement(FL proposal 5-1)

- RAN1 to further study the potential RAN1 enhancements and spec impact to perform at least the following procedures prior to the reception of L1/L2 cell switch command aiming at the reduction of handover delay / interruption
 - DL synchronization for candidate cell(s)
 - TRS tracking for candidate cell(s)
 - CSI acquisition for candidate cell(s)
 - Activation/Selection of TCI states for candidate cell(s), if feasible
 - Note: Uplink synchronization aspect will not be discussed under this A.I.

FFS: Whether the above procedures prior to the reception of L1/L2 cell switch command can be performed on candidate cell when it is deactivated SCell (if defined in RAN2)

[Conclusion at RAN1#111]

Agreement

- Regarding the potential RAN1 enhancements to reduce the handover delay / interruption for Rel-18 LTM
 - Support at least DL synchronization for candidate cell(s) based on at least SSB before cell switch command
 - Further study the necessary mechanism, e.g. signaling and UE capability

[Conclusion at RAN1#112]

DL sync issue is discussed based on the following FL proposal

- Companies are encouraged to study the following aspects related to the DL synchronization and TCI state

activation when Rel-17 unified TCI is used for LTM beam indication:

- Timing to perform DL synchronization
 - Alt.1 Two-step DL synchronization procedure
 - UE maintains DL synchronization (to find frame boundary and for TA management) with SSB after L1 measurement and then gNB activates TCI state(s), and then the UE starts DL synchronization (for PDSCH/PDCCH reception) with the QCL source of the TCI states
 - Alt.2-1 One-step DL synchronization procedure
 - UE maintains DL synchronization with SSB after L1 measurement
 - Alt.2-2 One-step DL synchronization procedure
 - gNB activates TCI state(s), and then UE starts DL synchronization with the QCL source of the TCI states
 - Necessity for DL synchronization for TA: whether and how DL synchronized is performed before TA
 - Applicability of CSI-RS (if agreed) in addition to SSB
 - RAN1 spec impact (UE capability, configuration, activation etc)
- Timing of TCI state activation, i.e. whether TCI state activation is performed before TCI state indication or together with TCI state indication.

- Given the explanation by proponent companies in RAN1#112, it seems necessary to clarify whether DL synchronization includes only one or both of following UE behavior:
 - UE behavior 1: Maintain frame/symbol boundary information and [TA management] after L1-measurement on a candidate cell
 - Open issue 1: whether to introduce procedure to configure/activation of the cells/beams to maintain DL synchronization
 - Open issue 2: whether/how to introduce the related UE capability (this can be discussed in UE feature session)
 - Open issue 3: Relationship with TA procedure for candidate cells
 - UE behavior 2: TCI state activation to achieve fine synchronization with candidate cells for PDSCH/PDCCH reception
 - Open issue 1: Details of TCI state activation (including when and how TCI state is activated), e.g., whether activating TCI states associated with candidate in inter-frequency is feasible
 - Open issue 2: how many cells/beam and TCI states can be activated (this can be discussed in UE feature session)
 - Open issue 3: Details for TCI state RRC configurations (note: RRC structure would be up to RAN2)

DL synchronization issue (including TCI state activation) is prioritized in RAN#112b-e

Thank you

