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RP-232128

Mobility Enhancements in Rel-19

Agenda Item: 8A.2.6

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Introduction

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Categorization of topics based on WS contributions

- AI/ML Air Interface
- MIMO Evolution
- Duplex Evolution
- Ambient IoT
- Network Energy Saving Enhancements
- Mobility Enhancements
- NTN Evolution
- XR Evolution
- AI/ML for NG-RAN
- SON/MDT
- Channel Modeling (& possibly additional aspects e.g. for ISAC) for further evolution

- Additional RAN1-led Candidate Topics
  - LP-WUS/WUR
  - Multi-carrier Enhancements
  - Coverage Enhancements
  - Positioning Enhancements
  - SL Evolution
- Additional RAN2-led Candidate Topics
  - NCR
  - SL Relay Enhancements
  - UAV/UAM
  - MU-SIM
  - Broadcast/multicast
  - UE aggregation, collaboration, and backup
- Additional RAN3-led Candidate Topics
  - Topological enhancements
    - IAB/WAB/Femto
    - E.g.., for public safety/emergency services
  - QoE

- Others
  - Lean protocol stack/High speed packetization/Layer 2 UP enhancements
  - RAN architectural enhancements/AS Security Enhancements
  - Network/Outer coding
  - RedCap Enh./High reliability and low complexity IoT
    - Combination w/ SL or NTN can be discussed in the SL/NTN topics, respectively)
  - TaaS (Timing as a service)/High Accuracy Timing Service
  - SDT enhancements
  - LTE enhancements
  - Dynamic UE capability update
  - Others (e.g.,, Idle/Inactive enhancements, RAN slicing enhancements, etc.)

- According to Rel-19 WS in June, Mobility Enhancements drew great attention from companies. Thus, the motivation has been crystal clear and the scope discussion would be more important than that for justification.
- This contribution focuses on the potential scope for this WI

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General

- **Scope of Mobility Enhancements in Rel-19**
  - As mentioned in RWS-230488 (RAN Chair's Summary of Rel-19 Workshop), we can focus only on LTM in Rel-19
    - *One area raised by many companies is to further evolve Layer 1/2 triggered mobility (LTM)*
  - Enhancements based on L3 mobility is not necessary in Rel-19 because of the lack of companies' interest

Proposal 1: Focus on LTM enhancement in Rel-19 mobility enhancement WI

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L1 scope – L1 measurement

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- **Support of CSI-RS for L1 measurement**
  - There was a big support on the introduction of CSI-RS in Rel-18. However, this was dropped from the Rel-18 scope due to the reasons e.g. :
    - High workload especially in RAN4
    - Complexity for gNB to handle many CSI-RSs caused by narrower beams than SSB

- **Support of L1-SINR**
  - Introduction of L1-SINR drew big attention in Rel-18 by e.g. operators
    - Measurement quantity reflecting interference situation is important especially for inter-frequency LTM
  - However, L1-SINR is dropped in Rel-18
    - Common understanding was that L1-SINR is not so useful without CSI-RS

- Considering the lower TU pressure than Rel-18, we can discuss if this functionality can be included in the scope of Rel-19 mobility enhancements

Proposal 2: Introduction of CSI-RS for L1 measurement and L1-SINR should be discussed for Rel-19 scoping
Fujitsu is positive for this functionality

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L1 scope – Reporting

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- **UE/Event triggered Reporting**
  - This topic was also supported by many companies, but not specified in Rel-18 because companies views on the detailed design were quite diverse
    - The TUs allocated for this WI in Rel-19 was too small to specify this functionality
  - The common understanding in Rel-18 was that this report is carried on MAC CE → This can be the starting point of Rel-19

Proposal 3: Introduction of UE/Event triggered reporting carried by MAC CE should be discussed for Rel-19 scoping
Fujitsu is positive for this functionality

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L1 scope – beam indication 1

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- **Beam indication mechanism applicable to gNBs not supporting Rel-17 unified TCI framework**
  - Rel-18 LTM is based on Rel-17 unified TCI framework. Thus, gNB is required to support Rel-17 unified TCI framework to support Rel-18 LTM
  - It was discussed in Rel-18 to support beam indication mechanism applicable to Rel-15/16 mechanism. However, it was not specified due to the lack of time (and companies' support as well)
  - Even though this increase the deployment flexibility, we are afraid the potential market fragmentation.

Proposal 4: Introduction of beam indication mechanism applicable to gNBs not supporting Rel-17 unified TCI framework should be discussed for Rel-19 scoping
Fujitsu is NOT positive for this functionality

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L1 scope – beam indication 2

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- **Beam indication for mTRP**
  - It was proposed in RAN1 that mTRP can be discussed for Rel-18, but this functionality was not supported
    - In this case Rel-18 unified TCI framework for mTRP needs to be considered
  - Considering the fact that mTRP is not a typical deployment scenario, support of mTRP for LTM is not essential even in Rel-19

Proposal 5: Introduction of beam indication for mTRP should be discussed for Rel-19 scoping
Fujitsu thinks this is not a high priority issue.

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L1 scope – preparation for LTM before CSC

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CSC: Cell Switch Command

- **DL synchronization**
  - RAN1 identified two types of DL synchronization before CSC in Rel-18
    - Course sync: frame boundary detection and maintenance → This is done without RAN1 spec impact
    - Fine sync: preparation for DL (PDSCH, PUSCH) reception → TCI state activation procedure is introduced
      - Note: The QCL source for TCI state is SSB or TRS subject to UE capability
  - CSI acquisition before CSS was discussed, but not supported in Rel-18 due to the lack of consensus
    - CSI-RS for target cell is useful to boost the DL throughput right after LTM
    - On the other hand, transmission of CSI-RS for target cell requires not only the complexity of gNB but also specification impact

Proposal 6: Introduction of CSI-RS for CSI acquisition of target cell(s) should be discussed for Rel-19 scoping
Fujitsu thinks this is not a high priority issue.

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Higher layer scope – LTM DC scenario

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- **MCG/SCG change**
  - In Rel-18 the following scenarios are supported
    - PCell (MCG) change without SCG
    - SCG change without MN involvement
  - Other scenarios are excluded due to its complexity from network perspective
  - The support of other scenarios e.g. MCG change with SCG should be discussed in Rel-19 as FR1 as MCG + FR2 as SCG is a widely used scenario.

Proposal 6: Introduction of LTM DC scenario, e.g. MCG change with SCG, should be discussed for Rel-19 scoping
Fujitsu is open for the discussion: operators' view is important

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Higher layer scope – Early TA

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- **TA with RAR (from target and candidate) for LTM**
  - This discussion is triggered by RAN1, and RAN2 concluded that no necessity is seen for a solution with RAR in Rel-18
  - In our understanding, the major differences between with-RAR and without-RAR are
    - the coordination between candidate DU and serving DU
    - UE support to receive RAR from candidate cell (in case RAR is transmitted from candidate cell)
  - Addition of TA with RAR may be a useful optional feature, but the tradeoff should be carefully investigated

Proposal 7: Introduction of TA with RAR for LTM should be discussed for Rel-19 scoping
Fujitsu is NOT supportive for this issue.

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Higher layer scope – HARQ

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- **HARQ continuity after LTM cell switch**
  - There was a big discussion on HARQ continuity after LTM cell switch in RAN1.
  - The reason was not the workload, and a technical concern was raised from gNB complexity perspective
  - We are OK to discuss this issue for Rel-19 scoping. However study phase for this functionality shouldn't be included in the WI as it will just consume RAN2 precious time.

Proposal 8: Introduction of HARQ continuity after LTM cell switch should be discussed for Rel-19 scoping
Fujitsu is NOT supportive for this issue.

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Higher layer scope – Security

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- **Security update**
  - RAN2 concluded that security update is not supported in Rel-18 because Rel-18 scenario is only intra-CU and it is an optional feature
  - However, if inter-CU need to be supported, security update shall also be considered. If so, security update for inter-CU case may be applicable to intra-CU case as well.

Proposal 9: Introduction of security update after cell switch should be discussed together with inter-CU scenario

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New functionality (Higher layer)

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- **Support of Inter-CU scenario**
  - During the Rel-19 workshop discussion, so many operators showed their interest on Inter-CU scenario
  - If Inter-CU scenario is supported, the following aspect needs to be considered
    - Benefit of LTM: The benefit of latency reduction might not obvious compared with L3 mobility
    - Necessary functionality: at least security update needs to be considered

Proposal 10: The benefit of LTM for inter-CU case and the necessary functionality should be carefully discussed for Rel-19 scoping

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New topic

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- **Introduction of UE-triggered mobility action**
  - In addition to LTM, conditional handover drew big attention so far
  - We expect that LTM procedure in Rel-18 can be further improved/simplified by introducing conditional action:
    - Measurement report is not always required
    - Reception and processing of cell switch command is not required
    - TCI state activation can (may) also be included in the conditional action
  - However, the concept of UE-triggered mobility action has not been discussed yet. More discussion is necessary

Proposal 11: The benefit and the details of UE-triggered mobility action (i.e. conditional LTM) should be discussed for Rel-19 scoping

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New topic

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- **Group handover**
  - Group handover for L3 mobility has been proposed and discussed in multiple WIs (e.g. NTN and NES).
  - We believe LTM is an important and essential feature for the future (next generation) access, so the concept of group handover should be discussed for LTM
  - Note that this functionality should not be specified under different WIs: i.e. a unified mechanism shall be defined under mobility WI, if necessary

Proposal 11: The benefit and the details of group handover for LTM should be discussed for Rel-19 scoping

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Conclusion

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Focus on LTM enhancement in Rel-19 mobility enhancement WI
The following aspect should be discussed in the scoping discussion:

L1 Aspect	Fujitsu's view
CSI-RS for L1 measurement and L1-SINR	Positive
UE/Event triggered reporting carried by MAC CE	Positive
Beam indication mechanism applicable to gNBs not supporting Rel-17 unified TCI framework	Not positive
Beam indication for mTRP	Not positive
CSI-RS for CSI acquisition of target cell(s)	Not positive
Higher Layer Aspect	**Fujitsu's view**
LTM DC scenario, e.g. MCG change with SCG	Open
TA with RAR	Not positive
HARQ continuity after LTM cell switch	Not positive
LTM for inter-CU case and the necessary functionality Including security update after cell switch	Open
UE-triggered mobility action (i.e. conditional LTM)	Positive
Group handover for LTM	Positive

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Thank you

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