3GPP TSG RAN 101
Bangalore, Sep 11 - 15, 2023

RP-232428

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Scoping Rel-19 Mobility Enhancements Objectives

Apple

R19 Mobility | Hindsight on Rel-18 FeMob

- **Looking back:**
  - R18 Mobility Enhancements objectives **were ambitious**
    - This WI had objectives that some WGs simply did not have the resources to complete.
    - Mobility in general spans wide aspects of NR operation
      - Particularly, RAN2 needs to specify for many scenarios and procedures of the UE for a given mobility enhancement.
    - Towards the tail end of Rel-18, items were **down-scoped/actively discussed to be downscoped.**
      - LTM Aspects
        - LTM in SCG
        - LTM with DC
        - Items that were considered as optimizations of LTM - some of these do not have enough time to be included in Rel-18.
          - PCell/SCell swap as an LTM operation
          - CA Swap in SCG.
          - Gap-based intra-frequency neighbor cell L1 measurement
          - Gap-less inter-frequency neighbor cell L1 measurement (e.g. via NFG or NCSG)
      - Conditional DC Aspects
        - Selective SN activation is limited to a single MN alone
        - Any of the CPAC related features were expected to be not operated with LTM - RAN2 simply does not have time in Rel-18 to address this.
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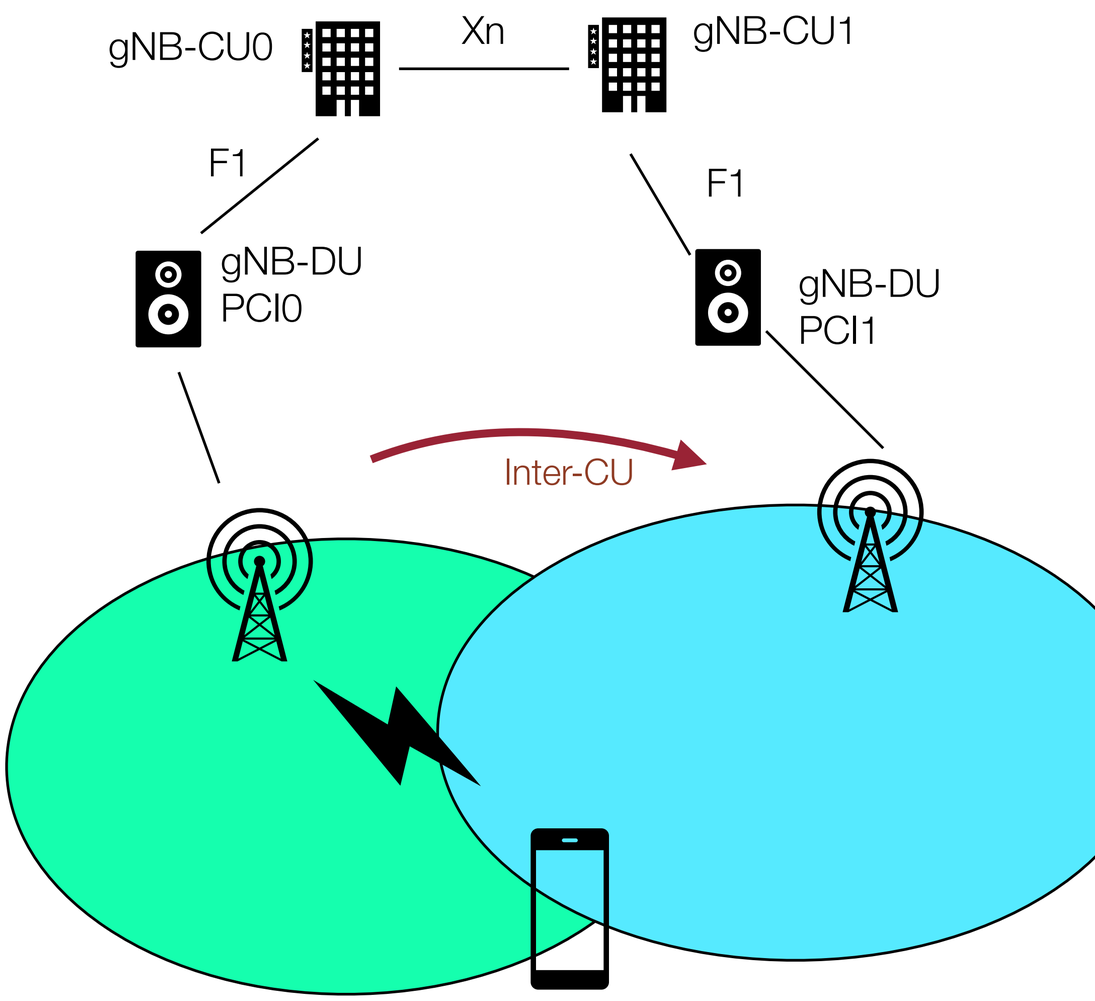
R19 Mobility | Guiding principles for Rel-19 FeMob Objectives

- **Guiding principles:**
  - Considering the wide-scale specification impact and effort that Mobility brings to multiple WGs, objectives should be specific and clear in providing what scenarios (and what not) are to be addressed/specified by the WGs.
  - Only consider scenarios/sub-features that have commercial impact and are practical to be adopted by operators and vendors of the 3GPP community.
  - LTM would need to be enhanced, but Rel-19 FeMob should also consider the fact that all UEs are not required to support LTM, to be able to use the Rel-19 features.
    - LTM requires some level of complexity at UE implementations - for eg: ability to search/sync to NCell beams while still in CONNECTED with serving cell.
    - Latency reducing features without dependency on LTM should also need to be analyzed for Rel-19 FeMob.
      - In other words - Rel-19 enhancements should also benefit low cost devices that do not intend to support LTM.
  - Through Rel-16/Rel-17/Rel-18, many aspects of conditional SN handling from mobility were specified:
    - Intra-SN/inter-SN/inter-MN CPC, CPAC, selective SN activation, CHO with candidate SNs etc.
    - Many of these are not deployed, even after several years of 3GPP specifying these features.
    - We do not need to add more “fancy” scenarios to the conditional SN handling
      - Just need to close any open items with the above, to ensure feature completeness
    - So, Rel-19 FeMob should only contain objective to address any open areas in “conditional SN handling” from earlier releases.

- **RANP should use the below guidelines for drafting the Rel-19 FeMob objectives:**
  - LTM enhancements that are deemed to be practical/commercial from 3GPP ecosystem.
  - Mobility related interruptions/latency reduction for low-cost devices should be evaluated without dependency on LTM.
  - Conditional SN mobility handling should focus on addressing ”only” left over items that are deemed useful for feature completeness.

R19 Mobility | Further Enhancements to LTM

- **LTM Areas for improvement and enhancements:**
  - Rel-18 LTM brings in features and procedures to reduce the interruption and handover latency.
  - Also reduces the L3 signaling overhead to a large extent.
  - However there are shortcomings with Rel-18 in terms of practicality and feature operation:
    - Rel-18 LTM is limited to SSB-based L1 Measurement only. CSI-RS-based L1 measurement needs to be further explored to improve the Handover efficiency and performance.
    - UE-initiated beam reporting is beneficial in terms of latency and efficiency, which is not supported by Rel-18 LTM.
    - Rel-18 LTM is limited to a single gNB-CU. Advantages of LTM UE mobility is constrained by this. Cannot span across larger geographical deployments or in case of dense NWs where multiple gNB-CUs are operating
    - Operation driven by L2 signaling inherently has security risks (compared to L3 based legacy Mobility)
    - Rel-18 LTM does not support UE/event triggered report for L1 measurement report, which results in a larger overhead and increased handover latency.
    - Due to lack of availability of TUs, likely the RAN4 requirements for Rel-18 LTM would be more intra-frequency focused and so optimizations related to inter-frequency would likely need to be deferred, e.g. L1 measurement with dedicated gap, NCSG or NeedForGaps may not be supported in R18. All of the above further narrows the deployment and usage of Rel-18 LTM.
    - LTM related FR2 specific enhancements could also be left out
    - Conditional Handover (conditional LTM switch) is very useful for mobility robustness, and is likely not specified in Rel-18



R19 Mobility | Further Enhancements to LTM - Proposals

- **Draft Objective for LTM:**
  - *Leftovers from Rel-18:*
    - ***Further enhance the L1 measurement and reporting for LTM operation, including support CSI-RS based measurement and UE initiated beam reporting [RAN1, RAN2].***
    - ***If not specified in Rel-18 FeMob, specify latency and interruption reduction methods in LTM where the source and target LTM cells are limited to the serving cells of the UE CA operation. [RAN2, RAN1]***
    - ***Specify LTM operation in SCG [RAN2, RAN4]***
    - ***Specify UE triggered LTM [RAN2, RAN3]***
      - ***Consider NR Rel-16 Conditional HO and Rel-18 LTM as the baseline***

  - ***Specify LTM with source and target DUs belonging to different CUs [RAN2, RAN3, RAN1]***
  - ***Specify protection of L2 (MAC CE) signaling that carries LTM control messages. [RAN2, RAN3]***
    - ***Protection should be limited to detection of tampering (integrity of the MAC CE control message).***
  - ***Specify LTM UE measurement and beam handling when the candidate LTM cell is on a different frequency or band from the source cell [RAN4, RAN1]***

R19 Mobility | Latency reduction for low-cost devices

- Bring LTE related latency reduction enhancements without dependency on LTM
  - Make-before-break HO
  - RACH-less HO

- The above features are already specified in LTE, and efforts should be minimal in having them specified in NR (without using LTM as the platform)

- **Draft Objective:**
  - ***Specify in NR the L3 based make-before-break and RACH-less handover features using the LTE features as the baseline [RAN2, RAN4]. This is applicable to non-LTM scenarios.***
    - ***The scope of the new additions to the above is limited only to the functioning of the features in NR.***

R19 Mobility | Conditional SN mobility handling

- Other than the case of allowing the UE to “change” the MN while configured with conditional candidate SNs (of the source MN), many “practical” scenarios of conditional SN mobility were covered in previous releases.
  - MN change (handover) with conditional candidate SNs (of the target MN) should be possible with Rel-18 FeMob from signaling perspective for the most part.
    - Does need some assessment on the specification impact and UE procedures.
    - WGs should looks making minimal changes to make the MN handover work in such cases
      - Handling of security, inter-node exchange etc.
    - But WGs should not lose sight of the fact that this is mostly not very practical, and would be more useful from feature completeness. And so, the resources spent on this should be minimal, and to this effect.

- **Draft Objective:**
  - ***Specify operation of MN handover when the UE is configured with candidate SNs in source and target MNs [RAN2, RAN3].***
    - ***Effort should be on minimal changes to make the handover work.***

R19 Mobility | WID objectives

- **Draft Objective for LTM:**
  - *Leftovers from Rel-18:*
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    - ***Specify UE triggered LTM [RAN2, RAN3]***
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    - ***The scope of the new additions to the above is limited only to the functioning of the features in NR.***
  - ***Specify operation of MN handover when the UE is configured with candidate SNs in source and target MNs [RAN2, RAN3].***
    - ***Effort should be on minimal changes to make the handover work.***

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