3GPP TSG RAN Meeting #102
Edinburgh, Scotland, December 11-15, 2023
Agenda item: 9.1.2.4

RP- 232876

Study on AIML for mobility

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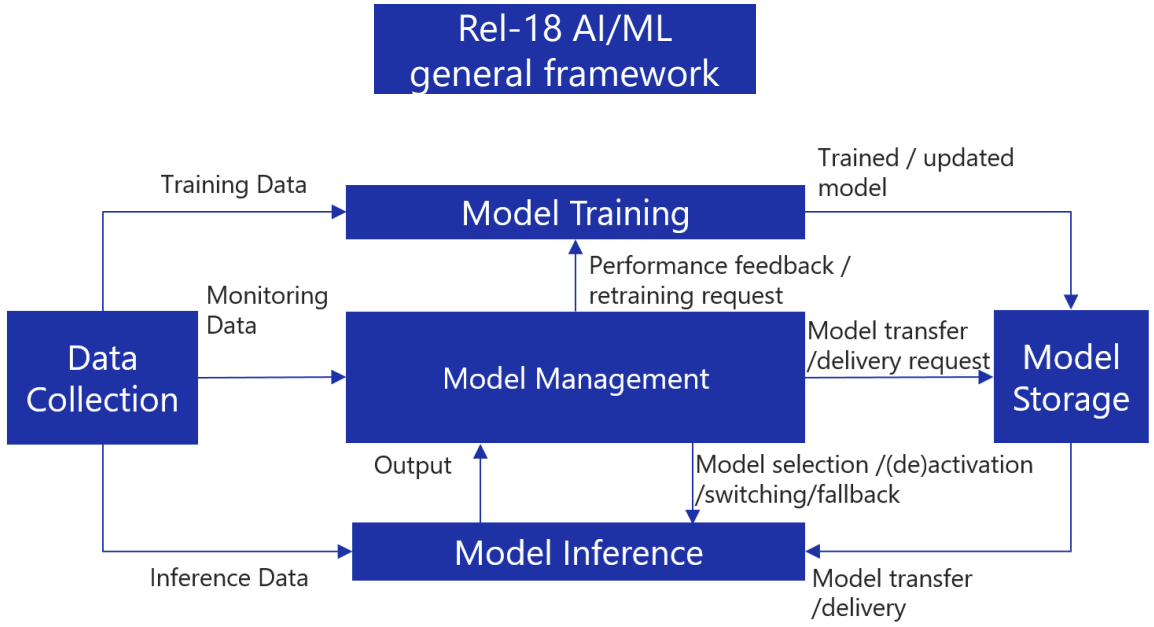
Consideration on the extended AI/ML study at Rel-19

- The study on AI/ML for air interface at Rel-18 set up a framework for the support of AI/ML based features for NR including the AI/ML data collection, model transfer, model inference, model monitoring, etc.
- More AI/ML use cases can be studied in Rel-19 under the same AI/ML framework as concluded from the Rel-18 study.
- From RAN2 perspective, the use case of study on mobility enhancement should be considered.



Additional use cases in Rel-19 SI from RAN2 perspective

- ✓ L1/L2 triggered mobility (LTM) enhancement
- ✓ L3 based Mobility enhancement

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Current status on AI/ML for mobility

- In RANP#101, the following status was captured in the endorsed summary (RP-232622):
  - For mobility under connected mode, the potential scopes/directions of the study item include:
    - Type of mobility
      - L3-based mobility and L1/L2-triggered mobility (LTM) are both considered
    - HO optimization in Network side [/UE side], including
      - Candidate/target cell prediction in L3-based mobility, or, candidate/target beam(s) and cell(s) prediction in LTM
    - RRM measurement and event prediction, including
      - Beam-level measurement prediction
      - Cell-level measurement prediction, e.g., using intra-frequency measurement results to forecast the RRM measurement of inter-frequency/inter-RAT cells
      - HO failure/RLF prediction
      - Measurement events prediction
    - LCM framework and others
      - The conclusions in Rel-18 AI/ML study should be used as baseline
      - Other impacts are further studied
- From RAN2 point of view, the study for AI/ML-based mobility will be discussed.

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AI/ML for L1/L2 triggered mobility (LTM)

- **Justification:**
  - The L1/L2 triggered mobility (LTM) being discussed at Rel-18 may introduce very frequent cell switch (or ping-pong issue) if the LTM handover decision is not made properly.
  - The L1 measurements and reporting for L1/L2 triggered mobility may introduce even higher overhead on the air interface than traditional handover.
  - Acquiring the TA of candidate LTM cell(s) is critical for RACH-less LTM performance. The prediction of the TA and its change of the candidate LTM cell(s) can save the efforts from the UE to acquire the TA.
  - The Cell switch command (CSC) transmission may fail due to deteriorating radio link at the edge of the serving cell (especially in FR2). The prediction of the target cell can facilitate an early CSC transmission to enhance the reliability of the CSC transmission.
- **Objectives:**
  - Study AI/ML for L1/L2 triggered mobility (LTM) as a new use case from RAN1/2 perspective
    - Enhancement on target cell / beam prediction based on AI/ML model to facilitate reliable cell switch command;
    - Enhancements on L1 measurements prediction and reporting for L1/L2 triggered mobility based on AI/ML model;
    - Enhancements on TA measurement configuration and TA update prediction based on AI/ML model.

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AI/ML for L3-based mobility enhancement

- **Justification:**
  - The traditional handover decision for mobility is controlled by the network based on the measurement report from the UE. However, the measurement report causes high overhead and latency on the air interface.
  - The traditional mobility procedure lacks self-learning ability for handover decision, which may make an inappropriate decision on handover, e.g., inappropriate parameters, early/late/incorrect handover.
  - The traditional handover events have some drawbacks, the UE could handover to a new target cell but leave it in a short time even though the configured event is fulfilled, i.e., unnecessary handover or ping-pong issue could happen.
- **Objectives:**
  - Study L3-based mobility enhancement with assistance of AI/ML, including
    - Handover prediction/request based on AI/ML model, e.g., the UE predicts target cell and report/request to NW for handover decision.
    - Temporal/spatial RRM measurement result prediction based on AI/ML model, e.g., the RS measurement results of future time instances can be predicted, using intra-frequency measurement results to predict inter-frequency measurement results;
    - Temporal RLM measurement result prediction based on AI/ML model, e.g., the RLM-RS measurement results of future time instances can be predicted;
    - Dynamic adjustment on handover parameters/events based on AI/ML model, e.g., adjustment on Hys, TTT;
  - Study the following scenarios based on LCM framework in Rel-18 for L3-based mobility enhancement
    - AI/ML model is trained by network side and using the LCM procedure - model transfer to transfer the trained AI/ML model to the UE for its execution;
    - AI/ML model is trained by UE side;
    - Further model training (update) at peer side, e.g., When the UE receives the initial AI/ML model from the network, each UE may continue AI/ML model training. Then eventually, different UE may run totally different AI/ML models for inference.
  - Study the benefit of AI/ML for L3-based mobility enhancement over NG-RAN AI/ML mobility enhancement

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Summary for new SI

- Based on the previous observations, we make the following proposals.
- **Proposal 1:** New SI for AI/ML-based mobility includes both AI/ML for L1/L2 triggered mobility (LTM) and AI/ML for L3-based mobility.
- **Proposal 2:** Regarding AI/ML for LTM, the following objectives can be considered:
  - Enhancement on target cell / beam prediction based on AI/ML model ;
  - Enhancement on L1 measurements prediction and reporting based on AI/ML model;
  - Enhancement on TA prediction based on AI model
- **Proposal 3:** Regarding AI/ML for L3-based mobility, the following objectives can be considered:
  - Enhancement on handover prediction/request based on AI/ML model;
  - Enhancement on temporal/spatial RRM measurements and temporal RLM measurements prediction based on AI/ML model;
  - Enhancement on dynamic adjustment on handover parameters/events based on AI/ML model;
  - Study the LCM scenarios including:
    - Model training at NW-side and transferred to UE-side;
    - Further model training at peer side;
    - Model training at UE-side.
  - Study the benefit of AI/ML for L3-based mobility enhancement over NG-RAN AI/ML mobility enhancement

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