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Views on Rel-19 study on AI/ML for mobility

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Overview on Objectives & Scopes

- **RAN2-led SI with the following scope & objectives**
  - **Type of mobility: Consider both L3 mobility & LTM**
    - » For L3 Mobility, the prediction/optimization by AI/ML may reduce the HoF and ping-pong rate.
    - » For LTM, the prediction/optimization by AI/ML may reduce the measurement overhead, ping-pong rate, short ToS rate, etc.
  - **Sub-use cases: Consider 4 sub-use cases**
    - » RRM measurement prediction
    - » HO target/candidate prediction
    - » Prediction-based event operation
    - » HO strategy/parameter optimization
  - **AI/ML Mobility optimization on NW-side [and UE-side]**
    - » Study the NW-side AI/ML optimization for all sub-use cases.
    - » Down scope UE-side AI/ML optimization. If it is included, consider only limited use cases such as RRM measurement prediction.
  - **Identify potential specification impacts**
    - » LCM of AI/ML: Based on Rel. 18 SI and the progress of Rel. 19 WI, study the use-case-specific LCM details.
    - » Other specification impacts, e.g.,
      - – Enhancements utilizing inference results; mobility procedures
  - **Evaluations of the complexity and performance gain**
    - » Study the potential performance gain and the complexity of AI/ML Mobility with simplified and aligned models/KPIs.
    - » If the evaluation is necessary, study performance gain and the associated complexity E.g., select evaluation items from the following list,
      - – Model complexity (model size, FLOPs, etc) to achieve a target performance.
      - – Potential gain based on simplified models and metrics such as intermediate KPIs on the performance of direct output of AI/ML models.
      - – Potential gain based on system-level scenarios with UE mobility and eventual KPIs.
        - ✓ L3 Mobility: HoF rate, Ping-Pong rate, interruption occasions, etc.
        - ✓ LTM: Ping-Pong rate, interruption occasions, short ToS rate, etc.

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Mobility Types & Sub-use Cases

- We suggest considering the following 4 sub-use cases for both L3 Mobility and LTM at NW-side
  - **RRM measurement prediction**
  - **HO target/candidate prediction**
  - **Prediction-based event operation**
  - **HO strategy/parameter optimization**
- As shown in the table, all 4 sub-use cases are beneficial to both L3 Mobility & LTM.
  - **Proposal: Consider both L3 Mobility & LTM at the NW-side with all 4 sub-use cases.**
- The performance of AI/ML models for mobility highly depend on the cell coverage/deployment information, which is suitable on the NW-side due to the necessity of model delivery for the UE-side. For UE-side optimization, the RRM measurement prediction (e.g., inter-frequency band prediction) may be feasible and beneficial to reduce the measurement gap.
  - **Proposal: Down scope UE-side AI/ML Mobility considering the limited TU budget for this study. If it is included, only include limited use cases such as RRM measurement prediction.**

Sub use cases	Examples	L3/LTM	NW/UE-side
RRM Measurement Prediction	Cell level measurement prediction (incl. intra-frequency, inter-frequency, inter-RAT)	L3	NW [UE]
	Measurement event prediction	L3/LTM	NW [UE]
	Beam level measurement prediction	LTM	NW [UE]
HO Target/Candidate Prediction	Target cell prediction	L3	NW
	Target beam/TCI states prediction	LTM	NW
Prediction-based event operation	Prediction based HoF, Ping-Pong, RLF, BF, event-triggered operation	L3/LTM	NW
HO Strategy/Parameter Optimization	Timing optimization	L3	NW
	HO parameter optimization	L3	NW
	HO decision optimization	L3/LTM	NW

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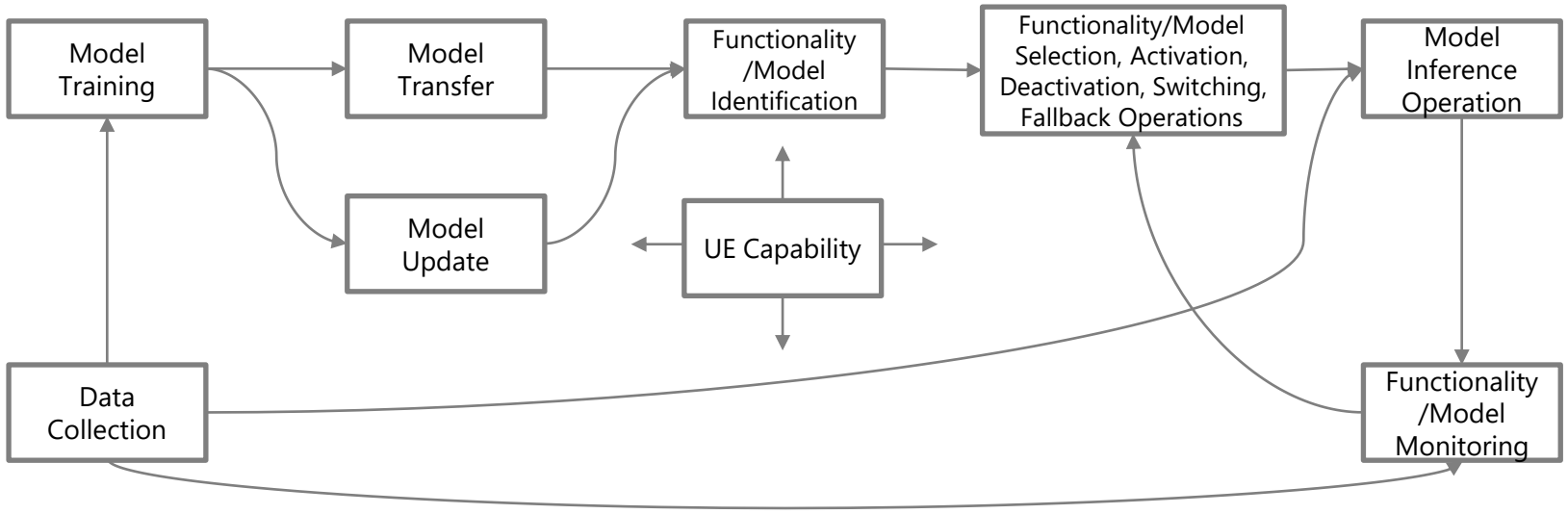
Potential Specification Impacts

- State of the Art
  - During Rel. 18, several AI/ML use cases have been studied (CSI compression, CSI prediction, beam management on spatial domain, beam management on time domain, and positioning), while the major specification impacts have been identified for a general AI/ML framework and use case specific ones in TR38.843.
  - Normative work for Rel. 18 AI/ML use cases may be conducted in Rel. 19.
  - There is a significant similarity between the AI/ML prediction for mobility and beam management.
- Specification impacts for Rel.19 AI/ML Mobility SI
  - **Proposal: Study and identify the use case-specific specification impacts of AI/ML Mobility use cases based on the Rel. 18 AI/ML LCM framework and the progress of Rel. 19 AI/ML-air interface normative work if any.**
  - **Proposal: Study and identify other potential specification impacts, e.g., enhancements utilizing inference results and mobility procedures.**

General LCM framework of Rel. 18 AI/ML use case:



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Evaluations on Complexity and Performance

- To validate the complexity and potential performance gain of using AI/ML model for HO optimization, evaluation based on aligned scenario and/or assumption and/or methodology is needed. Moreover, to avoid over-complex simulation work, re-use the scenario and/or assumption and/or methodology of previous releases as much as possible.
  - **Proposal: Study the complexity and potential performance of AI/ML model for HO optimization by using valid, simple, and aligned evaluation cases, assumptions, and methodology.**
  - **Proposal: To study the complexity and potential performance gains, consider the following aspects of the evaluation methodology,**
    - » **Scenario**
      - – Both FR1 & FR2
      - – Dense deployment scenario (e.g., based on NR-UMi) with UE mobility model
    - » **Baseline HO schemes**
      - – For simplified intermediate KPI: Legacy non-AI/ML methods.
      - – For system-level eventual KPI: L3 HO (w/ or w/o CHO) and Rel. 18 LTM.
    - » **Performance metrics**
      - – Model complexity (model size, parameter number, FLOPs) w/ performance evaluations.
      - – Intermediate KPIs on the performance of direct output of AI/ML models.
        - ✓ Prediction accuracy, Prediction successful ratio, etc.
      - – Eventual KPIs for mobility.
        - ✓ L3 Mobility: HoF rate, Ping-Pong rate, interruption occasions, etc.
        - ✓ LTM: Ping-Pong rate, interruption occasions, short ToS rate, etc.

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