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Discussion on AI/ML mobility

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Background

- In AI/ML for air interface WI, Several use cases are under study, e.g., beam management, CSI enhancement and positioning accuracy enhancement. AI/ML can provide performance improvement compared with legacy mechanism. These uses cases mainly focus on physical layer procedure.
- Mobility performance may degrade in high frequency and dense deployment. Mobility management can also benefit from the utilization of AI/ML.
- In this contribution, we provide our initial simulation results to show the potential benefits.

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Potential use case

- **HOF prediction**
- **Cell measurement result prediction**
- **Time of stay prediction**

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HOF prediction

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Motivation

- Network deployment is expected to be more dense, due to high frequency. UE may move in high speed, e.g. high way or high speed train. Radio channel changes rapidly. Reported measurement result may be outdated, which may result in HOF.
- AI/ML can provide inference on HOF to assist mobility management.

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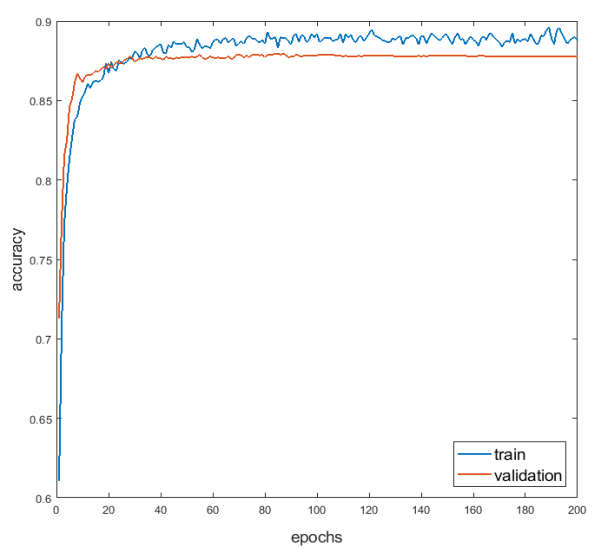
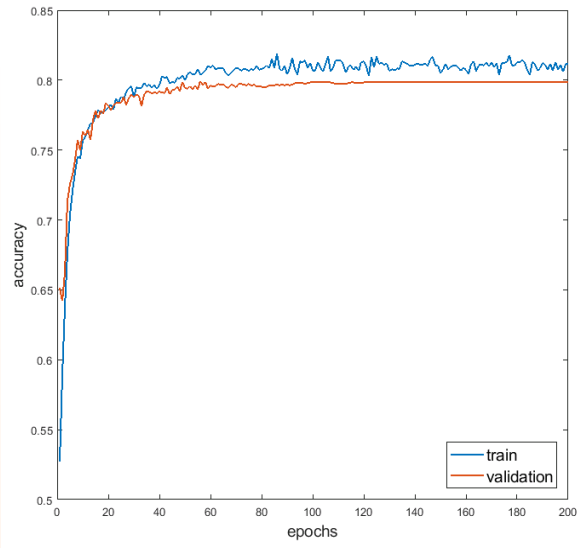
Simulation result

- **Following is the simulation result of AI inference on different mobility failure, including handover command loss and HOF to target cell**
  - Simplified LSTM algorithm is used to adapt UE capability.
  - Information at UE is used as input, e.g. measurement of serving cell and neighbor cells in short period, UE location.



Handover command loss inference



HOF inference

- **Observation: AI/ML could achieve high prediction accuracy regarding the potential HOF.**
- **Proposal: Study HOF prediction to assist mobility management.**

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Cell measurement result prediction

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Motivation

- In R18, the study result shows AIML can provide high accuracy prediction on beam measurement results in spatial or temporal domain. The cell level measurement result is derived from one or multiple beams. Therefore, AIML may also provide high accuracy prediction on the cell level measurement results.
- In legacy, frequent measurement is required to obtain up to date cell measurement result, which results in power saving. Measurement gap may be needed to measure inter-frequency neighbor cell, which results in service interruption. Furthermore, target cell may not be the optimal cell from throughput point of view.

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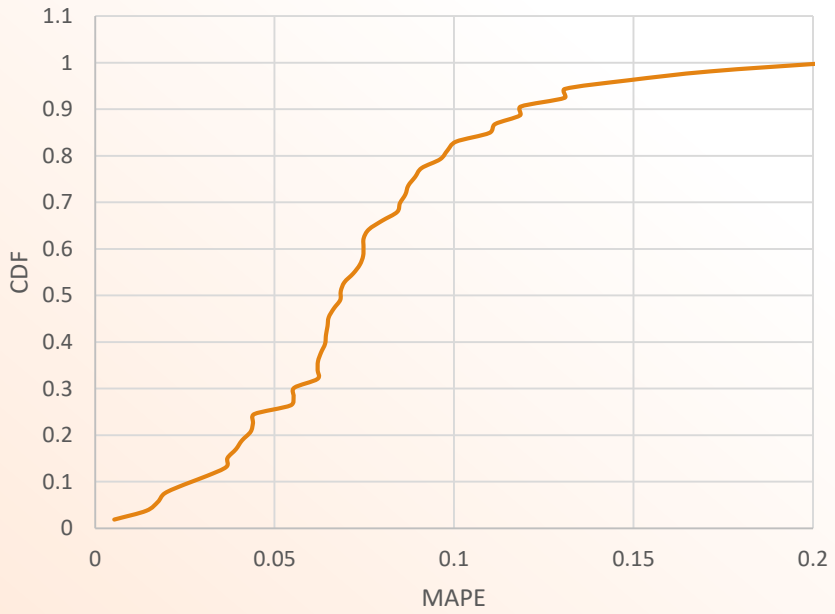
Simulation result

- **Initial simulation is carried out to verify the accuracy of AI-based RRM management**
  - LSTM is utilized to predict the strongest neighbor cell. Inputs include measurement result of serving cell and limited neighbor cells and UE location. Error difference is derived by the difference between prediction and ground truth.



- **Observation: AI/ML could achieve high prediction accuracy regarding the cell level measurement result.**
- **Proposal: Study cell measurement result prediction to assist mobility management.**

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Time of Stay prediction

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Motivation

- The network is expected to become more dense due to high frequency deployment. There may be multiple neighbor cells with similar channel quality. In this case, the time of stay in each cell may be important to determine the handover target cell.
- Ping pong handover can be avoided if target cell's ToS can be predicted.

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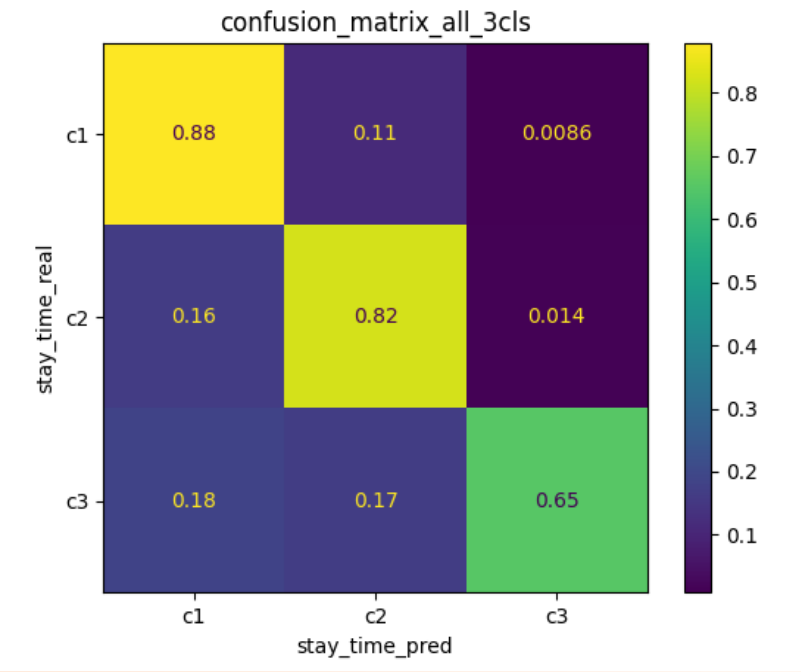
Simulation result

- **Following is the initial simulation result on the ToS prediction**
  - LSTM is utilized to predict the ToS of target cell.
  - ToS is categorized into 3 levels, short (0,3.5*TTT), medium (3.5*TTT, 10*TTT) and long (10*TTT+). The confusion matrix is showed as below.



- **Observation: AI/ML could achieve high prediction accuracy regarding the ToS of target cell.**
- **Proposal: Study ToS prediction to assist mobility management.**

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AI model deployment

- AI model could be deployed at NW side or UE side. Both options are studied and supported in R18. In mobility management, related LCM procedure can be reused.
- If model is deployed at NW side, model delivery to UE can be avoided. But UE need to report data for training/inference/performance monitoring.
- If model is deployed at UE side, model delivery may be required. But training/inference/performance monitoring can be done at UE, which avoids the data report.
- As discussed above, there are pros and cons on either option.
- **Proposal: RAN2 to study both UE and NW side AI model.**

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Study objective

Study the AI/ML-based mobility management

- Study following use cases [RAN2]
  - HOF prediction to reduce HOF rate
  - Cell measurement result prediction to improve throughput and reduce latency
  - ToS prediction to reduce ping pong handover
- Assess the potential specification impact [RAN2]
  - Reuse LCM procedure in Rel-18 AI/ML study as much as possible
  - Data collection for training/inference/performance monitoring
  - Assistance info exchange between UE and NW
- Study both AI model at UE and NW [RAN2]
- Interoperability and testability aspects [RAN4]

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