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RP-233131

Views on scope for AI/ML for NR Air Interface in Rel-19

AI: 9.1.1.1

3GPP TSG RAN meeting #102

Edinburgh, Scotland

December 11-15, 2023

Rel-19

Proposed high-level scope

- Normative phase of recommended 1-sided cases (BM+POS) – down-select sub use cases
  - LCM Management [RAN2/RAN1]
  - Optimizations for specific use cases [RAN1]
  - Core requirements [RAN4]
  - Performance requirements (including test cases) [RAN4]
- RAN4 to continue study on testability (1-sided & 2-sided models)
  - Checkpoint in Sept ‘24
- RAN1 to continue study on 2-sided compression and CSI-prediction
  - Address open issues identified for CSI compression
  - Address open issues identified for CSI prediction
  - Checkpoint in Sept ‘24 on how to proceed
- RAN2 to reply to SA2's LS
- TR updates based on studies

Beam management

Rel-19 normative work

- **Proposal**: Rel-19 normative work on the following
  - Both **BM-Case1** and **BM-Case2**:
    - **BM-Case1**: Spatial-domain DL Tx beam prediction for Set A of beams based on measurement results of Set B of beams
    - **BM-Case2**: Temporal DL Tx beam prediction for Set A of beams based on the historic measurement results of Set B of beams
  - DL Tx beam prediction for both **UE-sided model** and **NW-sided model**
  - Necessary **signaling/mechanism**(s) to facilitate **data collection**, **model inference**, and **performance monitoring** for both UE-sided model and NW-sided model, including
    - Enhanced L1 report enabled by UE-side AI/ML inference
    - RS configuration to facilitate UE side data collection, model inference, and performance monitoring
    - Assistance information from NW to UE to help UE categorize data
  - **Signaling/mechanism**(s) to facilitate necessary **LCM operations** via 3GPP signaling for UE-sided model, including
    - Methods to ensure consistency across training and inference, including consistency in association/mapping of Set A beams and Set B beams for UE-side models, considering NW-side additional conditions

Positioning accuracy enhancements

Rel-19 normative work

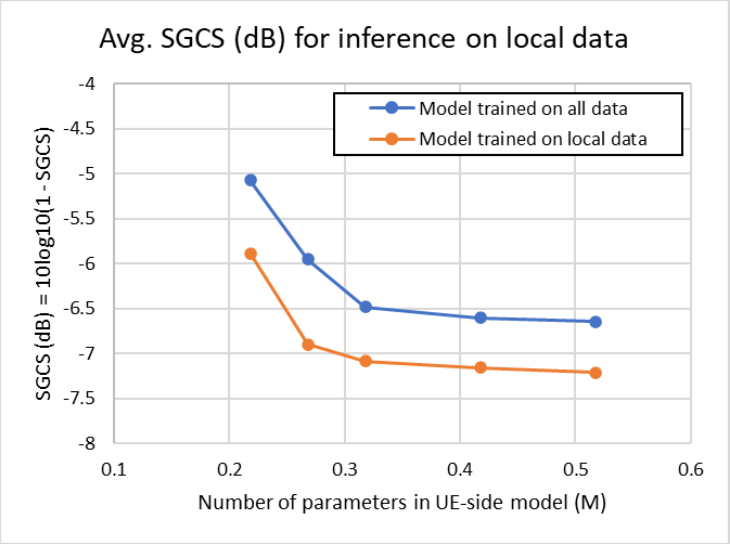
- **Proposal**: Specify **Direct AI/ML Positioning** and **AI/ML Assisted Positioning** in R19 WI:
  - Direct AI/ML Positioning (at least Case1) and AI/ML Assisted Positioning (Case2a and Case3a)
  - Specify necessary **signalling** of **data collection** and **related other information**:
    - e.g., assistance information from LMF to UE to help UE categorize data and generate label; signaling for RS configurations; data collection quality requirements, etc.
  - Specify necessary **signalling** and details for **measurement enhancements**:
    - e.g., Prioritize reusing existing measurement; considering tradeoff of signaling overhead & achieved positioning accuracy
  - Specify necessary **signalling** details of **monitoring method**(s):
    - e.g., labeling assistance from LMF; configuring model failure detection and related signaling
  - Specify necessary **signalling** details and applicability of **generalization method**(s):
    - e.g., assistance signaling from LMF to UE to help UE: identify positioning scenario/ (mixed) dataset, select/switch model, apply finetuning and labeling; considering applicability/feasibility of generalization to positioning with non-ideal settings (e.g., non-ideal labeling in mixed dataset & finetuning, non-ideal scenario identification & model selection, non-ideal model switching, etc.)

CSI compression

Rel-19 RAN1 to continue study and revisit at checkpoint

- **Address** the following aspects that led to the **lack of RAN1 consensus** on the recommendation for normative work:
  - Trade-off between performance and complexity/overhead.
  - Issues related to inter-vendor training collaboration.
- Recommended directions (study objective):
  - Temporal domain aspects
    - e.g., temporal compression, joint prediction and compression, use of past CSI-RS, differential feedback
  - Localized models
  - Complexity/performance tradeoff
  - Specification and collaboration flavors that reduce inter-vendor logistical complexity

Localized models can achieve the same performance with significantly lower complexity



Source: R1-2305328, RAN1#113

CSI prediction

Rel-19 RAN1 to continue study and revisit at checkpoint

- **Address** the following aspect that led to the lack of RAN1 consensus on the recommendation for normative work:
  - Lack of results on the performance gain over non-AI/ML based approach and associated complexity.
- Recommended directions (Study objective):
  - Further evaluation of AI/ML relative to a non-AI/ML based approach
  - Further evaluation covering aspects such as generalization across scenarios, scalability across configurations
  - Rel-18 MIMO temporal domain CSI feedback as a baseline

Data Collection

Continue study & possible architecture impact

- RAN2 discussions on UE data collection concluded by capturing that:
  - *The following proposals were discussed in RAN2*
    1. *UE collects and directly transfers training data to the OTT server*
       1a) OTT (3GPP transparent)
       1b) OTT (non-3GPP transparent)
    2. *UE collects training data and transfers it to CN. CN transfers the training data to the OTT server.*
    3. *UE collects training data and transfers it to OAM. OAM transfers the needed data to the OTT server.*
  - *RAN2 did not study or analyze the proposals and did not agree to requirements or recommendations.*
- Since much of this discussion is outside RAN expertise, since SA2 has offered to help in LS (S2-2311921/RP-232727), and that we have concerns with options 2 and 3, we propose that:
  - RAN reply to SA2 requesting help in designing:
    - A secure UE data collection between the UE and an OTT server (option 1 above)
    - A secure UE model transfer between the OTT server and the UE
    - Model ID management that ensures uniqueness

Testability and Interoperability

RAN5 involvement

- AI/ML testability/interoperability is raising new challenges in RAN2/4 & RAN5
  - New test setup/procedures will likely be needed for all use cases under discussion.
  - Testing options identified for two-sided model could lead to a change in 3GPP testing framework/paradigm.
- Close RAN2/4/5 interaction in the discussion might be needed to enable progress and identify the best solutions
  - RAN5 has no precedence of formally participating in SI/WI led by other workgroups.
  - RAN5 possible participation framework
    - RAN2/4 identifies the list of items that need RAN5 WG study.
    - RAN5 is formally added to the objectives of the SI/WI.

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