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Views on Rel-19 AI/ML for air interface

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Background

- **In the summary for RAN Rel-19 Package in RP-232745, the potential objectives for AI/ML for for Air Interface WI were captured as below:**

  - References: RWS-230488, RP-231540, RP-232611
  - Potential objectives:
    - Consider support single sided models for,
      - Positioning, further discuss whether to support all 5 sub use cases.
      - Beam management for DL Tx prediction in both UE-sided and NW sided model,
      - Consider support of single sided model for CSI prediction, if it is recommended to proceed with normative work taken all WG's outcome in Q4-23 into account
    - Consider support two-sided model for CSI compression, if it is recommended to proceed with normative work taken all WG's outcome in Q4-23 into account
    - Consider support the necessary/recommended LCM components for selected sub use cases
    - RAN4 requirements and test cases for AI/ML enabled features
  - Taking into account the progress in RAN WGs in 4Q'2023

Considerations on Rel-19 WI

- In Rel-18 NR_AIML_Air study item, following agreements have been made:

Agreement

Capture the following into the conclusion section of the AI/ML TR

The following aspects have been studied for the general framework of AI/ML over air interface for one-sided models and two-sided models.

- Various Network-UE Collaboration Levels
- Functionality-based LCM and model-ID-based LCM
- Functionality/model selection, activation, deactivation, switching, fallback
- Functionality identification and model identification
- Data collection
- Performance monitoring
- Various model identification Types and their use cases
- Reporting of applicable functionalities/models
- Method(s) to ensure consistency between training and inference regarding NW-side additional conditions (if identified) for inference at UE
- Model delivery/transfer and analysis of various model delivery/transfer Cases

The above studied aspects for General Framework can be considered for developing/specifying AI/ML use cases and common framework (if needed for some aspects) across AI/ML use cases.

Proposal 1: Rel-18 SI should be transferred to Rel-19 WI and approve a RAN1 leading WI for the normative work.

Proposal 2: Support to include the following aspects for General Framework for specifying AI/ML use cases and common framework across AI/ML use cases in Rel-19 AI/ML WI.

- ***Model transfer/deliver, Functionality/Model identification, Model inference operation, Data collection, Performance monitoring, UE capability, Functionality/Model selection, activation, deactivation, switching, fallback.***

Considerations on Rel-19 WI

- In Rel-18 study, following conclusions have been made on normative work of use cases in Rel-18 SI

- CSI compression

Agreement

Capture the following as a conclusion in section 8 of the TR

- From RAN1 perspective, there is no consensus on the recommendation of CSI compression for normative work.
- At least the following aspects are the reasons for the lack of RAN1 consensus on the recommendation of CSI compression for normative work.
  - Trade-off between performance and complexity/overhead
  - Issues related to inter-vendor training collaboration
- Other aspects that require further study/conclusion are captured in the summary

- CSI prediction

Agreement

Capture the following conclusion in section 8 of the TR 38.843

- From RAN1 perspective, there is no consensus on the recommendation of CSI prediction for normative work.
- The reason for the lack of RAN1 consensus on the recommendation of CSI prediction for normative work is due to
  - Lack of results on the performance gain over non-AI/ML based approach and associated complexity
- Other aspects that require further study/conclusion are captured in the summary.

Our considerations

» Based on the current evaluation results, we think both **CSI compression and CSI predication show gains** compared with legacy scheme.

» Spatial-frequency CSI compression is with less gain compared to other cases but can **be easily extended** to time domain compression with much larger gains.

» Spatial-frequency domain CSI compression is **the only case using two-sided model** which has higher value for LCM definitions.

» There are **the limited** specification/implementation complexity for CSI predication, and could follow the high-level principle of other one-sided model sub-cases.

» At least, study above use cases and check at 2024 September for normative work

Considerations on Rel-19 WI

Beam management

Agreement

Confirm the following working assumption (with modification in red) agreed in RAN1#114bis

Working Assumption

For AI-based beam management, from RAN1 perspective, at least the following are recommended for normative work

- 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
- Signaling/mechanism(s) to facilitate necessary LCM operations via 3GPP signaling for UE-sided model

Positioning accuracy enhancements

Agreement

It is recommended to specify necessary measurement, signaling and procedure to facilitate training, inference, monitoring and/or other LCM operations for both direct AI/ML positioning and AI/ML assisted positioning

- specify necessary signaling of data collection; investigate the necessity of other information for supporting data collection, and if needed, specify during normative work
- investigate on the necessity and signaling details of measurement enhancements, and if needed, specify during normative work
- investigate on the necessity and signaling details of monitoring method(s), and if needed, specify during normative work

Our considerations

» Support to specify Spatial-domain DL Tx beam prediction for both BM-Case1 and BM-Case2 in Rel-19 WI.

» Support to specify spatial-domain beam prediction for both UE-sided model and NW-sided model in Rel-19 WI.

» Support to specify both direct AI/ML positioning and AI/ML assisted positioning in Rel-19 WI.

» Support all 5 use cases of AI/ML based positioning for Rel-19 AI/ML WI.

Considerations on Rel-19 WI

Considerations on use cases

Proposal 3: We support two-sided CSI compression and/or one-sided CSI prediction transferring to WI, or at least continuing study in Rel-19 and check at 2024 September for normative work.

Proposal 4: Support to specify Spatial-domain DL Tx beam prediction for both BM-Case1 and BM-Case2 in Rel-19 WI.

Proposal 5: Support to specify spatial-domain beam prediction for both UE-sided model and NW-sided model in Rel-19 WI.

Proposal 6: Support to specify both direct AI/ML positioning and AI/ML assisted positioning in Rel-19 WI.

Proposal 7: Support all 5 use cases of AI/ML based positioning for Rel-19 AI/ML WI.

Summary

- In Rel-19 AI/ML for air interface WI, we have following proposals:
- Proposal 1: Rel-18 SI should be transferred to Rel-19 WI and approve a RAN1 leading WI for the normative work.
- Proposal 2: Support to include the following aspects for General Framework for specifying AI/ML use cases and common framework across AI/ML use cases in Rel-19 AI/ML WI.
  - Model transfer/deliver, Functionality/Model identification, Model inference operation, Data collection, Performance monitoring, UE capability, Functionality/Model selection, activation, deactivation, switching, fallback.
- Proposal 3: We support two-sided CSI compression and/or one-sided CSI prediction transferring to WI, or at least continuing study in Rel-19 and check at 2024 September for normative work.
- Proposal 4: Support to specify Spatial-domain DL Tx beam prediction for both BM-Case1 and BM-Case2 in Rel-19 WI.
- Proposal 5: Support to specify spatial-domain beam prediction for both UE-sided model and NW-sided model in Rel-19 WI.
- Proposal 6: Support to specify both direct AI/ML positioning and AI/ML assisted positioning in Rel-19 WI.
- Proposal 7: Support all 5 use cases of AI/ML based positioning for Rel-19 AI/ML WI.

Thanks!