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Views on R19 AI/ML in air-interface

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General view of proceeding AI/ML in air interface in R19

Status of R18 AI/ML work

- Basic framework is established including identifying essential procedure and providing potential solutions
- AI-based beam management use cases and AI-based positioning use cases are recommended for normative work. While there are no consensus on the recommendation of AI-based CSI enhancement use cases for normative work
- Core/performance requirements and test methodology per use case is initially studied. While the test methodology and feasibility for CSI compression use case are not identified.

General view for R19

- Normative work is supported for the general aspects , AI-based beam management use cases and AI-based positioning use cases
  - Signaling/procedure/protocol to support the specified work (RAN1, RAN2, [RAN3])
  - Core/performance requirements and test methodology for each use case (RAN 4)
- Further study on the AI-based CSI enhancement including AI-based CSI compression and AI-based CSI prediction is recommended.

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General aspects

General Principle for common framework

- Strive for a future-proof framework not only for 5G but also for future 6G
- Strive for solutions not only facilitating the operation on network side but also operation on UE side
- Strive for common foundation which is easy to be extended to various use cases

Proposed objective

- **Data collection**
  - Common framework for the configuration/report
  - Support data collection on UE side and NW side
- **Model training/update**
  - Focus on offline manner
- **Model/Functionality identification**
  - Support both functionality identification and model identification
- **Reporting of functionalities/models**
  - Report of supported functionalities/models via UE capability
  - Report of applicable functionalities/models via procedure other than UE capability report

- **Model transfer/delivery**
  - At least support delivery/transfer from NW to UE
  - CN based model delivery is not considered.
- **Model inference**
  - Can be discussed per use case
- **Performance monitoring**
  - Target for both active model/functionality and inactive model/functionality
- **Model/ functionality activation/ deactivation/ switch/fallback**
  - Strive for common procedure for the model-based LCM and functionality-based LCM
  - Consider potential interruption due to processing time
- **Common framework for Interoperability and testability**

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AI-based CSI compression

Statues of AI based CSI compression with two-side model in R18

- From RAN1 perspective, there is no consensus on the recommendation of CSI compression for normative work due to at least the following reasons
  - Trade-off between performance and complexity/overhead
  - Issues related to inter-vendor training collaboration
- From RAN4 perspective, there is no conclusion on the test feasibility of two-side model.

Proposed objective of AI based CSI compression with two-side model in R19

- Further study potential approaches for further improvement, e.g., exploring the time domain correlation, to obtain better trade-off between performance and complexity/overhead or reduce complexity.
- Further study inter-vendor training collaboration approaches
- Further study the test feasibility of two-side model
- If substantial performance gain or affordable complexity is justified , all issues related to inter-vendor training collaboration are addressed and test is feasible, AI based CSI compression with two-sided could be recommended for normative work at second phase in R19.

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AI-based CSI prediction

Statues of AI based CSI prediction in R18

- From RAN1 perspective, there is no consensus on the recommendation of CSI prediction for normative work due to the following reason
  - Lack of results on the performance gain over non-AI/ML based approach and associated complexity

Proposed objective of AI based CSI prediction in R19

- Further evaluation could be considered to justified whether substantial performance gain can be obtained.
- If substantial performance gain and/or affordable complexity could be justified, AI based CSI prediction could be recommended for normative work at second phase in R19.

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AI-based beam management enhancement

Status of R18

- Both BM-Case1 and BM-Case2 are recommended for normative work
  - 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

Proposed objective in R19

- For both BM-Case1 and BM-Case2
  - Specify necessary signaling/mechanism(s) to facilitate data collection, model inference, and performance monitoring for both UE-sided model and NW-sided model (RAN1, RAN2, [RAN3])
  - Specify signaling/mechanism(s) to facilitate necessary LCM operations via 3GPP signaling for UE-sided model (RAN1, RAN2, [RAN3])
  - Core/performance requirements and test for BM-Case 1 and BM-Case 2, respectively (RAN 4)

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AI-based positioning enhancement

Status of R18

- Both direct AI-based positioning and AI assisted positioning are recommended for normative work
- For all five positioning cases (Case 1/2a/2b/3a/3b), RAN1 has not considered prioritization.

Proposed objective in R19

- Specify all five positioning cases (Case1/2a/2b/3a/3b)
  - Signaling/procedure/protocol enhancement (RAN1, RAN2, RAN3)
    - Specify signaling/ procedure to facilitate the data collection
    - Specify functionality/model identification signaling/procedure beyond the common functionality/model identification framework
    - Investigate potential measurement report enhancement and specify it
    - Investigate the performance monitoring method and specify it
    - Specify signaling to facilitate the functionality/model LCM
  - Core/performance requirements and test methodology for different positioning cases (RAN 4)

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Conclusion

- **Start normative work for the following items including signaling/procedure/protocol and performance requirement / test**
  - General aspects of AI/ML in air-interface
  - AI-based beam management including BM-Case1 and BM-Case2
  - AI-based positioning including all five positioning cases
- **Set a studying phase for the AI-based CSI enhancement**
  - AI-based CSI compression including performance improvement, inter-vendor training collaboration and test methodology
  - AI-based CSI prediction including performance comparison with non-AI based approach
  - Whether to further proceed a normative work phase in R19 depends on the outcome of the study

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Thank You