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3GPP TSG RAN Rel-19 workshop RWS-230084
Taipei, June 15 - June 16, 2023

Agenda Item: 5

Source: Spreadtrum Communications

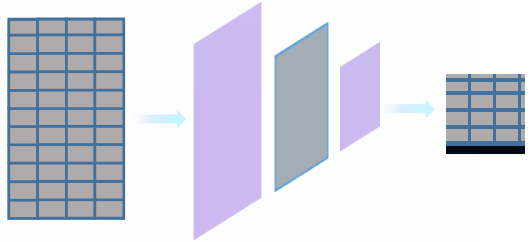
Title: AI/ML for Air interface in Rel-19

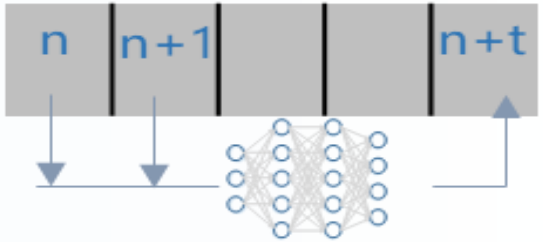
Document for: Discussion and decision

The progress of R18 AI/ML for Air Interface

RAN1

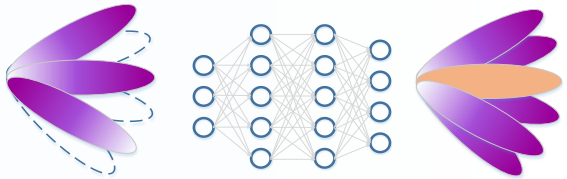
- Identify the general framework, and work on the AI/ML related stages, e.g., model/functionality identification, LCM, collaborative level, data collection
- Select six representative sub-use cases, evaluate the performance, and study the specification impact
  - CSI feedback: CSI compression and recovery, CSI prediction
  - Beam management: Beam prediction in spatial domain/time domain
  - Positioning: Direct positioning, Assisted positioning





RAN2

- Study the general architecture, and some procedures including data collection, model transfer/delivery for future proof



RAN4

- Start work at Q2.2023, and define requirements and tests for inference for some use case(s)

Use case – CSI compression and recovery

Observations

- **AI based CSI Compression and recovery can achieve better SGCS performance and less overhead than legacy R16 eTypeII codebook .**
- **AI based CSI Compression and recovery can achieve better SGCS performance in generalization verification with various scenarios.**
- **The model for AI based CSI Compression and recovery is the only one two-sided model**
  - **It can be considered to provide general guidance for future.**
  - **However, it is the most complex, and much offline engineer coordination among multi-vendors is needed when it comes to commercialization.**

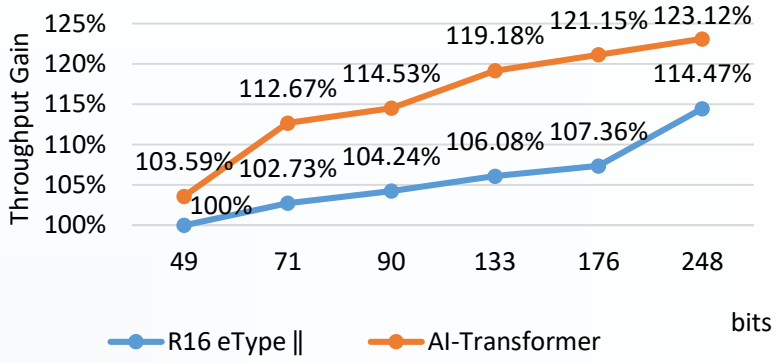


Fig 1. R16 eType II vs AI-transformer(Dense urban)

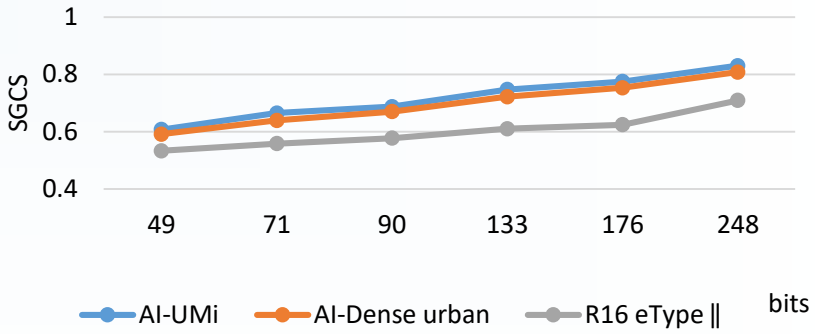


Fig 2. AI-transformer generalization verification(Umi)

Use case – CSI prediction

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Observations

- AI based CSI prediction can achieve better SGCS performance than the nearest historical CSI w/o prediction.
- AI based CSI prediction can achieve good SGCS performance in generalization verification with various UE speeds
- The spec workload is limited
  - The model for AI based CSI prediction is one-sided model, and could follow the high-level principle of other one-sided model sub-cases.
  - The CSI prediction of R18 MIMO work also can be leveraged.

Table 1. The comparison of SGCS for AI based CSI prediction

	AI based CSI prediction	The nearest historical CSI w/o prediction
SGCS	0.9182	0.6994

Table 2. The verification of generalization performance with various UE speeds

	Inference: 10km/h	Inference: 30km/h	Inference: 60km/h
Training: 10km/h	0.9919 (case1)	0.7465(case2)	0.5426(case2)
Training: 30km/h	0.9804(case2)	0.9182(case1)	0.6484(case2)
Training: 60km/h	0.9707(case2)	0.8625(case2)	0.8302(case1)
Training: 10, 30, 60km/h	0.9816(case3)	0.8979(case3)	0.8137(case3)

Use cases for BM & Positioning

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Observations

- **Beam management:**
  - **Tx prediction in both spatial and temporary domain with AI/ML enabled demonstrates good gains over legacy beam measurement and reporting with the assumption that the scenarios/configures for training is consistent with that for inference;**
  - **However, in reality it is typical that different gNBs may adopt different configures, e.g., #Tx beam, the angle of Tx beam, which will result in generalization degradation, so it is a high challenge for implementation.**

- **Positioning：**
  - **Both direct positioning and assisted positioning can significantly improve the positioning accuracy compared to existing RAT-dependent positioning methods when the generalization aspects are not considered;**
  - **The generalization is not good, especially for direct positioning.**

R19 AI/ML enabled air interface WI

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Motivations

- **Explore the benefits provided by AI/ML operation for air interface**
- **Establish the foundation - general framework of AI enabled air interface for nowadays and future air interface use cases leveraging AI/ML techniques**

Objectives

- **Specify general framework of AI/ML enabled air interface, and specify general protocol aspects, e.g., capability indication, configuration and control procedure . (RAN1, RAN2)**
- **Specify AI/ML related procedures/signallings, e.g., AI/ML Model lifecycle management, model/functionality identification, etc. (RAN1, RAN2)**
  - CSI prediction can be with high priority;
  - CSI compression and recovery also can be considered as one typical two-sided model for future proof;
  - Other use cases can be considered if TU budget allowed
- **Specify interoperability and testability aspects. (RAN4)**

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