3GPP TSG RAN Rel-18 workshop
Electronic Meeting, June 28th – July 2nd, 2021

RWS-210273

Source: NTT DOCOMO, INC.
Agenda item: 4.3

Study on AI/ML for PHY/MAC in Rel-18

NTT DOCOMO, INC.

Introduction

- There are multiple contributions proposing to have a study on AI/ML for radio interface including PHY and/or MAC layers in Rel-18 [1-6]
  - It intends to have a separate item from the normative work on AI for RAN (further enhancements for data collection) in Rel-18
- In this contribution, we present our views on the possible study on AI/ML for PHY/MAC in Rel-18, including its scope

Reference

[1]	RP-210256	Motivation of study on radio enhancement based on AI	OPPO
[2]	RP-210293	Initial Views on Release 18 NR	Samsung
[3]	RP-210321	Study on AI based PHY layer enhancement in Rel-18	vivo
[4]	RP-210393	New SID on evaluation methodology for AI enabled RAN	CMCC
[5]	RP-210614	Support of Artificial Intelligence Applications for 5G Advanced	ZTE, Sanechips
[6]	RP-210672	On the Scope of Rel-18 PHY Layer Enhancements using AI-based Solutions	InterDigital, Inc.

Discussion

- AI/ML can be considered as a useful tool to address specific challenges for radio interface, e.g., for following PHY/MAC layer procedures
  - CSI acquisition
  - RS overhead reduction
  - Positioning enhancement
  - …
  - Mobility/Beam management
  - Link adaptation
  - Resource allocation
  - …
- Although some companies presented benefits/gain of AI/ML for above use cases, 3GPP should have a study on AI/ML for PHY/MAC with considering followings
  - Target use cases for Rel-18
  - Evaluation methodologies
  - Feasibility, achievable gain and necessary spec impacts

Proposals

- **Considering the Rel-18 timeline, 3GPP should firstly consider the use cases with potential gain but limited spec impact**
  - For example, CSI report enhancement for beam management should be prioritized since it provides noticeable performance gain and requires minor specification impact
- As for the topics which may require big spec impact (such as signaling of neural network information), we could further clarify the pain and gain as next step
- **In the first study on AI/ML for air interface, it is important to have some general discussion such as evaluation methodology, data model and so on**
  - 3GPP should avoid discussion on detailed AI/ML algorithms and models for use cases
  - The study on AI/ML for PHY/MAC in Rel-18 can be performed by using whole Rel-18 period, and possible follow-up work item if any can be considered in future release (e.g., in Rel-19)

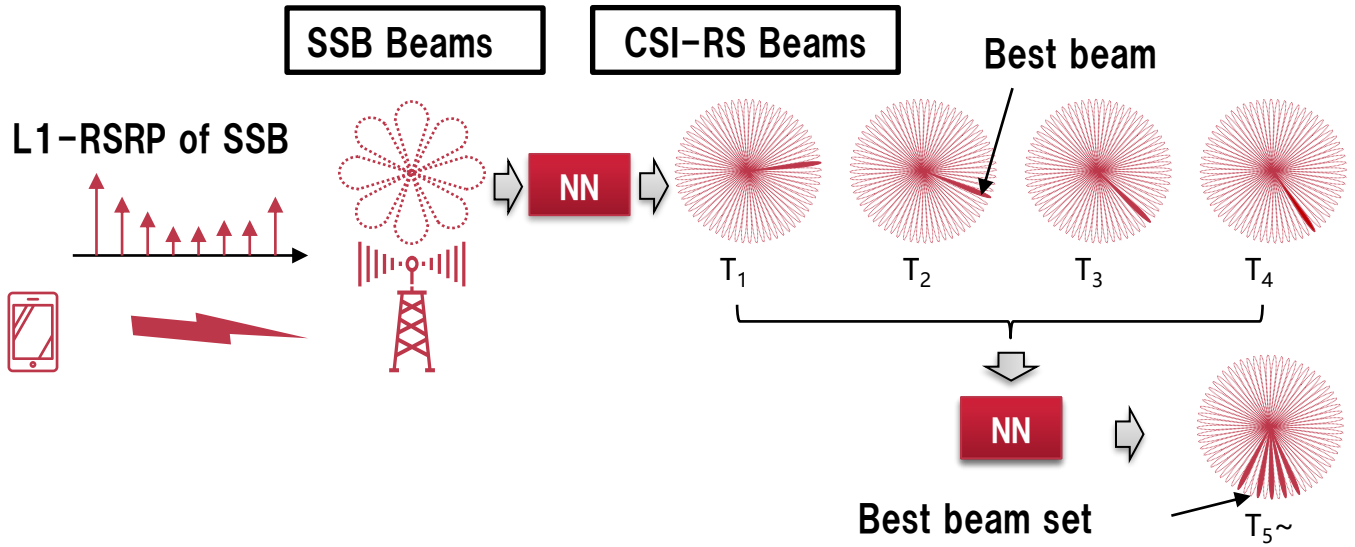
Possible objectives of the study on AI/ML for PHY/MAC

- Study the potential benefits and specification impacts of AI/ML enabled radio air interface including PHY and/or MAC layers through possible use cases:
  - Identify the target use cases, e.g. CSI acquisition, beam management, etc, which may benefit from AI/ML-based PHY/MAC enhancements with limited specification impacts
  - Study and align on evaluation methodology, metrics and data model for the target use cases.
  - Study and evaluate the potential performance gain of various AI/ML-based functionalities for the identified use cases
    - » Avoid discussion on detailed AI/ML algorithms and models for use cases.
    - » Prioritize the use cases with high performance gain.
  - Study standardization impacts on the air interface including PHY and/or MAC layers to convey the necessary information/data to support the AI/ML functionalities for prioritized use cases.
    - » Possible follow-up work item could be considered in future release for the use cases with high performance gain but limited spec impact (e.g., in Rel-19).

[Appendix] Potential Applications: CSI FB for Beam Management

- CSI feedback enhancement:
  - Current status: CSI-RS based beam tracking, reporting and indication introduce a great amount of CSI-RS overhead and latency.
  - Benefit: In order to reduce the CSI-RS overhead and latency, while keeping the same performance on beam management, AI/ML based method could be utilized to infer the best CSI-RS beam, based on:
    - » L1-RSRP report for SSB beams or sparse CSI-RS beams
    - » Historical L1-RSRP report for SSB/CSI-RS beams
  - Enhancement on L1-RSRP report for SSB or CSI-RS beams would be needed.

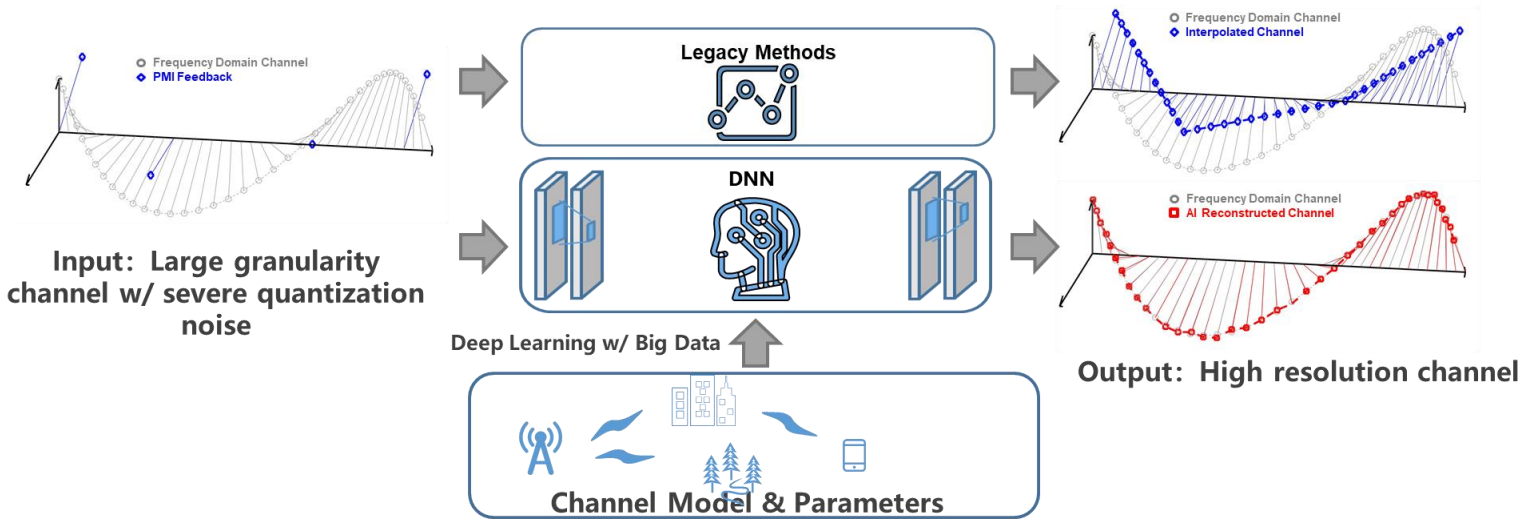
Example:



[Appendix] Potential Applications: Lean Air-Interface

- Receiver w/ deep learning techniques can recover the signal under non-ideal conditions such as,
  - Large granularity where legacy methods can not work well enough.
  - Non-linear signal model and severe non-Gaussian noise (quantization).
- Potential Usage & Specification Impacts:
  - RS design w/ reduced overhead and/or reduced RS types.
  - Grant-free transmissions w/ enhanced initial access and PUSCH/PDSCH TRx schemes.
  - Feedback content design to boost the performance of deep learning-based receivers.

Example: Deep learning-based CSI reconstruction w/ PMI feedback



Performance Evaluations