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Motivation on AI/ML for NR air interface high layer

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Background

- AI/ML for NR air-interface study item in Rel-18 focuses on the study of three typical physical layer use cases.
- In Rel-18 workshop, many AI/ML enabled high-layer use cases have been raised by companies.
- Based on the current working progress, more use cases related with high layer may be initiated.

Use case 1: mobility management

Background

- » Temporal beam prediction is studied as a sub-use case of AI/ML based beam management use case at RAN1 and is also helpful for improving mobility performance due to the UE trajectory prediction.
- » Mobility enhancement specified at RAN3 is mainly about AI/ML for NG-RAN focusing on AI/ML model deployed at Network-side.

Motivation

- » AI/ML based mobility enhancement can be further studied and enhanced for NR air-interface.
- » Mobility is mainly about user movement behavior and network coverage. AI/ML is expected to be used to construct radio channel map/fingerprint, process UE trajectory prediction and make better HO decisions.
- » Besides, some specific scenarios can also be studied such as for high speed mobility, high-speed train or V2X scenario mobility enhancement, UE group mobility enhancement.
- » Therefore, further enhancements may be investigated to improve mobility performance.

Use case 1: mobility management

Scope

- Study AI/ML based mobility enhancement scenarios and use cases:
  - Mobility enhancement based on UE model inference
  - Mobility enhancement based on centralized and distributed radio channel map/fingerprint construction
- Evaluate performances of AI/ML based algorithms for the agreed use cases.
- Study potential mobility enhancement, such as measurement and reporting aspects to enable AI/ML on NR air-interface.
- Study life cycle management, e.g., model performance monitoring.

Use case 2: higher layer positioning enhancement

Motivation

- » In practice, high-quality labeled data samples are relatively small compared with the present evaluation assumptions. Many data samples without high-quality label may be used. Data security and personal privacy are crucial issues with public concern.
- » Current RAN1 study focuses on data centralized model training. Federal learning based positioning enhancement can decrease data transmission overhead and satisfy data security and personal privacy requirements. Since it is very limited time left for the industry to study and make clear how to introduce AI/ML integrated with B5G or even to design an AI native 6G RAN. For making better preparation for 6G, distributed learning based architecture should also be study and have fully discussion. The current studying use cases are mainly about low layer use case for air-interface. Rel-19 is a good time, and we should start pre-6g-research on AI/ML for NR higher layer aspects, especially federal learning based higher layer positioning enhancement.
- » Therefore, further enhancement may be investigated on AI/ML based higher layer positioning enhancement.

Use case 2: higher layer positioning enhancement

Scope

» Study higher layer scenarios and sub use cases of AI/ML based positioning enhancement.

» Study distributed learning (e.g., federal learning) based positioning enhancement to satisfy data security and personal privacy requirements

- such as centralized/distributed learning mode selection and configuration, model monitoring of LCM etc.

» Study potential Xn and F1 interface enhancements.

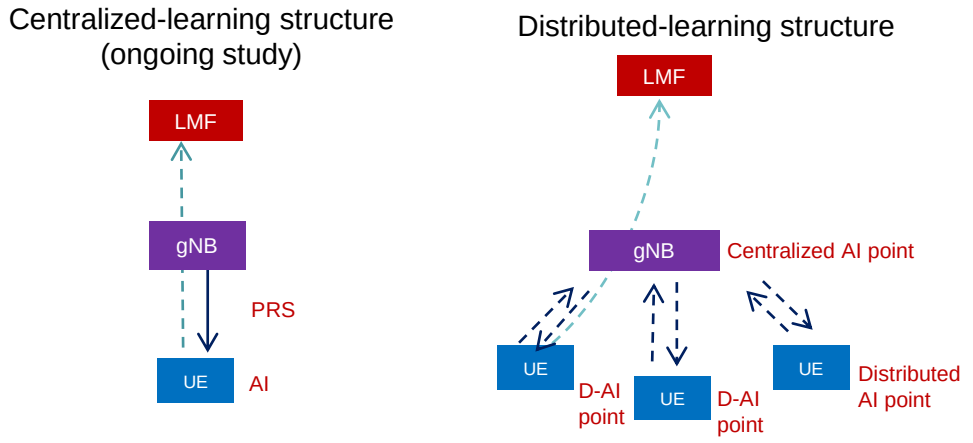

Figure 1. Examples of use case

Simulation results

Observation: Federal learning based positioning enhancement can achieve faster convergence and comparable positioning accuracy.

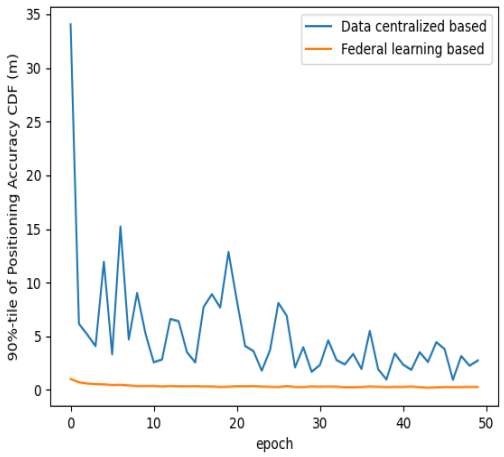

Figure 2. Performance of federal learning @InF-DH

Use case 3: dynamic TDD

Background

» Dynamic TDD is defined in former releases supporting signalling combination configuring transmission pattern. CLI measurements and reporting at UE and network coordination mechanism is supported in order to avoid co-channel CLI within the same network.

» Considering adjacent carrier leakage (ACL) in TR38.828, dynamic TDD can be used in indoors (indoor-2-indoor, indoor and macro) and certain micro (e.g., FR2) deployments as long as care is taken.

Motivation

» There are strong demands for dynamic TDD in B5G specific scenarios

- Requirements of low latency, high data-rate and hot plugging in smart factory, automation control and other industry scenarios will lead to the requirement of adaptive subframe configurations.
- Smart Home, smart building and office have different service requirements at different time.

» Current 5G network configurations Usually adopt a fixed subframe configuration, which cannot meet the above scenarios' requirements simultaneously.

» If we rely on manual configuration and optimization, it will lead AI/ML can be introduced to learn from the environment and service and help to generate flexible subframe configurations accordingly.

Use case 3: dynamic TDD

Scope

- » Study AI/ML based subframe optimization with semi-static/dynamic configurations for interference management.
  - semi-static configuration of cell-level RRC signalling and UE-level RRC signalling.
  - dynamic configuration with CLI management for UE group common PDCCH signalling or UE specific PDCCH signalling.
- » Study life cycle management, e.g., model performance monitoring.
- » Study based on split or non-split architecture, and multi-TRP coordination may be needed, where L2/L3 enhancement may be required.

Use case 4: service awareness RRM

Background

- » There are several techniques supported in NR to satisfy the requirement of specific scenarios and services.
- » High valuable services (e.g., URLLC, V2X, XR..) usually have higher transmission requirements, and several resource allocation management mechanisms have been identified to guarantee QoS/QoE of users, decrease power consumption etc.

Motivation

- » RRM mechanisms, such as DRX, power control, link adaptation etc., are expected to be further improved by introducing AI/ML.
- » AI/ML can be used to process service awareness, interference management, user scheduling, as well as generate signalling and policy of UE or network.

Scope

- » Study potential service awareness RRM use cases which are expected to be improved by introducing AI/ML.
- » Evaluate performance benefits of AI/ML based algorithms for the agreed use cases.
- » Study potential RRM enhancement to enable AI/ML on NR air-interface.

Proposal

- Start initial discussion on AI/ML for NR air interface high layer use cases
  - » Identify AI/ML enabled high layer use cases.
  - » Study performance evaluation methodology of AI/ML enabled high layer use cases.
  - » Study specification impact of the performance enhancement for high layer use cases.

Thanks!