SHARP
Be Original.

Views on Rel-18 AI/ML for RAN1/RAN2

RWS-210225

Agenda Item: 4.3
3GPP TSG Rel-18 Workshop
Electronic Meeting, June 28 - July 2, 2021

Background and status

SHARP
Be Original.

Industry requirements & academic research

- Network-level data analysis: network prediction, network classification, etc
- App-level applications: mobile health, mobile pattern reorganization, etc
- User localization, network security, etc
- Network control: routing optimization, traffic optimization, etc
- Signal processing: signal detection, channel estimation, etc

…

[1]

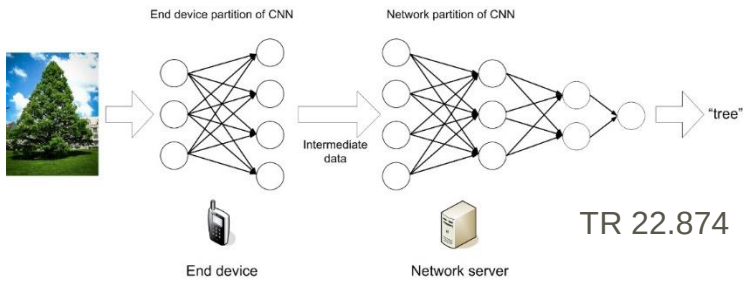
From requirements & research to standardization

3GPP RAN standardization

- RAN3 progress: Principles for RAN intelligence enabled by AI; Functional framework; Use cases and solutions (under discussion)
- **RAN1/RAN2 aspects: to be studied**

3GPP SA1 standardization

- New WID on AI/ML model transfer in 5GS
- Objectives: Splitting AI/ML operation, AI/ML model/data distribution, distributed learning over 5G system



TR 22.874

[1] Zhang C, Patras P, Haddadi H. Deep learning in mobile and wireless networking: A survey. IEEE Communications surveys & tutorials, 2019, 21(3): 2224-2287.

General view

Flexibility/features vs. optimization/utilization

- Optimizing configurations for various QoS/QoE targets is difficult
- Conventional optimizations depend on engineering experience and skills
- AI/ML solutions are automatic and more reliable with improved performance

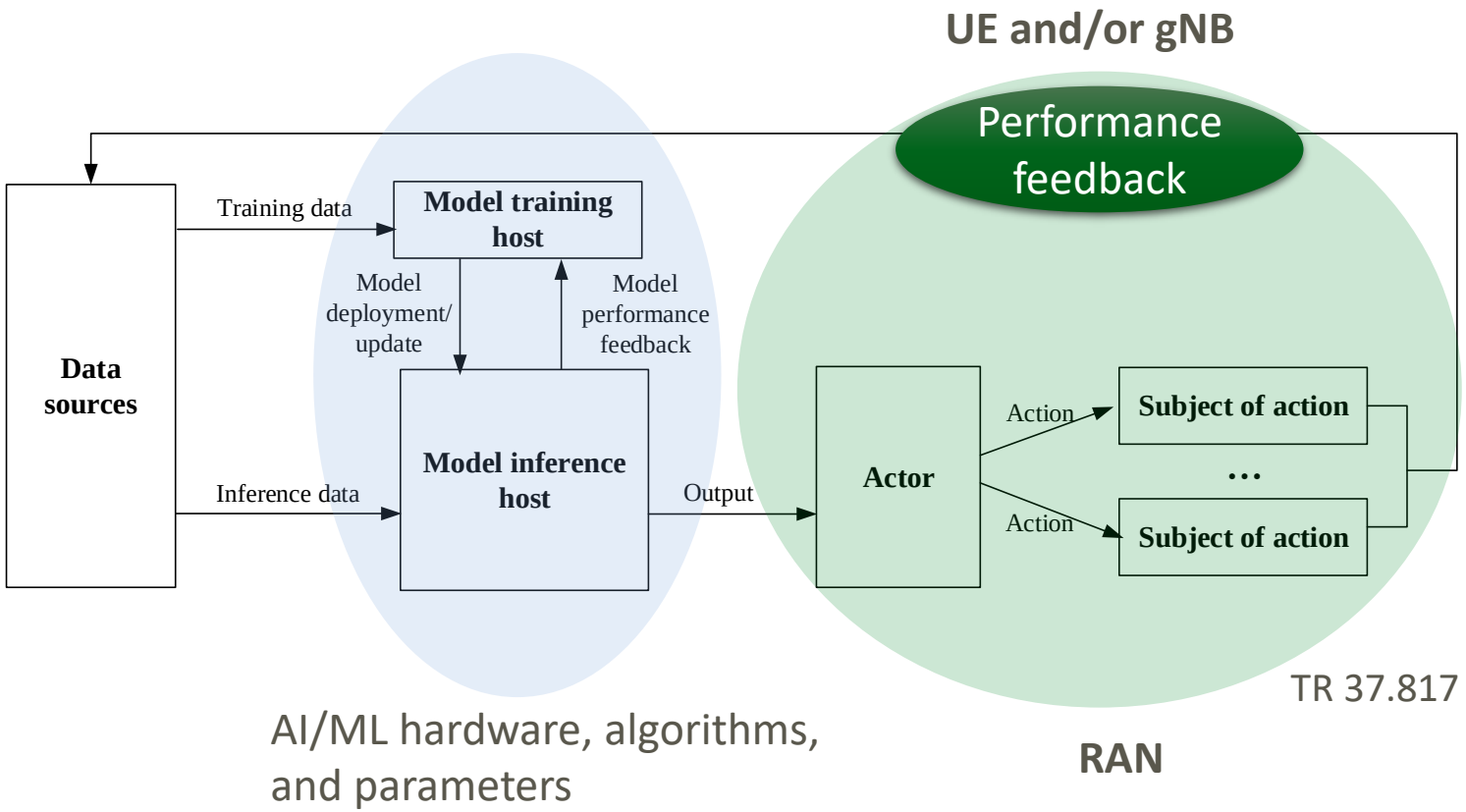
Targets in 3GPP RAN1/RAN2 for AI/ML applications

- Enhance measurement/reporting and signaling to better support higher layers
- Optimize air interface by AI/ML

Main scope of 3GPP RAN1/RAN2

- Data collection/measurement reporting in RAN1: enhance performance feedback (training data, inference data)
- Signaling enhancements

Need to determine targets and scope, e.g., to specify standardization works by SI firstly



Use cases can assisted by AI/ML

SHARP
Be Original.

Vertical optimization (an example)

- As NR evolves to provide simultaneous support for the primary usage scenarios (i.e. eMBB, URLLC, mMTC), contention in dimensioning the NW resources to serve the overlapping requirements for will need to be addressed.
  - For example, of 8K-based medical applications require both low latency and 10xGBps throughput.
- AI/ML applied toward the dimensioning of RAN resources can reduce congestion and provide the required QoS of target applications.
- AI for RAN is necessary for the prediction and detection of localized congestion, and the optimize management of resources towards multiple overlapping use cases.

Feature optimization

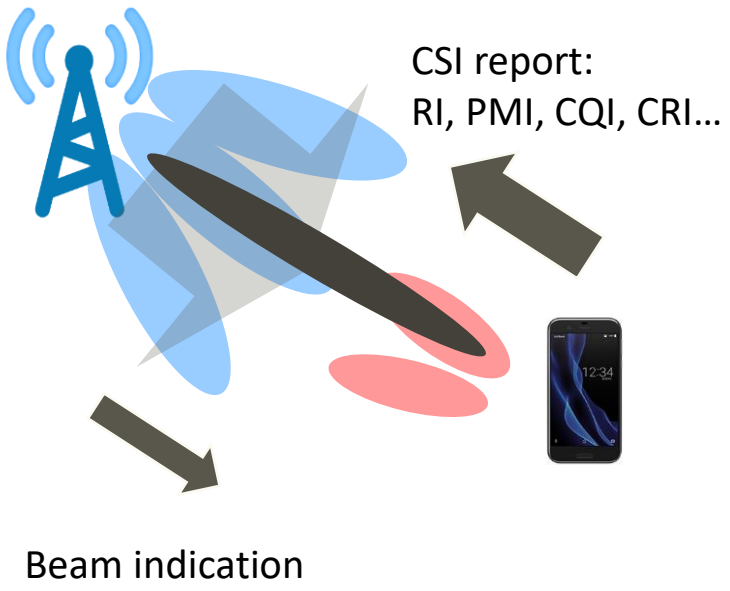
- Channel estimation/reference signal/CSI
  - DMRS configuration
  - CSI-RS configuration
  - CSI content/feedback
- Beam management
- Interference management
- Resource allocation efficiency
- Power efficiency
- Positioning

…

An example of AI/ML assisted beam management

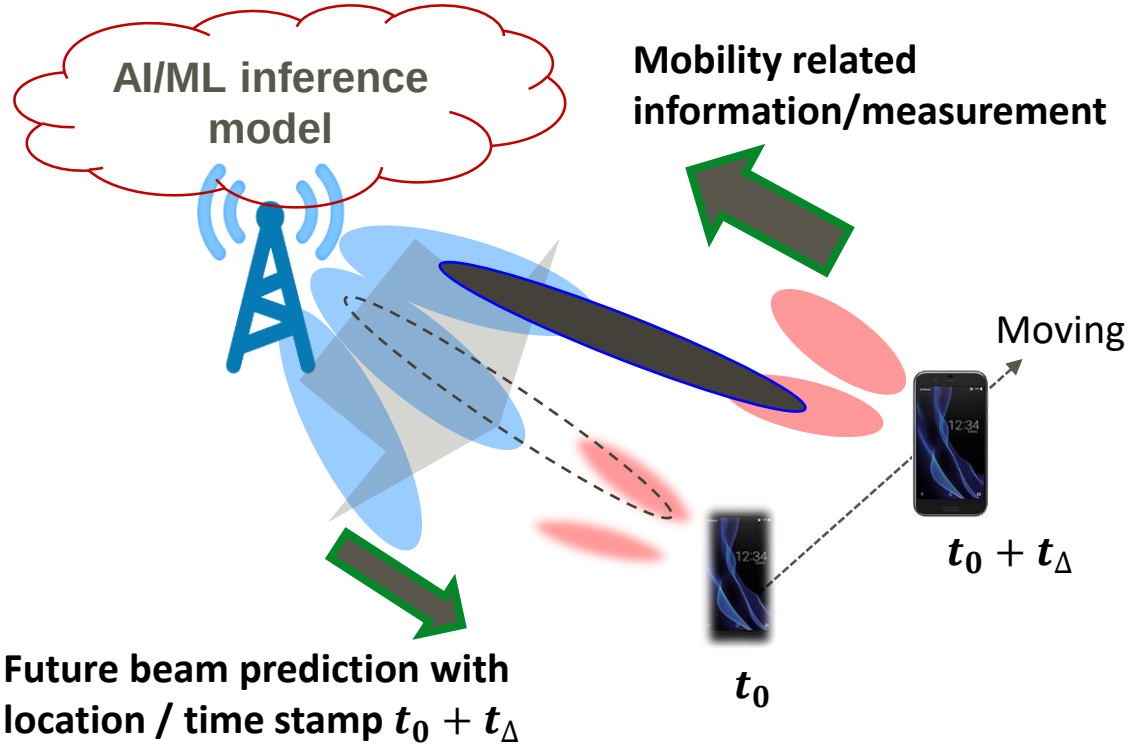
Beam management (DL) without AI/ML assistance

- Beam sweeping, beam measurement, beam reporting, beam determination, …
- Beam indication to UE, assuming that UE will not move out of that beam (from performing beam measurement to detecting beam indication)



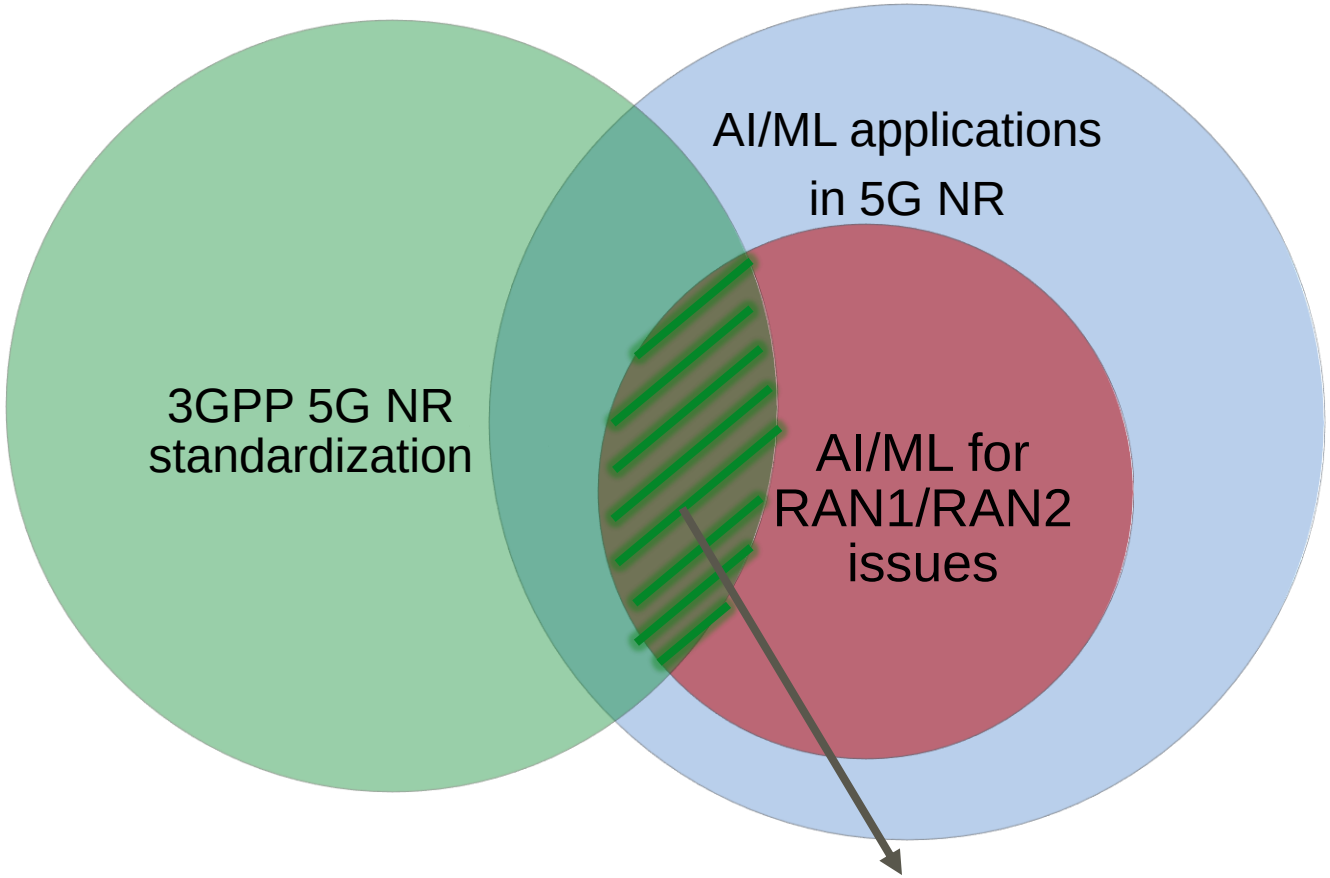
Beam management (DL) with AI/ML assistance

- Predict future beam by AI/ML with additional mobility information (potential better QoS, reduced signaling overhead)
- Spec impact: UE reports mobility related information (details could be specified during SID/WID)



[2] Li YNR, Gao B, Zhang X, et al. Beam management in millimeter-wave communications for 5G and beyond. IEEE Access, 2020, 8: 13282-13293.

Scope and specification impact



To obtain inference data and/or training data timely/efficiently/accurately,
expected scope and specification impact on physical layer measurement:

- Enhancement on connected mode measurement mechanisms (in 38.331)
- Enhancement on reference signal design and utilization (in 38.211)
- Enhancement on CSI content/feedback (in 38.212, 38.214)

SHARP

Be Original.