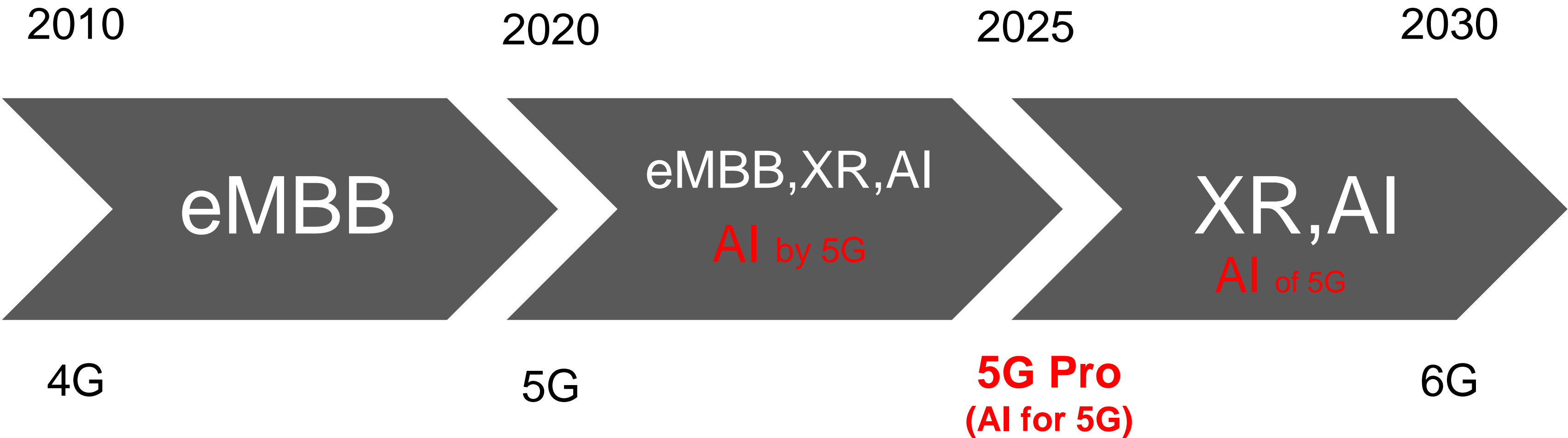


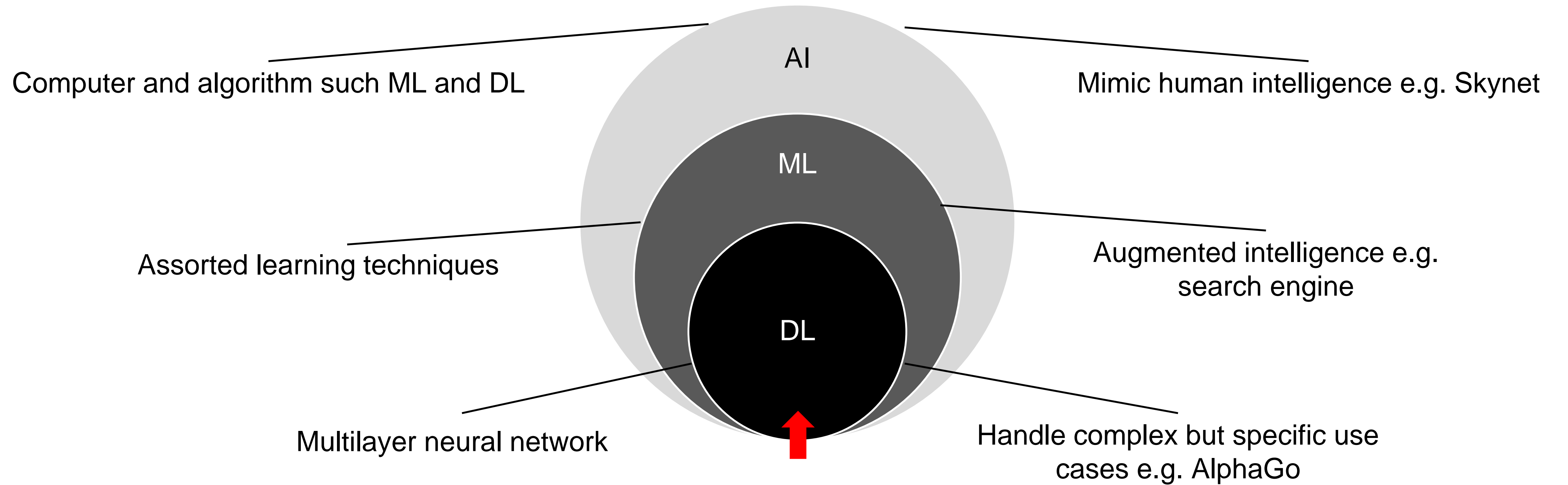
2021/12/17

Motivation of introduction of AIML in physical layer

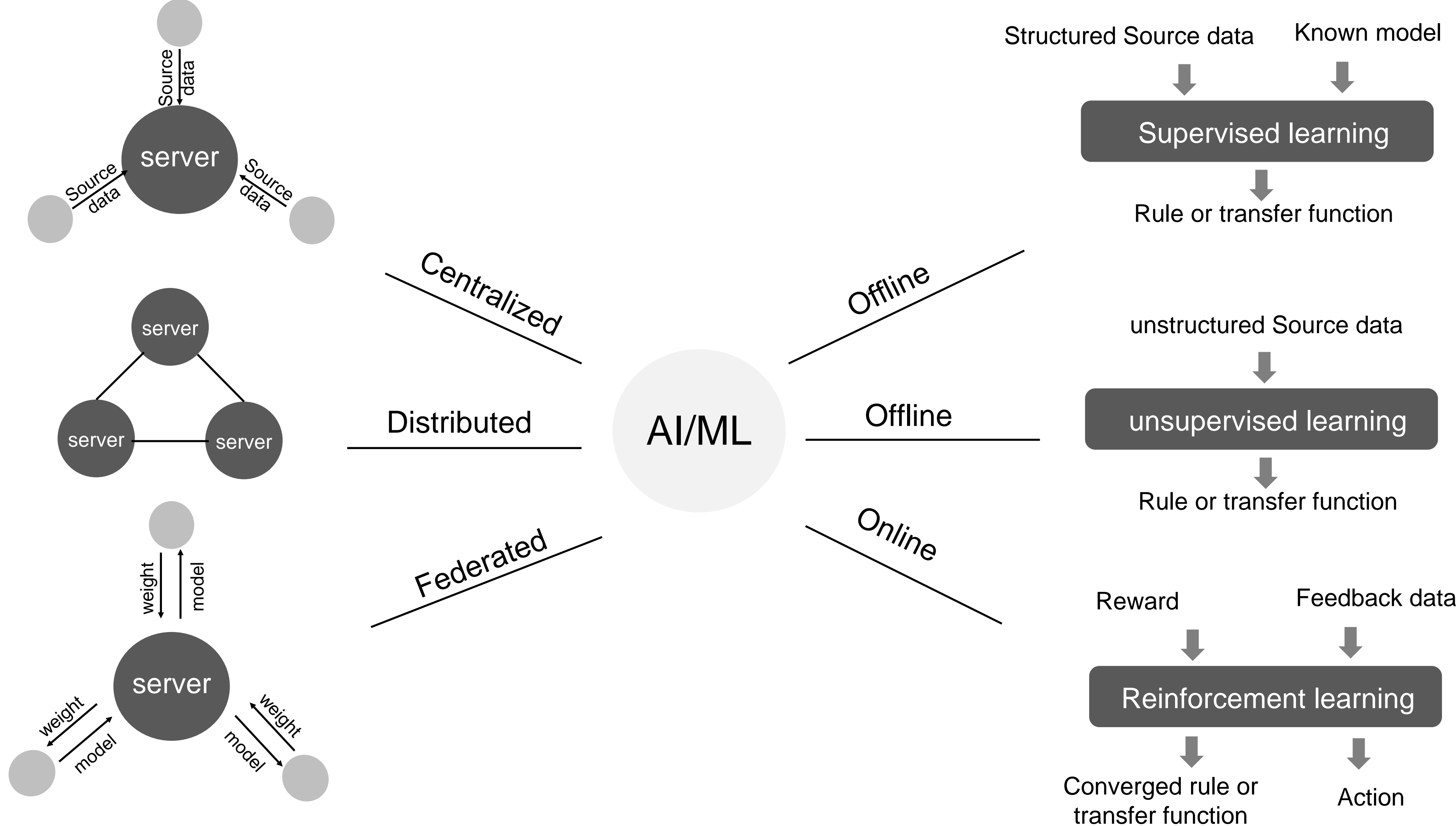
OPPO' s vision in decades on AI



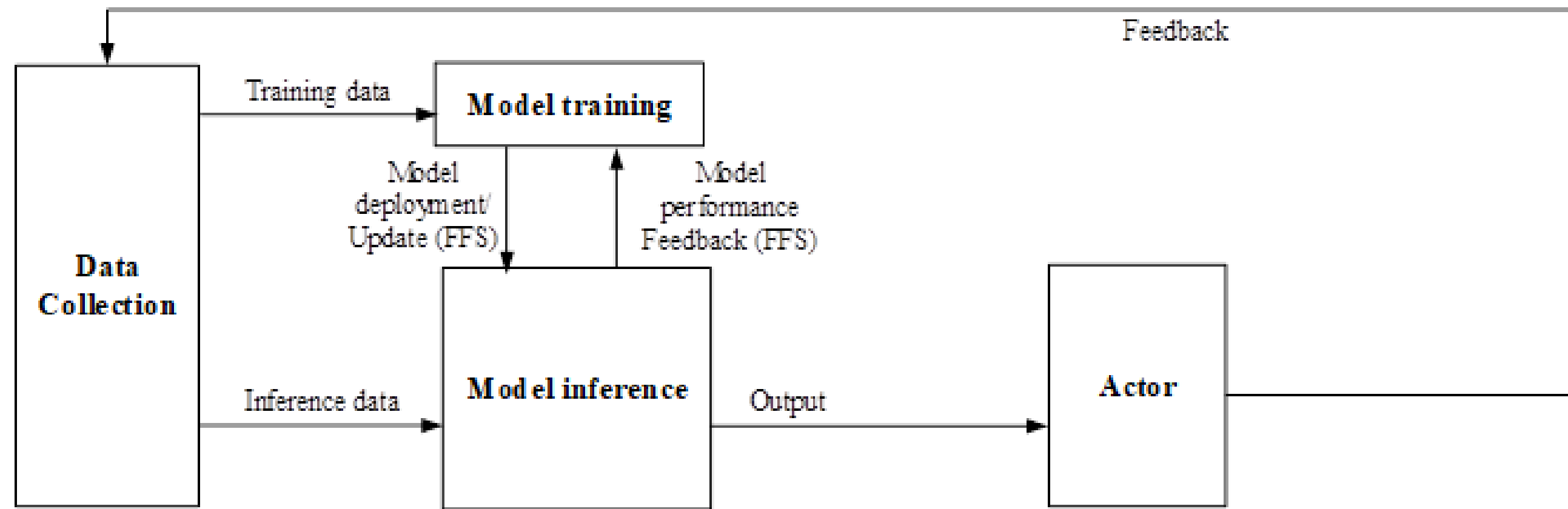
AI or ML or DL



AI/ML categories



Principles and framework @ FS_NR_ENDC_data_collect



Data collection: Providing input data to Model training and Model inference

Model training: Prepare data and train model

Model inference: Predict or decide to do something based on trained model and input

Actor: Function to act on following instruction from ML

Feedback: Outcome of the action

Main principle:

- 1, AI/ML algorithm and models itself are black box for RAN
- 2, RAN focus on input/output , AI/ML' s functionality and its location
- 3, SA architecture is prioritized

Typical use case in wireless communication system

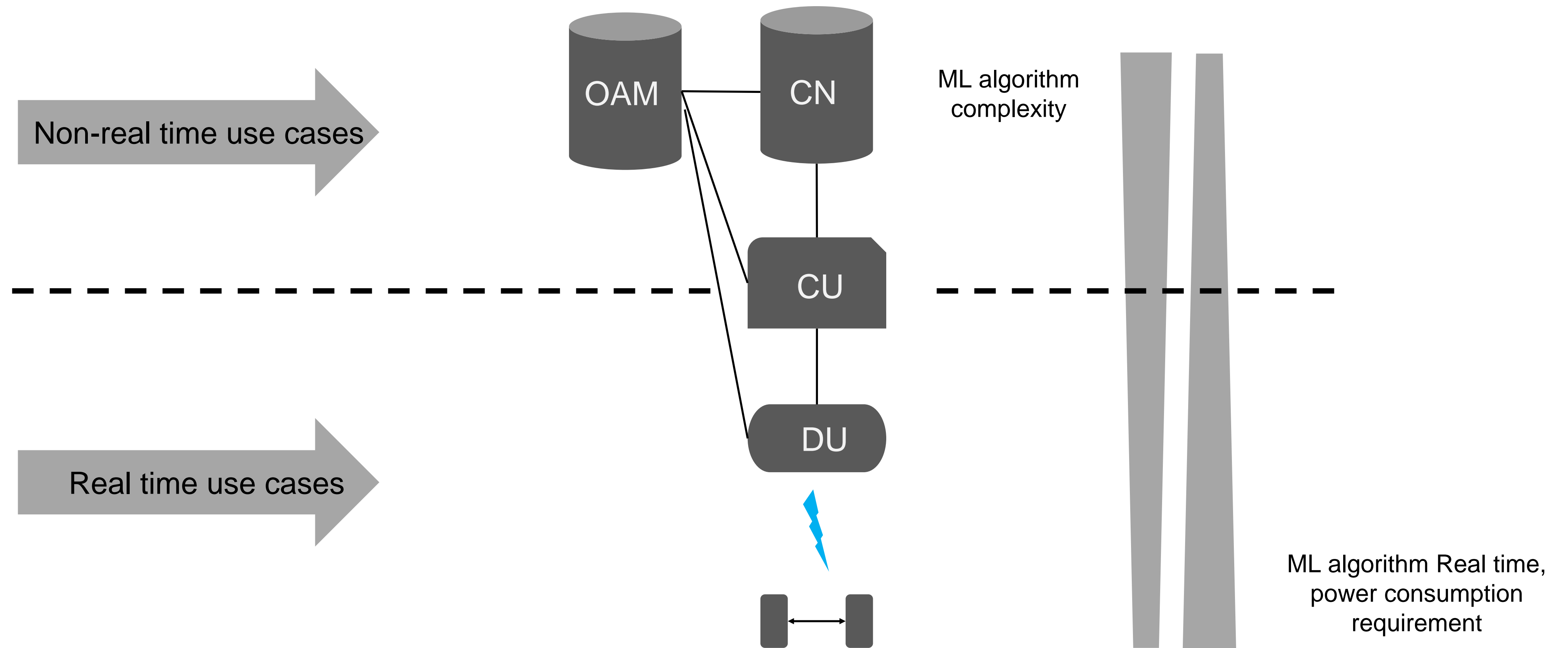
Non-real time use case:

- System level:
 - NWDAF to maintain the network by operator
- Cell level:
 - QoE optimization
 - Network energy saving
 - Network load balancing
 - Mobility optimization
 - Coverage optimization
 - Traffic steering
 - ...

Real time use case(link level):

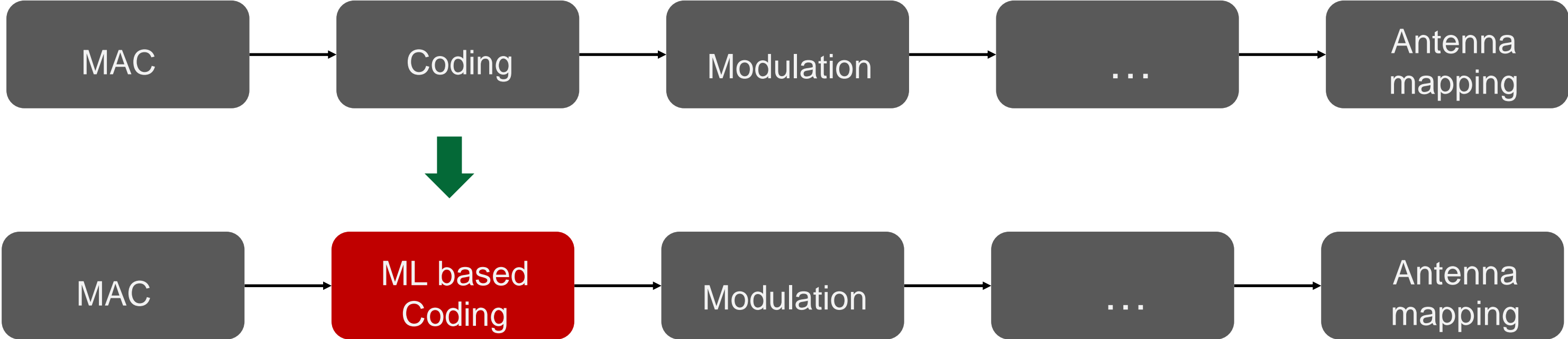
- UE specific
 - CSI compression
 - MIMO beam forming and selection
 - Channel estimation and modelling
 - Link adaption e.g. MCS
 - Receiver enhancement
 - ...

ML algorithm applicability



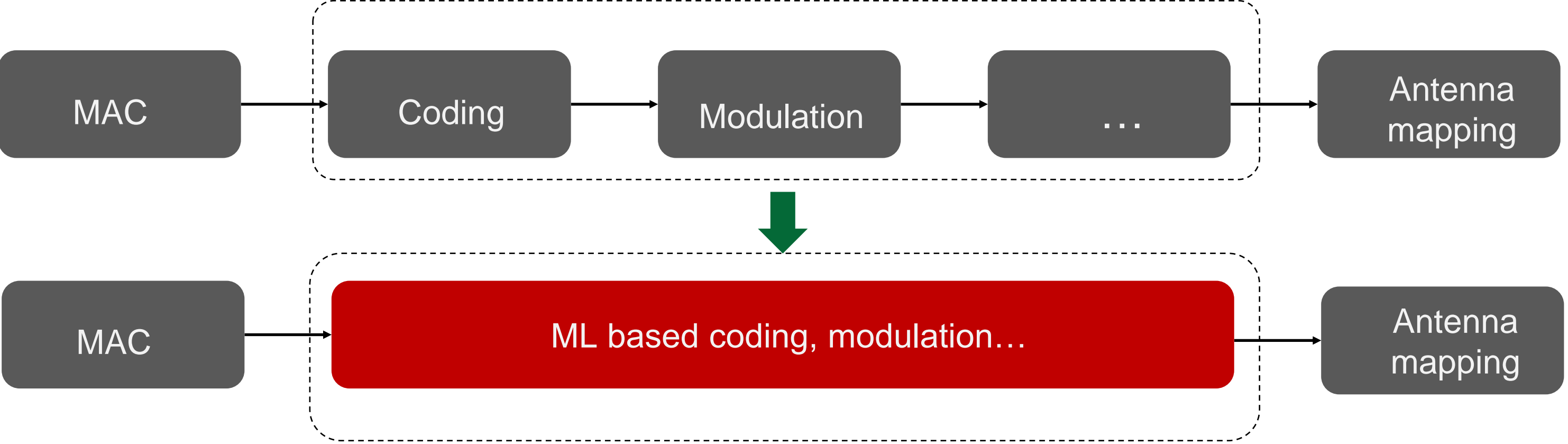
Two basic ML approaches

ML approach is applied for one specific step in the processing chain

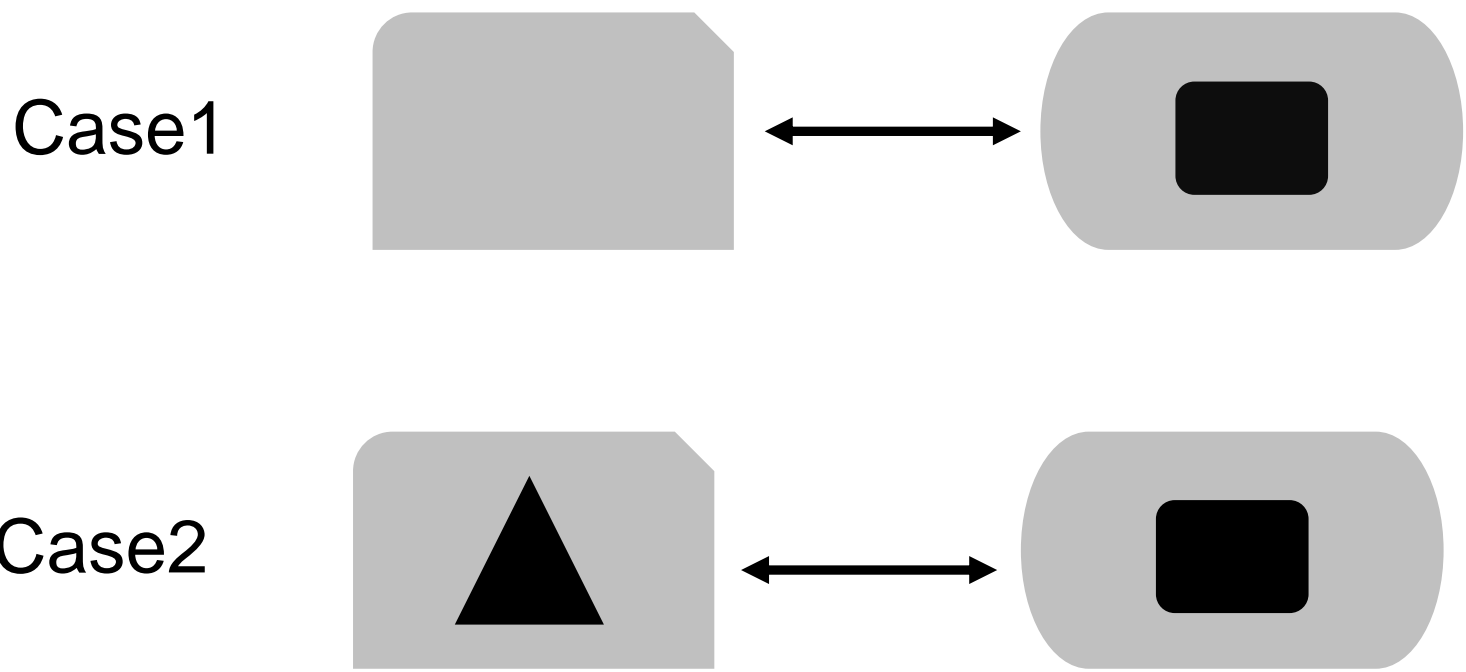


Or mixed of two approaches

ML approach is applied for contiguous multiple steps or whole processing chain

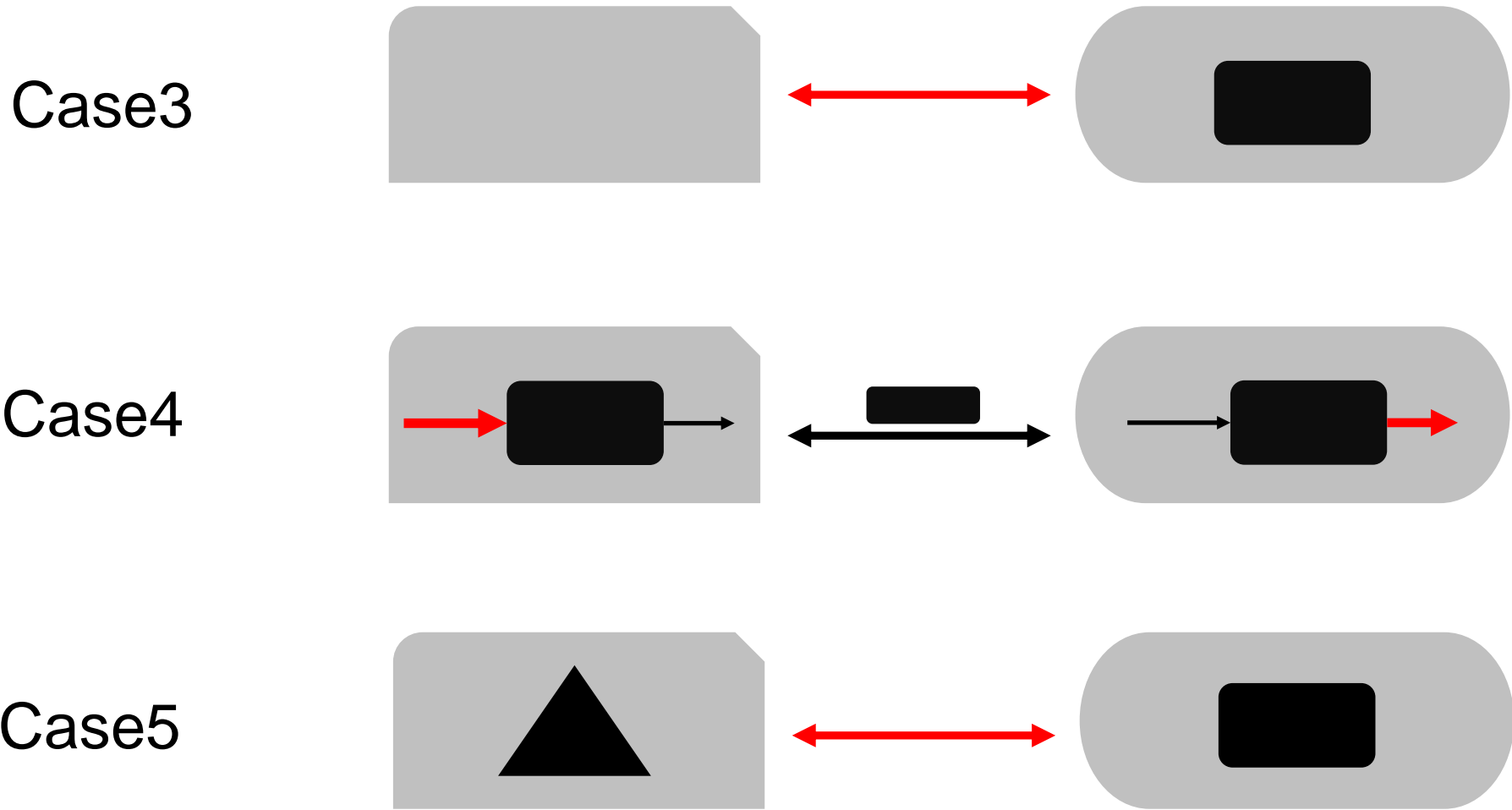


Standard impact



For case 1 and case2:

- No standard impact at all i.e. purely implementation



Case3: AI/ML algorithm may need some new **input and/or output** to/from other nodes

Case4: Same AI/ML algorithm to accomplish same task in distributed way but the output/input in-between could be a container. **Input and output** of algorithm should be standardized

Case5: Different AI/ML algorithm accomplish same task in distributed way. **Output and Input** over interface may need standardization

CSI compression

The basic idea:

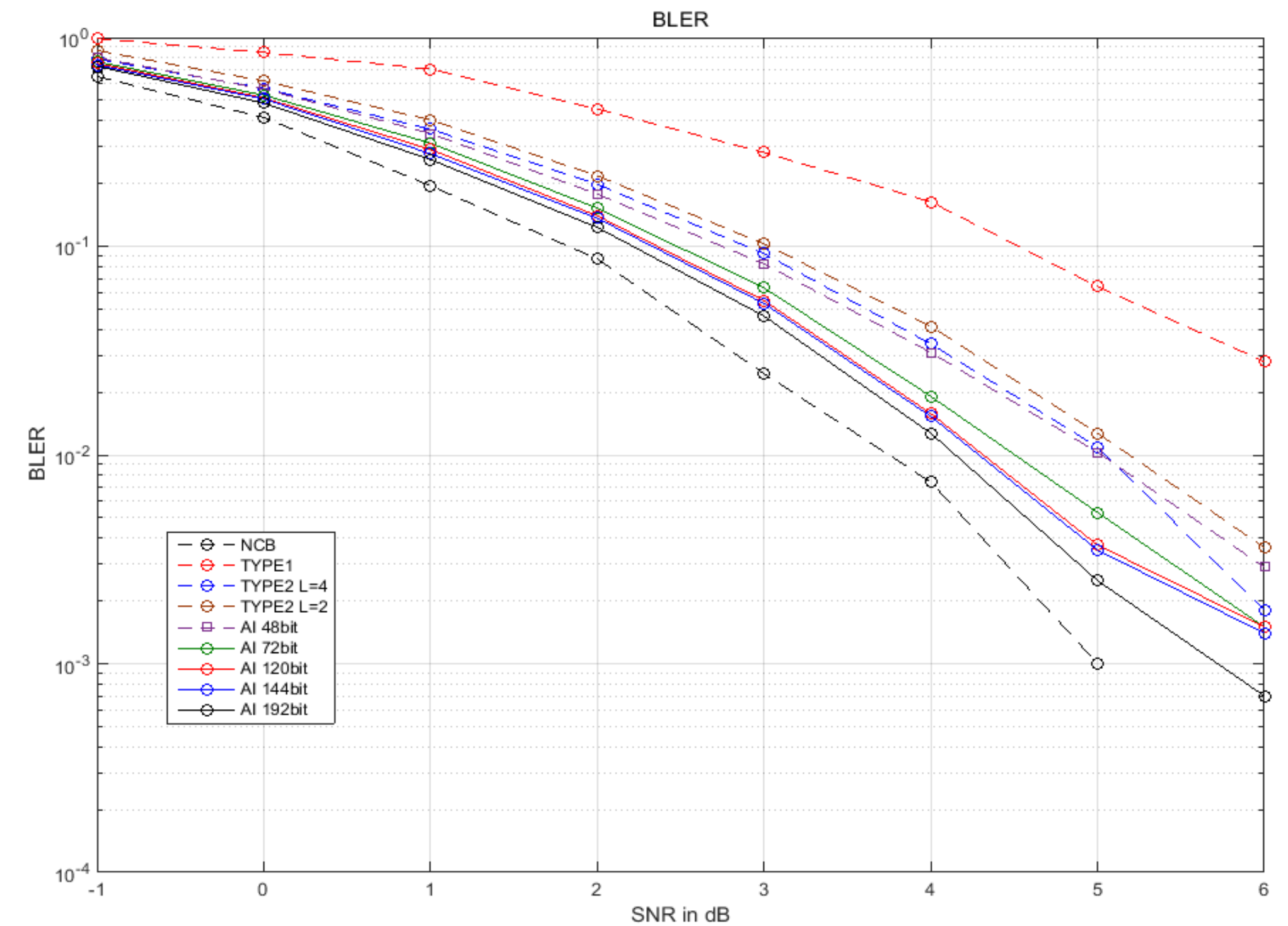
- The measured raw CSI is compressed by a DML algorithm

The benefit:

- More precise channel status information can be transferred in order to improve MIMO performance



AI based CSI vs 3GPP CSI code book

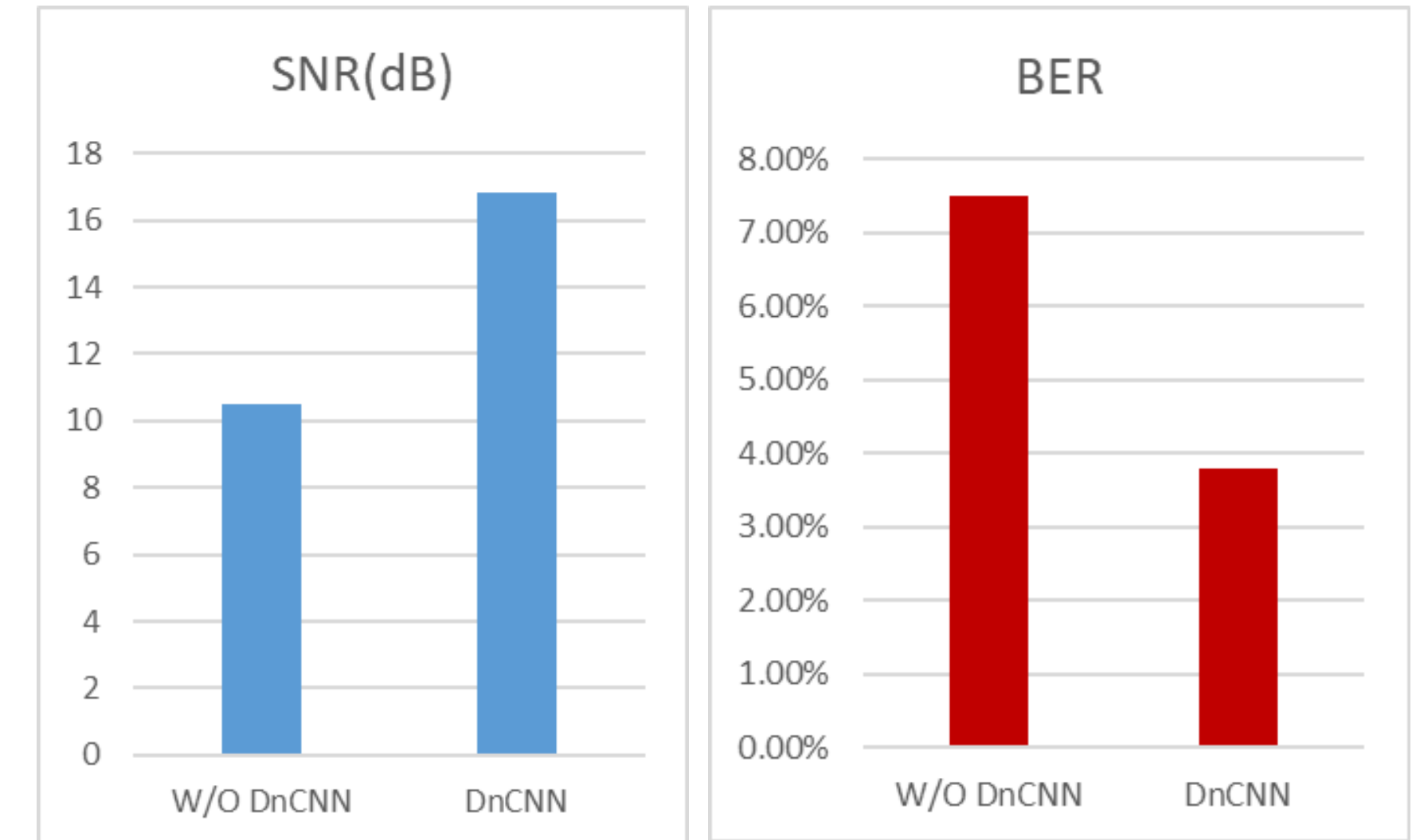
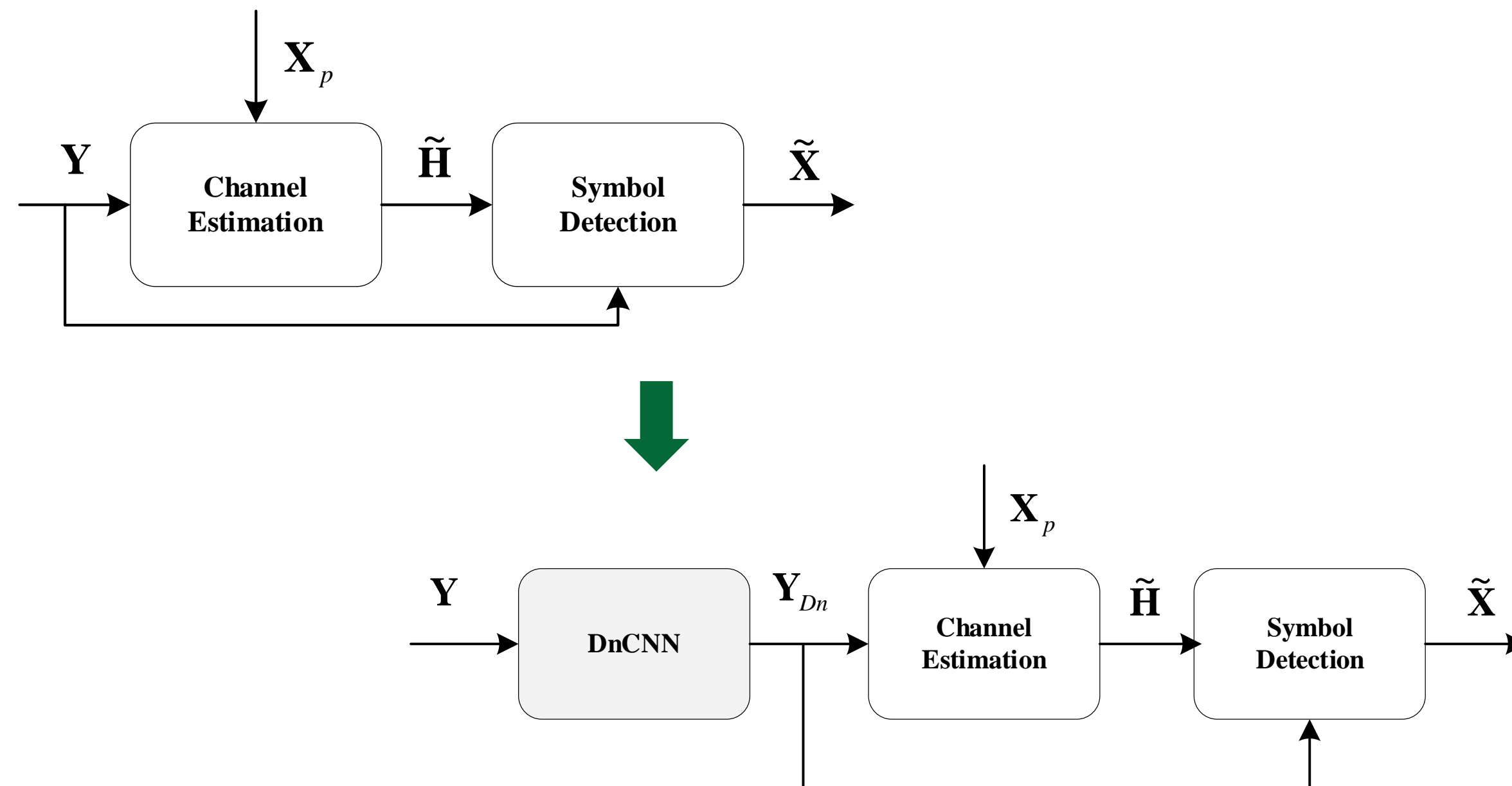


Receiver with noise-compression

Basic idea:

- DnCNN helps to remove some noise for pilot and data

Benefit: to improve the SNR and BER



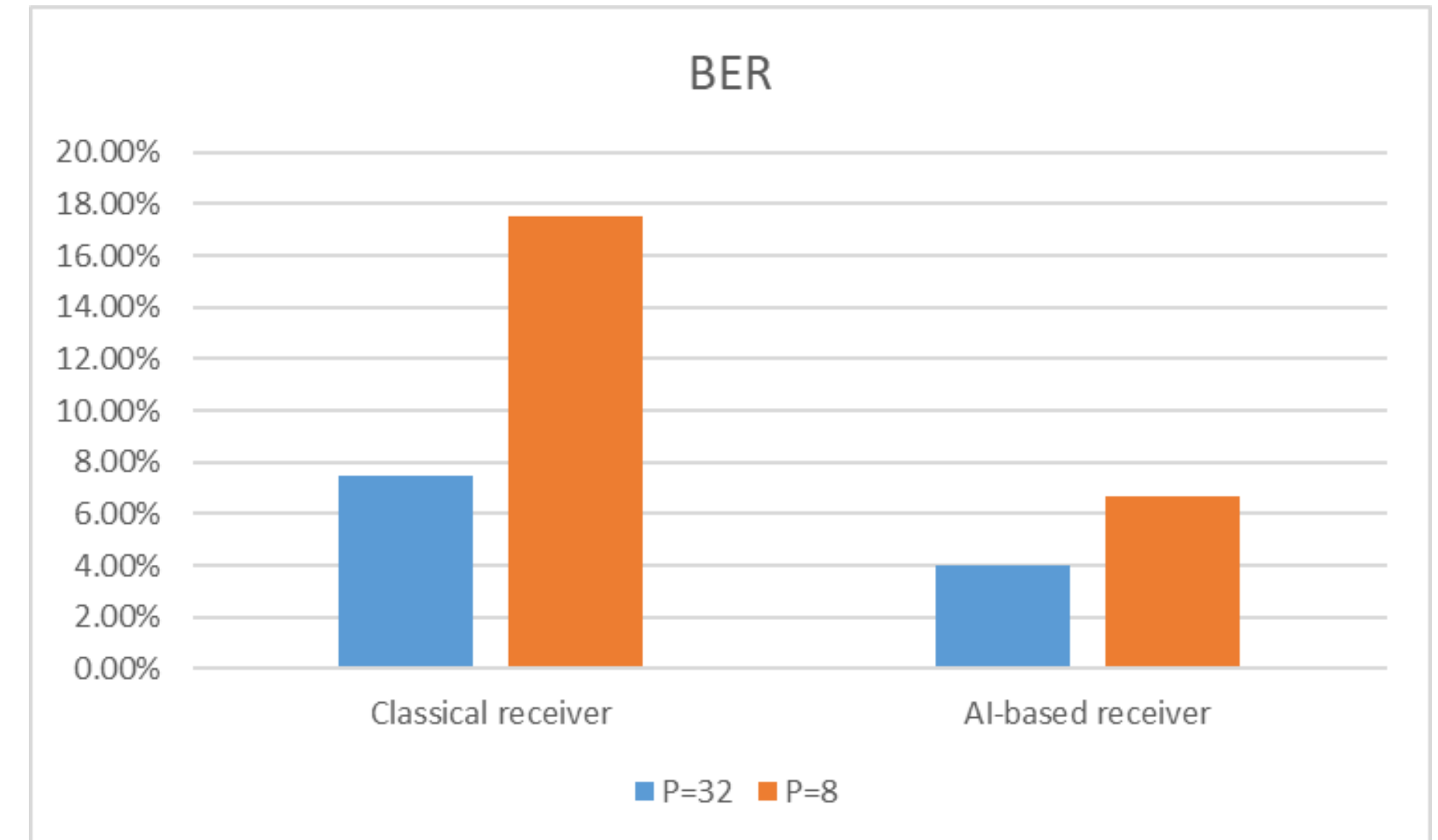
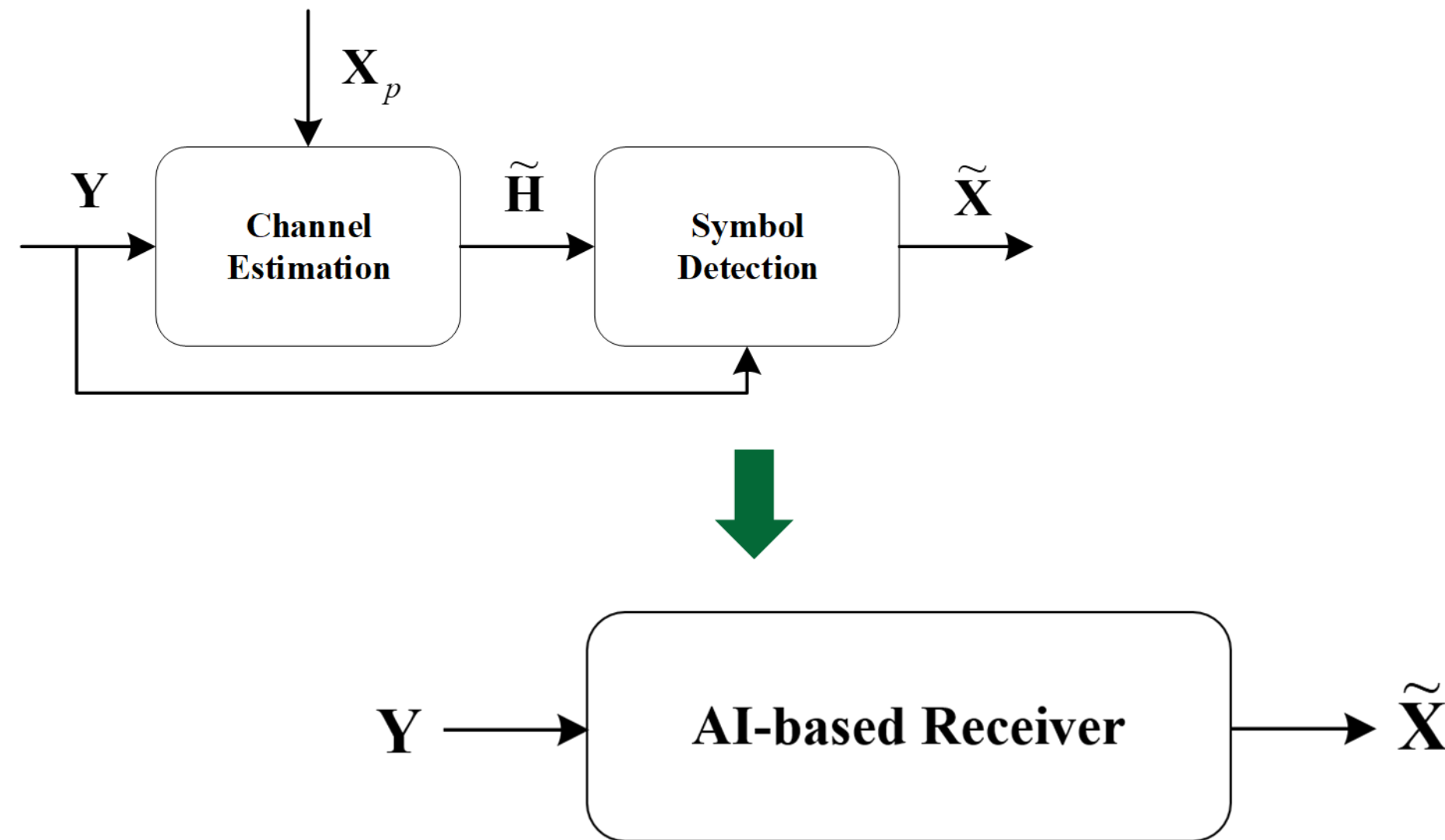
Simulation assumption	value
Number of Tx antenna N_t	2
Number of Rx antenna N_r	2
Subcarriers K	256
Slots T	2
SNR (dB)	10

Reception based on low dense pilot

Basic idea:

- NN based solution helps to get high BER performance with low dense pilot

Benefit: pilot dense can be reduced

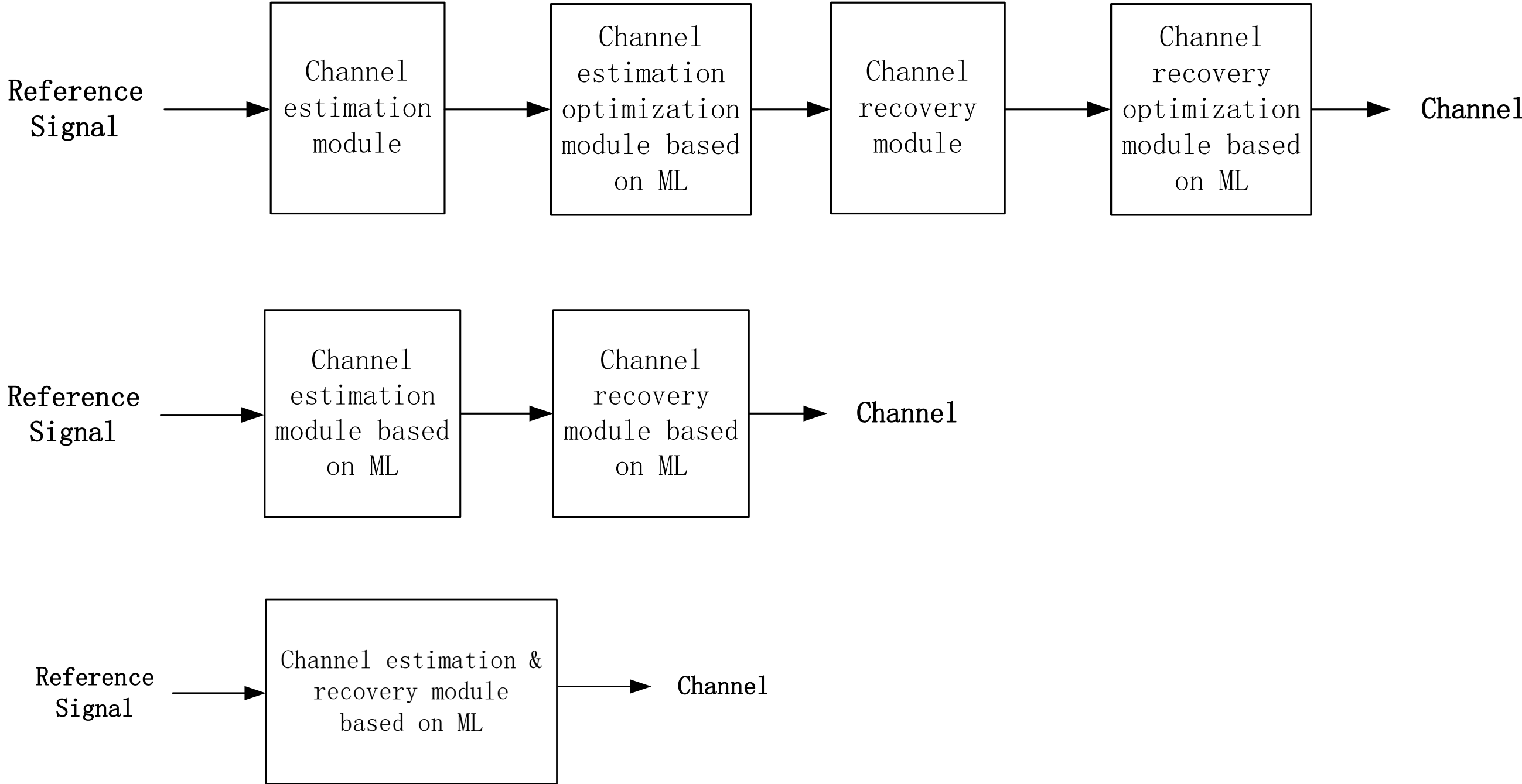


Simulation assumption	value
Number of Tx antenna N_t	2
Number of Rx antenna N_r	2
Subcarriers K	256
Slots T	2
SNR(dB)	10
Number of reference signals P	32 or 8

AI enhanced Channel Estimation

The basic idea:

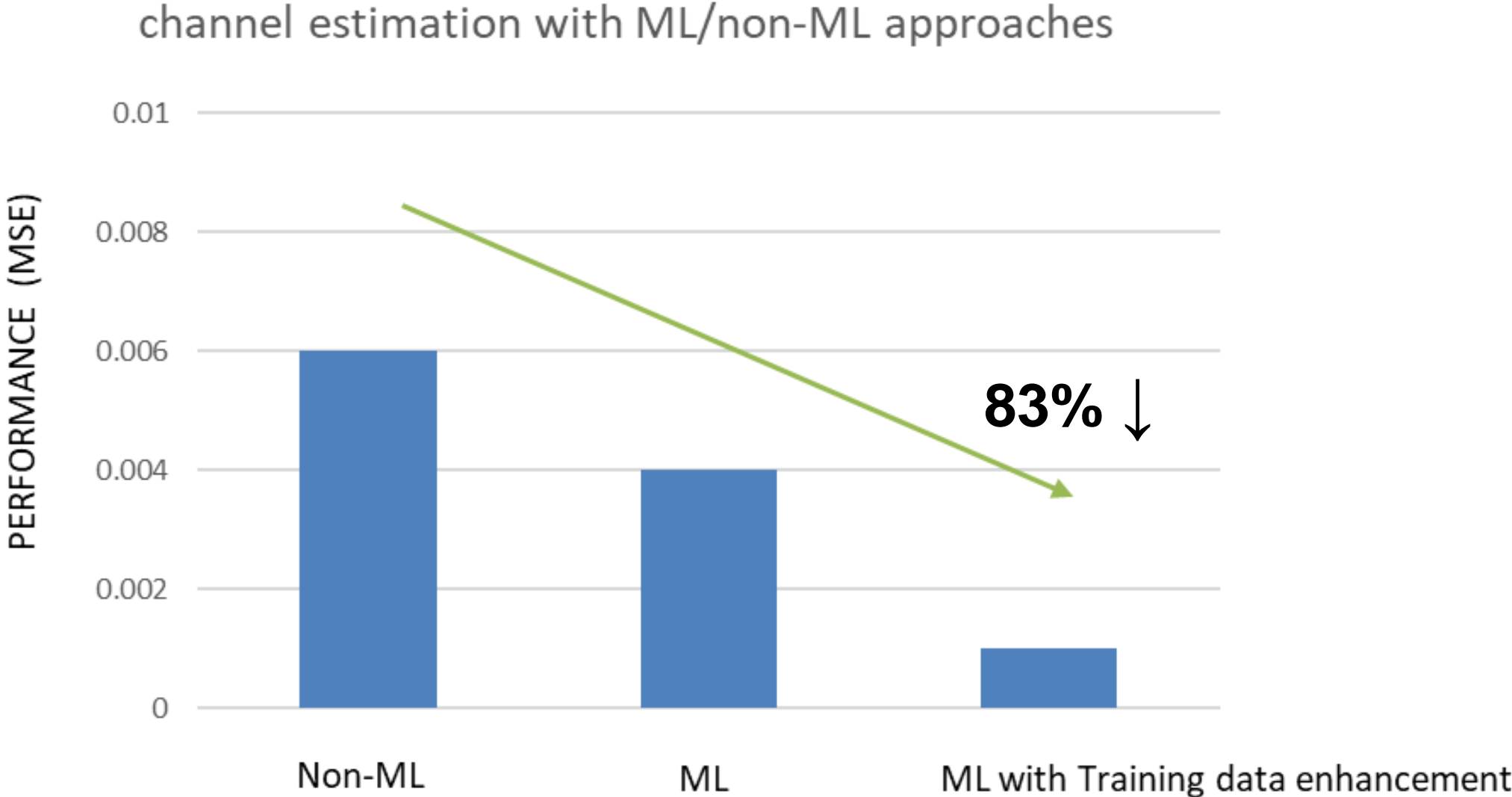
- Traditional channel estimation module could be replaced (or partially replaced) by ML approaches



The benefit:

- High performance can be obtained with limited DMRS resources
- Accurate channel estimation can bring a higher system throughput

Performance illustration:



@ 100slot 1w UE 3.5GHz 4PRB 2T2R 1DMRS symbol/slot 3km/h CDL C300

Initial Proposal

To have a Rel-18 study item:

- To have a common understanding of AI/ML algorithm frame work without touching algorithm itself:
 - For example which ML/AI category or architecture is applied for which use cases
 - The potential impact on hardware and software e.g. computing power, storage capability etc.
- To take principle introduced in FS_NR_ENDC_data_collect for network optimization into account;
- To focus on link level use cases including:
 - Technical justification, feasibility and potential performance enhancement compared to benchmark of 5G network
 - To conclude which ones are valuable to be specified
- To investigate potential standard impact case by case including but not limited to:
 - Output and input of ML/AI algorithm
 - Information exchanged over Uu and/or network interface

Note: It is assumed both network node and UE can be ML/AI model training or inference host

Thank you

oppo