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第三节: 5G-Advanced 助力打造智能网络

会议主持人

刘鸿
GSMA大中华区
技术总经理

日程

第三节: 5G-Advanced 助力打造智能网络

主题演讲嘉宾

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- **Kevin Xu,** TM Forum, Head of APAC

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主题演讲 #1

3GPP的人工智能/机器学习进展

Xie Fang
Principal Researcher
Technical Manager
China Mobile

AI/ML Progress in 3GPP

Fang Xie

CMCC

2023-06

- **AI/ML for Air Interface**
- AI/ML for NG-RAN
- AI/ML for 5GS
- AI/ML for OAM

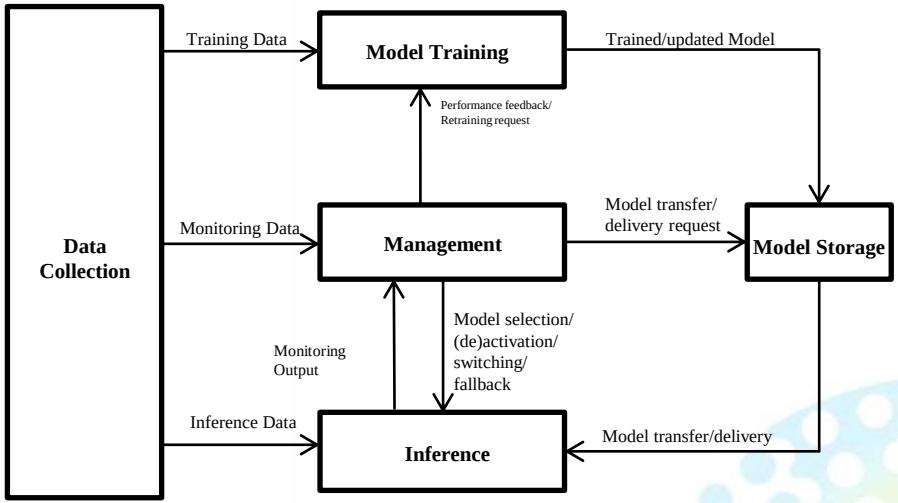
Rel18 SI on AI/ML for Air-Interface

3 major training collaboration types between NW side and UE side

- Level x: No collaboration
- Level y: Signaling-based collaboration without model transfer
- Level z: Signaling-based collaboration with model transfer

General framework for life cycle management (LCM), including model-based LCM and functionality-based LCM

- Data collection
  - For training, inference, monitoring, etc.
- Model training
- Functionality/model identification
- Model transfer/delivery
- Model inference
- Functionality/model selection, activation/deactivation, switching, and fallback
- Functionality/model monitoring
  - For Functionality/model management
- UE capability



Rel18 SI on AI/ML for Air-Interface (cont.)

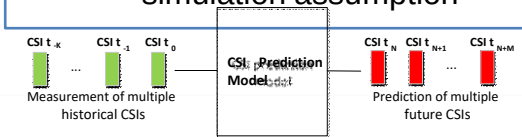
CSI

CSI compression:

- Baseline: R16 eType-II codebook
- Observation:
  - **CSI feedback overhead reduction** can be achieved under some configurations and simulation assumptions

CSI prediction :

- Baseline: non-AI prediction scheme/ nearest historical CSI
- Observation:
  - **CSI estimation accuracy can be improved** with some configurations and simulation assumption

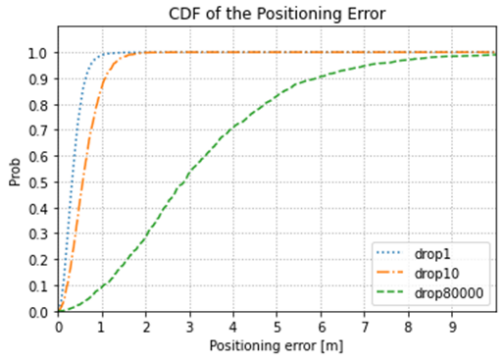


Beam Management

- Application scenario:
  - **Spatial domain beam prediction**: Beam prediction in spatial domain , N beam pairs for L1 measurement, M (M>N) beam pairs for estimated at a time instance
  - **Temporal domain beam prediction**: Beam prediction in time domain, N beam pairs for L1 measurement with periodicity t_1 for time period T_1, predict the beams for time period T_2
- Observation:
  - **Decent beam prediction accuracy with less measurements/RS overhead** for at least for DL Tx beam prediction for spatial domain prediction

Positioning

- Application scenario: InF-DH heavy NLOS
- Baseline: conventional positioning method
- Observation:
  - For direct AI positioning, **<1m@90% horizontal positioning accuracy** as compared to >15m for baseline



Outlook of R19 AI/ML for Air-Interface

R19 WI - Motivation

- All the 6 sub use cases have shown performance gain over non-AI/ML scheme in Rel-18 SI evaluation
- The selected sub use cases are diverse to support various gNB-UE collaboration levels targeting at separate or joint ML operation (one-sided/two-sided model)
- The general LCM framework should be specified for the identified use cases in Rel-18 and potential new use cases in the future

R19 WI - Potential Objectives

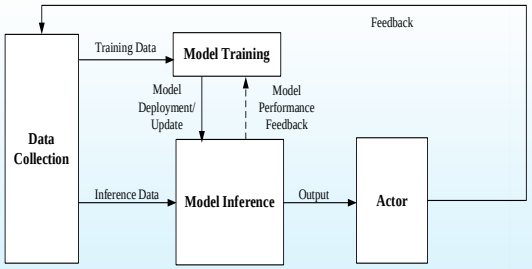
- Specify procedures, protocol and signaling aspects to support the sub-use cases studied in Rel-18 SI
  - Sub-use cases selection for Rel-19 standardization in air interface, considering
    - One-sided model based sub use cases and two-sided model based sub use cases, respectively
  - Specify LCM related procedures and signaling enhancements for selected use cases, including functionality identification/ activation/ deactivation, model identification/ activation/ deactivation/ switching/ selection, model training/ inference/ monitoring etc.
  - Specify the procedure and signaling for model transfer/delivery between the UE and network entities
  - Specify a unified data collection framework to support model training, inference and management, etc.
    - Enhancements on the existing framework (e.g., MDT, LPP, L3 reporting), or define a new data collection entity
  - Model and functionality related UE capability signaling, e.g., static or dynamic UE capability reporting

- AI/ML for Air Interface
- **AI/ML for NG-RAN**
- AI/ML for 5GS
- AI/ML for OAM

R18 WI on AI for RAN

- Specify data collection enhancements and signaling support within existing NG-RAN interfaces and architecture (including non-split architecture and split architecture) for AI/ML-based Network Energy Saving, Load Balancing and Mobility Optimization

Functional Framework



Use cases

- **Load Balancing**
- **Mobility Optimization**
- **Network Energy Saving**

Enhancements

- **NG-RAN interfaces and architecture enhancement**
  - New procedures
  - Partial reporting mechanism
  - Event-based reporting
- **Data collection enhancement** (different for each use case)

- **Overall AI for RAN WI status**: (until June 2023)
  - WI completion level reach **60%**
  - The target completion date **postpone to Dec. 2023**

Outlook of R19 AI for RAN

- Study and specify data collection enhancements and signaling support within existing NG-RAN interfaces and architecture (including non-split architecture and split architecture) for AI/ML-based new use cases:
  - Slice management
  - QoE optimization
  - Mobility enhancement
  - Inter-frequency measurements prediction with no gap required based on intra-frequency measurements
  - AI/ML-based Device Efficiency Improving
  - .....
- R18 leftover issues:
  - NG-RAN interface enhancement to support AI for RAN
  - CU-DU split scenario
- MDT procedure enhancements, if needed
- New UE measurements, if needed

- AI/ML for Air Interface
- AI/ML for NG-RAN
- **AI/ML for 5GS**
- AI/ML for OAM

R18 WI on AI for 5GS

- Further investigating system enhancements for NWDAF to allow 5GS to support network automation
- Focus on analytics for 5GC NFs with the target to support their decision making
- Further study the necessary inputs to NWDAF and the necessary NWDAF outputs and potential architecture enhancement, new scenarios and R17 leftovers to support:

Distributed AI Architecture	Use cases	Intelligent collaboration across different domains
• **Federated Learning based Architecture** • **Decoupling of training& inference function** • **Architecture for International Roaming**	• **Intelligent traffic recognition** • **Intelligent URSP update** • **Positioning for finer granularity** • **Accuracy improvement for AI/ML model**	• **intelligent interaction between OAM and 5GC** • **Analysis for finer granularity Location** • **ML Model sharing between different vendors**

- **Overall eNA_Ph3 WI status**: (until June 2023)
  - WI completion level reach **100%**

R19 Outlook of AI/ML for 5GS

- Expand the scope of network AI services to leverage AI/ML technologies to enable 5GC and Air interface Intelligence by providing network automation and improving the efficiency of 5G network architecture

- **Study possible AI/ML enabled Use Case(s) of 5GS Service**
  - Detection/prevention/ mitigation of signalling storm.
  - NWDAF assisted energy saving.
  - NWDAF assisted policy recommendation.
  - ……
- **Study whether and how leverage AI/ML technologies for 5GS AI/ML Service**
  - Vertical federal learning, including UE, RAN, 5GC and AF.
  - Enhance architecture to support online learning in the 5GC.
  - Enhance architecture to support reinforcement learning in the 5GC.
  - ……

- **Potential coordinate and align to support for AI/ML for air interface**
  - Terminology alignment btw RAN and SA2
  - UE data collection framework enhancement to support AI/ML use cases..
  - ML Model delivery to UE.
  - Lifecycle management of AI/ML model btw RAN and SA2.
  - SA2 and RAN Convergence for Model ID/Analytics ID defined in SA2 since R16 eNA and Model ID/feature ID studied/concluded in RAN R18.
  - Architecture enhancement to support AI based Positioning.
  - ……

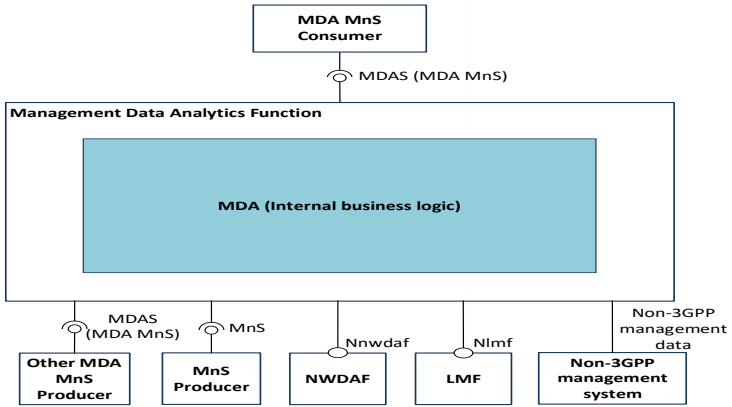
- AI/ML for Air Interface
- AI/ML for NG-RAN
- AI/ML for 5GS
- **AI/ML for OAM**

R18 SI/WI on AI for OAM

10 AI-related SI/WI for OAM :

- MDAS for management data analysis service
- AI/ML, Closed Control Loop, intent-driven management, autonomous network levels

MDA functional overview and service framework



- Identify ongoing issues impacting the performance of the network and services
- Help to identify in advance potential issues that may cause potential failure and/or performance degradation.
- Assist to predict the network and service demand to enable timely resource provisioning and deployments

1	Study on enhancement of autonomous network levels	China Mobile, Huawei
2	Study on evaluation of autonomous network levels	China Mobile, Huawei
3	Study on enhanced intent driven management services for mobile networks	Huawei, Ericsson
4	Study on intent-driven management for network slicing	Ericsson, Huawei
5	AI/ ML management	Intel, NEC
6	Enhancement of the management aspects related to NWDAF	China Telecom
7	Enhancement of Management Data Analytics phase 2	Intel, NEC
8	Study on Fault Supervision Evolution	China Mobile, Huawei
9	Study on measurement data collection to support RAN intelligence	Intel, China Mobile
10	Self-Configuration of RAN NEs	China Mobile, Huawei

R19 Outlook of AI/ML for OAM

7 kinds of potential AI/ML items in SA5 to address management aspects in Rel-19 under discussion

1. AI/ML management phase2

- AI/ML management and operational capabilities to support additional 3GPP AI/ML functionalities
- Energy efficiency aspects of AI/ML
- Enhancements to support different types of learning

2. Management Data Analytics (MDA) (continuation)

- Edge computing performance and energy efficiency analytics
- Data correlation analytics
- (e)MIMO performance analytics
- ATSSS performance analytics
- … …

3. Enhanced Closed Control Loop (continuation)

- Enabling dynamic CCL composition
- Managing multi-vendor CCL
- Conflict resolution among CCL
- State management of a CCL
- CCL scope extension
- … …

4. Integration of ONAP on Zero-touch Orchestration and Management

- How the ONAP Zero-touch Orchestration and Management can be supported in 3GPP
- Find mismatches
- Feedback to ONAP to be 3GPP compliant for easier alignment

5. Trustworthiness in OAM

- Trustworthiness for Closed Loop (Autonomous operations)
- Trustworthiness for Data Analytics (non-ML)

6. Intent driven management services for mobile network (continuation)

- New scenarios: for user experience assurance, enabling 5G advanced feature
- New generic capabilities
- Support service and OAM APIs with collaboration with GSMA/CAMARA
- … …

7. Digital Twin aspects of management

- Potential scenarios, use cases and corresponding requirements based on digital twin of the 5G network
- Potential enhancements (e.g., new interfaces) and extensions(e.g., data collection type, frequency and methods)

中国移动 China Mobile

THANK YOU !

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谢谢

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