## **5G FUTURES SUMMIT**

## Welcome

**GSMA** Programme



## GSMA

## 5G Futures Summit

Session 3: 5G-Advanced Intelligent Networking

#### **Session moderator**



Hong Liu Head of Technology, Greater China GSMA



### **Agenda** Session 3: 5G-Advanced – Intelligent Networking







## 5G Futures Summit

# **Keynote #1 -** AI/ML Progress in 3GPP



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## **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<sub>1</sub> for time period T<sub>1</sub>, predict the beams for time period T<sub>2</sub>
- 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





## Al/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

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## **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





- Al/ML for Air Interface
- AI/ML for NG-RAN
- AI/ML for 5GS
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### **R18 WI on AI for 5GS**

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- 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:



- Overall eNA\_Ph3 WI status: (until June 2023)
  - WI completion level reach 100%

### **R19 Outlook of AI/ML for 5GS**

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- 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
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  - 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 Al-related SI/WI for OAM :

- MDAS for management data analysis service ٠
- AI/ML, Closed Control Loop, intent-driven management, autonomous network levels

#### MDA MnS Consumer MDAS (MDA MnS) Management Data Analytics Function MDA (Internal business logic) Non-3GPP MDAS (MDA MnS) ⊖ MnS management Nnwdaf NImf data Other MDA Non-3GPP MnS NWDAF LMF management MnS Producer Producer system

- 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	

#### MDA functional overview and service framework





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

1. AI/ML management phase2	2. Management Data Analytics (MDA) (continuation)	3. Enhanced Closed Control Loop (continuation)
AI/ML management and operational     capabilities to support additional 3CPP	Edge computing performance and energy     officiency analytics	Enabling dynamic CCL composition
Al/ML functionalities	Data correlation analytics	Conflict resolution among CCL
<ul><li>Energy efficiency aspects of AI/ML</li><li>Enhancements to support different types of</li></ul>	<ul><li> (e)MIMO performance analytics</li><li> ATSSS performance analytics</li></ul>	<ul><li>State management of a CCL</li><li>CCL scope extension</li></ul>
learning	•	•

4. Integration of ONAP on Zero- touch Orchestration and Management	5. Trustworthiness in OAM	6. Intent driven management services for mobile network (continuation)	7. Digital Twin aspects of management
<ul> <li>How the ONAP Zero-touch Orchestration and Management can be supported in 3GPP</li> <li>Find mismatches</li> <li>Feedback to ONAP to be 3GPP compliant for easier alignment</li> </ul>	<ul> <li>Trustworthiness for Closed Loop (Autonomous operations)</li> <li>Trustworthiness for Data Analytics (non-ML)</li> </ul>	<ul> <li>New scenarios: for user experience assurance, enabling 5G advanced feature</li> <li>New generic capabilities</li> <li>Support service and OAM APIs with collaboration with GSMA/CAMARA</li> <li></li> </ul>	<ul> <li>Potential scenarios, use cases and corresponding requirements based on digital twin of the 5G network</li> <li>Potential enhancements (e.g., new interfaces) and extensions(e.g., data collection type, frequency and methods)</li> </ul>





## **THANK YOU!**





## PANEL DISCUSSION

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#### **Panel moderator**



**Liu Hong** Head of Technology, Greater China GSMA

### **Panel members**



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Xinzhou Cheng Director of Network Intelligent Operation Center, China Unicom Research Institute

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

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## Thank you

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