**3GPP TSG-SA Meeting #109SP-251223**

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**Title:** **pCR TR 22.850: Updates related to AI/ML for RAN WGs**

**Document for: Approval**

**Agenda Item: 8**

# 1 Introduction

**5.3.2.1 Rel-19 RAN WG1/RAN WG4 WID - Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface (NR\_AIML\_air)**

SP-250578 ‘PCR TR 22.850: Updates to section 5.3.2’ was approved by SA#108 but the parts to clause 5.3.2.1.1 could not be implemented due to wrong TR baseline used in SP-250578. This pCR proposes again changes to clause 5.3.2.1.1 for Rel-19 RAN WG1/RAN WG4 WID - Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface (NR\_AIML\_air).

**5.3.2.2 Rel-19 RAN WG2 SID - AIML for mobility in NR (FS\_NR\_AIML\_Mob)**

Since there was no Rel-19 normative work as follow-up of this study, it is proposed to remove clause 5.3.2.2.2 ‘Activities summary’ and add a note in 5.3.2.2.1 to clarify that “No Rel-19 normative work was progressed as outcome of this study”.

**5.3.2.4 Rel-19 RAN WG3 SID - Enhancements for Artificial Intelligence (AI)/Machine Learning (ML) for NG-RAN (FS\_NR\_AIML\_NGRAN\_enh)**

Clause 5.3.2.4.2 is not needed considering the note introduced in SA#108 in clause 5.3.2.4.1 indicating “The outcome of this study was used to support the NR\_AIML\_NGRAN\_enh-Core Rel-19 RAN WG3 WID, see clause 5.3.2.6.”.

**6.3.4 Analysis on data collection and management for AI/ML**

Some summary for data collection for RAN2 is proposed.

# 2 Detailed proposal

The following changes are proposed to be included into TR 22.850.

\*\*\*\*\* START OF CHANGES \*\*\*\*\*

## 5.3 AI/ML related activities in TSG RAN Working Groups

### 5.3.2 AI/ML related activities

#### 5.3.2.1 Rel-19 RAN WG1/RAN WG4 WID - Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface (NR\_AIML\_air)

##### 5.3.2.1.1 Description

The objective of this work is to provide specification support for the following aspects:

- AI/ML general framework for one-sided AI/ML models within the realm of what has been studied in the FS\_NR\_AIML\_air project (RAN WG2):

- Signalling and protocol aspects of Life Cycle Management (LCM) enabling functionality and model (if justified) selection, activation, deactivation, switching, fallback:

- Identification related signalling is part of the above objective.

- Necessary signalling/mechanism(s) for LCM to facilitate model training, inference, performance monitoring, data collection (except for the purpose of CN/OAM/OTT collection of UE-sided model training data) for both UE-sided and NW-sided models.

- Signalling mechanism of applicable functionalities/models.

- Beam management - DL Tx beam prediction for both UE-sided model and NW-sided model, encompassing (RAN WG1/RAN WG2):

- Spatial-domain DL Tx beam prediction for Set A of beams based on measurement results of Set B of beams ("BM-Case1").

- Temporal DL Tx beam prediction for Set A of beams based on the historic measurement results of Set B of beams ("BM-Case2").

- Specify necessary signalling/mechanism(s) to facilitate LCM operations specific to the Beam Management use cases, if any.

- Enabling method(s) to ensure consistency between training and inference regarding NW-side additional conditions (if identified) for inference at UE.

- Positioning accuracy enhancements, encompassing (RAN WG1/RAN WG2/RAN WG3):

- Direct AI/ML positioning:

- Case 1: UE-based positioning with UE-side model, direct AI/ML positioning.

- Case 3b: NG-RAN node assisted positioning with LMF-side model, direct AI/ML positioning.

- AI/ML assisted positioning:

- Case 3a: NG-RAN node assisted positioning with gNB-side model, AI/ML assisted positioning.

- Specify necessary measurements, signalling/mechanism(s) to facilitate LCM operations specific to the Positioning accuracy enhancements use cases, if any.

- Investigate and specify the necessary signalling of necessary measurement enhancements (if any).

- Enabling method(s) to ensure consistency between training and inference regarding NW-side additional conditions (if identified) for inference at UE for relevant positioning sub use cases.

* CSI feedback enhancement, encompassing [RAN1/RAN2]:

- CSI prediction (UE-sided model):

- Functionality-based LCM leveraged from other use cases, when necessary and applicable,

- Study, and if necessary, specify consistency of training/inference,

- Core requirements for the above three use cases for AI/ML LCM procedures and UE features (RAN WG4):

- Specify necessary RAN WG4 core requirements for the above three use cases.

- Specify necessary RAN WG4 core requirements for LCM procedures including performance monitoring.

- For Beam Management, Positioning Accuracy enhancement and CSI prediction use cases, specify performance requirements and test cases for AI/ML LCM procedures (including performance monitoring) and UE features enabled by UE-sided models:

- Specify necessary performance requirements and tests (including metrics) for the above-mentioned use cases.

- Specify necessary test cases and performance requirements for LCM procedure, including performance monitoring.

Note: the following aspects may be considered:

- Relation to legacy requirements

- Performance monitoring and LCM aspects considering use-case specifics

- Generalization aspects

- Static/non-static scenarios/conditions and propagation conditions for testing (e.g. CDL, field data, etc.)

- UE processing capability and limitations

- Post-deployment validation due to model change/drift

- RAN5 aspects related to testability and interoperability to be addressed on a request basis

\*\*\*\*\* NEXT CHANGE \*\*\*\*\*

#### 5.3.2.2 Rel-19 RAN WG2 SID - AIML for mobility in NR (FS\_NR\_AIML\_Mob)

##### 5.3.2.2.1 Description

The study will focus on mobility enhancement in RRC\_CONNECTED mode over air interface by following existing mobility framework, i.e. handover decision is always made in network side. Mobility use cases focus on standalone NR PCell change. UE-side and network-side AI/ML model can be both considered, respectively. The investigation is to evaluate potential benefits and gains of AI/ML aided mobility for network triggered L3-based handover, considering the following aspects:

- AI/ML based RRM measurement and event prediction:

- Cell-level measurement prediction including intra and inter-frequency (UE sided and NW sided model) (RAN WG2):

- Inter-cell Beam-level measurement prediction for L3 Mobility (UE sided and NW sided model) (RAN WG2).

- HO failure/RLF prediction (UE sided model) (RAN WG2).

- Measurement events prediction (UE sided model) (RAN WG2).

- Study the need/benefits of any other UE assistance information for the network side model (RAN WG2).

- The evaluation of the AI/ML aided mobility benefits should consider HO performance KPIs (e.g. Ping-pong HO, HOF/RLF, Time of stay, Handover interruption, prediction accuracy and measurement reduction) etc.) and complexity trade-offs (RAN WG2).

- Potential AI mobility specific enhancement should be based on the Rel19 AI/ML-air interface WID general framework (e.g. LCM, performance monitoring etc) (RAN WG2).

- Potential specification impacts of AI/ML aided mobility (RAN WG2).

- Evaluate testability, interoperability and impacts on RRM requirements and performance (RAN WG4).

NOTE: There was no normative work performed in Rel-19.

\*\*\*\*\* NEXT CHANGE\*\*\*\*\*

#### 5.3.2.4 Rel-19 RAN WG3 SID - Enhancements for Artificial Intelligence (AI)/Machine Learning (ML) for NG-RAN (FS\_NR\_AIML\_NGRAN\_enh)

##### 5.3.2.4.1 Description

The objective of this study is to further investigate new AI/ML based use cases and identify enhancements to support AI/ML functionality and further discussions on the Rel-18 leftovers. The detailed objectives of the study are listed as follows:

- Study two new AI/ML based use cases, i.e. Network Slicing and CCO, with existing NG-RAN interfaces and architecture (including non-split architecture and split architecture).

- Rel-18 leftovers as candidates for normative work, based on the Rel-18 principles, as follows:

- Mobility optimization for NR-DC.

- Split architecture support for Rel-18 use cases based on the conclusions from Rel-18 WI.

- Energy Saving enhancements, e.g. Energy Cost Prediction.

- Continuous MDT collection targeting the same UE across RRC states.

- Multi-hop UE trajectory across gNBs.

NOTE: The outcome of this study was used to support the NR\_AIML\_NGRAN\_enh-Core Rel-19 RAN WG3 WID, see clause 5.3.2.6.

\*\*\*\*\* NEXT \*\*\*\*\*

### 6.3.4 Analysis on data collection and management for AI/ML

The analysis focuses on the specifications from SA WG2, SA WG6 and RAN WG3, considering these are the working groups defining services and operations related to data collection for AI/ML in 3GPP Release 18. SA WG1, SA WG3, SA WG4, SA WG5, RAN WG1 and RAN WG2 have not defined any services or operations related to data collection for AI/ML in Release 18. SA WG5 specifies data collection and performance measurement services that can be leveraged for AI/ML purposes (see TS 28.622 [72]). Table 6.3.4-1 provides a detailed overview of the specific services defined by each working group.

The key findings from the analysis are as follows:

- SA WG2: Defines multiple network functions capable of producing data collection services and defines a function for data storage related services. For example, the DCCF coordinates and manages the collection of data from various network functions for purposes such as computation of analytics and Analytics/ML Model Accuracy monitoring. Leverages event exposure framework and defines event exposure services for network functions that can be consumed by NWDAF (see clause 6.2.2.1 of TS 23.288 [8]) and DCCF (see clause 6.2.6.3 of TS 23.288 [8]). Defines data collection for AI/ML services through a clear consumer-producer relationship.

- SA WG6: Defines network functions similar to those in SA WG2. Data collection services defined for A-DCCF as well as data storage services defined for A-ADRF are generic and applicable to any ADAE services; however, while A-DCCF APIs are defined in a generic manner, the A-ADRF APIs (for data storage and fetching) are defined in a per use case specific manner.

- RAN WG3: Defines data collection messages exchanged between two gNBs over the Xn interface, in a P2P manner. It is to be noted that procedures used for AI/ML support in the NG-RAN shall be "data type agnostic", which means that the intended use of the data (e.g. input, output, feedback) shall not be indicated.

- RAN WG2: Defines data collection configuration procedures for offline training of network side models over existing RRC messages between UE and gNB. RAN WG2 also introduces the logging of data within UE and the retrieval of the logged data by gNB via UE Information procedure.

Editors' note: This analysis is based on Release 18 and does not consider Release 19. Further analysis needs to be conducted as Release 19 matures and normative work progresses in SA5.

While SA WG2 and SA WG6 both define data collection services, their approaches to data storage and retrieval are different. SA WG2 defines generic data storage and retrieval services that can be supported by an entity (ADRF) and requested by another entity but SA WG6 defines both generic and individual services (related to each analytics type) for storing and retrieving data. RAN WG3 operates independently and is unrelated to services defined in SA WGs and therefore can coexist.

Table 6.3.4-1: Data Collection for AI/ML related services and operations as specified across 3GPP WGs

|  |  |  |  |
| --- | --- | --- | --- |
| Data Collection for AI/ML | | | |
| TSG (TS/TR) | Service/API/Message Type | Service/API/IOC/Message Name | Description [Consumer, Producer] |
|  |  | Namf\_EventExposure\_Subscribe | The NWDAF uses this service operation to subscribe to or modify event reporting for one UE, a group of UE(s) or any UE.  *Producer*: AMF |
|  |  | Namf\_EventExposure\_Unsubscribe | The NWDAF uses this service operation to unsubscribe for a specific event for one UE, group of UE(s), any UE.  *Producer*: AMF |
|  |  | Namf\_EventExposure\_Notify | Provides the previously subscribed event information to the NWDAF which has subscribed to that event before.  *Producer*: AMF |
|  |  | Nsmf\_EventExposure\_Subscribe | This service operation is used by an NWDAF to subscribe or modify a subscription for event notifications on a specified PDU Session or for all PDU Sessions of one UE, group of UE(s) or any UE.  *Producer*: SMF |
| SA WG2 TS 23.288 [8] |  | Nsmf\_EventExposure\_UnSubscribe | This service operation is used by an NWDAF to unsubscribe event notifications.  *Producer*: SMF |
|  | Event Exposure services | Nsmf\_EventExposure\_Notify | Report UE PDU Session related event(s) to the NWDAF which has subscribed to the event report service.  *Producer*: SMF |
|  |  | Npcf\_EventExposure\_Subscribe | The NWDAF uses this service operation to subscribe to or modify event reporting for a group of UE(s) or any UE accessing a combination of (DNN, S-NSSAI).  *Producer*: PCF |
|  |  | Npcf\_EventExposure\_Unsubscribe | The NWDAF uses this service operation to unsubscribe for a specific event for a group of UE(s) or any UE accessing a combination of (DNN, S-NSSAI).  *Producer*: PCF |
|  |  | Npcf\_EventExposure\_Notify | This service operation reports the event to the NWDAF that has previously subscribed either using Npcf\_EventExposure\_Subscribe service operation or provided as part of the Data Set Application Data and Data Subset Service Parameters stored in UDR.  *Producer*: PCF |
|  |  | Nudm\_EventExposure\_Subscribe | The NWDAF subscribes to receive an event.  *Producer*: UDM |
|  |  | Nudm\_EventExposure\_Unsubscribe | The NWDAF deletes the subscription of an event if already defined in UDM.  *Producer*: UDM |
|  |  | Nudm\_EventExposure\_Notify | UDM reports the event to the NWDAF that has previously subscribed.  *Producer*: UDM |
|  |  | Nudm\_EventExposure\_ModifySubscription | The NWDAF requests to modify an existing subscription to event notifications.  *Producer*: UDM |
|  |  | Nnef\_EventExposure\_Subscribe | The NWDAF subscribes to receive an event, or if the event is already defined in NEF, then the subscription is updated.  *Producer*: NEF |
|  |  | Nnef\_EventExposure\_Unsubscribe | The NWDAF deletes an event if already defined in NEF.  *Producer*: NEF |
|  |  | Nnef\_EventExposure\_Notify | NEF reports the event to the NWDAF that has previously subscribed.  *Producer*: NEF |
|  |  | Naf\_EventExposure\_Subscribe | The NWDAF subscribes the event to collect AF data for UE(s), group of UEs, or any UE, or updates the subscription which is already defined in AF.  *Producer*: AF |
|  |  | Naf\_EventExposure\_Unsubscribe | The NWDAF unsubscribes for a specific event.  *Producer*: AF |
|  |  | Naf\_EventExposure\_Notify | The AF provides the previously subscribed event information to the NWDAF which has subscribed to that event before.  *Producer*: AF |
|  |  | Nnsacf\_SliceEventExposure\_Subscribe | This service operation is used by the NWDAF to subscribe or modify a subscription with the NSACF for event based notifications of the current number of UEs registered for a network slice or the current number of PDU Sessions established on a network slice.  *Producer*: NSACF |
|  |  | Nnsacf\_SliceEventExposure\_Unsubscribe | This service operation is used by the NWDAF to unsubscribe from the event notification.  *Producer*: NSACF |
|  |  | Nnsacf\_SliceEventExposure\_Notify | This service operation is used by the NSACF to report the current number of UEs registered with a network slice or the current number of PDU Sessions established on a network slice in numbers or in percentage from the maximum allowed numbers, based on threshold or at expiry of periodic timer.  *Producer*: NSACF |
|  |  | Nupf\_EventExposure\_Subscribe | This service operation reports the event and information to the NWDAF that has subscribed implicitly.  *Producer*: UPF |
|  |  | Nupf\_EventExposure\_Unsubscribe | This service operation is used by an NWDAF to subscribe or modify a subscription to UPF event exposure notifications e.g. for the purpose of UPF data collection on a specified PDU Session or for all PDU Sessions of one UE or any UE.  *Producer*: UPF |
|  |  | Nupf\_EventExposure\_Notify | The NF consumer uses this service operation to unsubscribe for a specific event.  *Consumer*: Any NF  *Producer*: UPF |
|  |  | Nscp\_EventExposure\_Notify | The NWDAF uses this service operation to unsubscribe for a specific event.  *Producer*: SCP |
|  |  | Nscp\_EventExposure\_Subscribe | This service operation is used by an NWDAF to subscribe or modify a subscription to SCP event exposure notifications.  *Producer*: SCP |
|  |  | Nscp\_EventExposure\_Unsubscribe | The NWDAF uses this service operation to unsubscribe from an existing subscription.  *Producer*: SCP |
|  |  | Nnwdaf\_DataManagement\_Subscribe | The consumer subscribes to data exposed by an NWDAF. It can be historical data or runtime data. The subscription includes service operation specific parameters that identify the data to be provided and may include formatting and processing instructions that specify how the data is to be delivered to the consumer.  *Consumer*: NWDAF, DCCF  *Producer*: NWDAF |
|  | NWDAF Data Management services | Nnwdaf\_DataManagement\_Unsubscribe | The consumer unsubscribes to the data exposed by an NWDAF.  *Consumer*: NWDAF, DCCF  *Producer*: NWDAF |
|  |  | Nnwdaf\_DataManagement\_Notify | The NWDAF notifies the consumer of the requested data or notifies of the availability of previously subscribed data when delivery is via an NWDAF. The NWDAF may also notify the consumer when Data or Analytics is to be deleted.  *Consumer*: NWDAF, DCCF, MFAF, ADRF  *Producer*: NWDAF |
|  |  | Nnwdaf\_DataManagement\_Fetch | The consumer retrieves from the NWDAF subscribed data, as indicated by Fetch Instructions from Nnwdaf\_DataManagement\_Notify.  *Consumer*: NWDAF, DCCF, MFAF, ADRF  *Producer*: NWDAF |
|  |  | Nnwdaf\_RoamingData\_Subscribe | The consumer subscribes for input data related to roaming UE(s) for NWDAF analytics. The subscription includes service operation specific parameters that identify the data to be provided and may include formatting and processing instructions that specify how the data is to be delivered to the consumer.  *Consumer*: H-RE-NWDAF, V-RE-NWDAF  *Producer*: H-RE-NWDAF, V-RE-NWDAF |
|  | NWDAF Roaming Data services | Nnwdaf\_RoamingData\_Unsubscribe | The consumer unsubscribes to input data related to roaming UE(s).  *Consumer*: H-RE-NWDAF, V-RE-NWDAF  *Producer*: H-RE-NWDAF, V-RE-NWDAF |
|  |  | Nnwdaf\_RoamingData\_Notify | NWDAF notifies the consumer about input data related to roaming UE(s) that the consumer has subscribed to.  *Consumer*: H-RE-NWDAF, V-RE-NWDAF  *Producer*: H-RE-NWDAF, V-RE-NWDAF |
|  |  | Ndccf\_DataManagement\_Subscribe | The consumer subscribes to receive data or analytics from the DCCF. The subscription includes service operation specific parameters that identify the data or analytics to be provided and may include formatting and processing instructions that specify how the data is to be delivered to the consumer. The consumer may also request that data be stored in an ADRF or an NWDAF hosting ADRF functionality.  *Consumer*: NWDAF, PCF, NSSF, AMF, SMF, NEF, AF, ADRF  *Producer*: DCCF |
|  |  | Ndccf\_DataManagement\_Unsubscribe | The consumer unsubscribes to DCCF for data or analytics.  *Consumer*: NWDAF, PCF, NSSF, AMF, SMF, NEF, AF, ADRF  *Producer*: DCCF |
|  | DCCF Data Management Services | Ndccf\_DataManagement\_Notify | DCCF notifies the consumer instance of the requested data or analytics according to the request or notifies of the availability of previously subscribed Data or Analytics when data delivery is via the DCCF. The DCCF may also notify the consumer instance when Data or Analytics is to be deleted.  *Consumer*: NWDAF, PCF, NSSF, AMF, SMF, NEF, AF, ADRF  *Producer*: DCCF |
|  |  | Ndccf\_DataManagement\_Fetch | The consumer retrieves from the DCCF, data or analytics as indicated by Ndccf\_DataManagement\_Notify Fetch Instructions.  *Consumer*: NWDAF, PCF, NSSF, AMF, SMF, NEF, AF, ADRF  *Producer*: DCCF |
|  |  | Ndccf\_DataManagement\_Transfer | The Source DCCF transfers UE data subscription context to the target DCCF.  *Consumer*: DCCF  *Producer*: DCCF |
|  |  | Nmfaf\_3daDataManagement\_Configure | The consumer configures or reconfigures the MFAF to map data or analytics received by the MFAF to out-bound notification endpoints and to format and process the out-bound data or analytics.  *Consumer*: DCCF, NWDAF  *Producer*: MFAF |
|  | MFAF Data Management Services | Nmfaf\_3daDataManagement\_Deconfigure | The consumer configures the MFAF to stop mapping data or analytics received by the MFAF to one or more out-bound notification endpoints.  *Consumer*: DCCF, NWDAF  *Producer*: MFAF |
|  |  | Nmfaf\_3caDataManagement\_Notify | MFAF provides data or analytics or notification of availability of data or analytics to notification endpoints.  *Consumer*: NWDAF, PCF, NSSF, AMF, SMF, NEF, AF, ADRF  *Producer*: MFAF |
|  |  | Nmfaf\_3caDataManagement\_Fetch | The consumer retrieves from the MFAF, data or analytics as indicated by Nmfaf\_3caDataManagement\_Notify Fetch Instructions.  *Consumer*: NWDAF, PCF, NSSF, AMF, SMF, NEF, AF, ADRF  *Producer*: MFAF |
|  |  | Nadrf\_DataManagement\_StorageRequest | The consumer NF uses this service operation to request the ADRF to store data or analytics. Data or analytics are provided to the ADRF in the request message.  *Consumer*: DCCF, NWDAF, MFAF  *Producer*: ADRF |
|  |  | Nadrf\_DataManagement\_StorageSubscriptionRequest | The consumer (NWDAF or DCCF) uses this service operation to request the ADRF to initiate a subscription for data or analytics. Data or analytics provided in notifications as a result of the subsequent subscription by the ADRF are stored in the ADRF.  *Consumer*: NWDAF, DCCF  *Producer*: ADRF |
|  | ADRF Data Management Services | Nadrf\_DataManagement\_StorageSubscriptionRemoval | The consumer NF uses this service operation to request that the ADRF no longer subscribes to data or analytics it is collecting and storing.  *Consumer*: NWDAF, DCCF  *Producer*: ADRF |
|  |  | Nadrf\_DataManagement\_RetrievalRequest | The consumer NF uses this service operation to retrieve stored data or analytics from the ADRF. The Nadrf\_DataManagement\_RetrievalRequest response either contains the data or analytics or provides instructions for fetching the data or analytics.  *Consumer*: NWDAF, DCCF  *Producer*: ADRF |
|  |  | Nadrf\_DataManagement\_RetrievalSubscribe | The consumer NF uses this service operation to retrieve stored data or analytics from the ADRF and to receive future notifications containing the corresponding data or analytics received by ADRF.  *Consumer*: NWDAF, DCCF  *Producer*: ADRF |
|  |  | Nadrf\_DataManagement\_RetrievalUnsubscribe | The consumer NF uses this service operation to request that the ADRF no longer sends data or analytics to a notification endpoint.  *Consumer*: NWDAF, DCCF  *Producer*: ADRF |
|  |  | Nadrf\_DataManagement\_RetrievalNotify | This service operation provides consumers with either data or analytics from an ADRF, or instructions to fetch the data or analytics from an ADRF. The notifications are provided to consumers that have subscribed using the Nadrf\_DataManagement\_RetrievalSubscribe service operation.  *Consumer*: NWDAF, DCCF  *Producer*: ADRF |
|  |  | Nadrf\_DataManagement\_Delete | This service operation instructs the ADRF to delete stored data.  *Consumer*: NWDAF, DCCF  *Producer*: ADRF |
|  |  | SS\_AADRF\_Data\_Collection Subscribe | The consumer subscribes for offline data from A-ADRF.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_Data\_Collection Notify | The consumer is receiving the offline data from A-ADRF as notification, based on subscription.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_ AADRF\_Historical\_ServiceAPI\_Logs Get | The consumer requests API logs from A-ADRF.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_NetworkSlice\_Data Get | The consumer requests network slice data from A-ADRF.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_Location\_Accuracy\_Data Get | The consumer is receiving offline location analytics/data from A-ADRF.  *Consumer*: ADAES  *Producer*: A-ADRF |
| SA WG6 TS 23.436 [33] | A-ADRF Data Collection APIs | SS\_AADRF\_EdgeData\_Collection Subscribe | The consumer subscribes for offline edge data from A-ADRF.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_EdgeData\_Collection Notify | The consumer is receiving the offline edge data from A-ADRF as notification, based on subscription.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_Edge\_Preparation\_Data Get | The consumer is receiving offline edge computing preparation data from the A-ADRF.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_Data\_Storage Request Subscription | The consumer requests A-ADRF to subscribe for data or analytics from ADAE server or A-DCCF for store. This service operation provides parameters needed by the A-ADRF to initiate the subscription (to an ADAE server or A-DCCF).  *Consumer*: ADAE server, A-DCCF  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_Data\_Storage Store Data | The consumer requests A-ADRF to store data or analytics from ADAE server or A-DCCF. Data or analytics are provided to the A-ADRF in the request message.  *Consumer*: ADAE server  *Producer*: A-ADRF |
|  |  | SS\_ADRF\_ ServerToServer\_Analytics Get | The consumer is receiving offline server-to-server analytics/data from A-ADRF.  *Consumer*: ADAES  *Producer*: A-ADRF |
|  |  | SS\_AADRF\_UE RAT connectivity analytics Get | The consumer is receiving offline UE RAT connectivity analytics/data from A-ADRF.  *Consumer*: ADAE server  *Producer*: A-ADRF |
|  |  | SS\_ADCCF\_Data\_Collection Subscribe | The consumer subscribes to receive data or analytics from A-DCCF. The subscription includes service operation specific parameters that identify the data or analytics to be provided.  *Consumer*: ADAE server  *Producer*: A-DCCF |
|  | A-DCCF Data Collection APIs | SS\_ADCCF\_Data\_Collection Notify | The A-DCCF notifies the consumer of the requested data or analytics according to the request or notifies of the availability of previously subscribed data or analytics when data delivery is via the A-DCCF. The A-DCCF may also notify the consumer when data or analytics is to be deleted.  *Consumer*: ADAE server  *Producer*: A-DCCF |
|  |  | SS\_ADCCF\_Data\_Collection Get | The consumer retrieves data or analytics from the A-DCCF.  *Consumer*: ADAE server  *Producer*: A-DCCF |
|  |  | DATA COLLECTION REQUEST | NG-RAN node 1 initiates the procedure by sending the DATA COLLECTION REQUEST message to NG-RAN node 2 to start information reporting or to stop information reporting. Upon receipt, NG-RAN node 2:  shall initiate the requested information reporting according to the parameters given in the request in case the Registration Request for Data Collection IE is set to "start"; or  shall stop all measurements and predictions and terminate the reporting in case the Registration Request for Data Collection IE is set to "stop".  Report Characteristics for Data Collection IE in the DATA COLLECTION REQUEST message indicates the type of objects NG-RAN node 2 performs measurements or predictions on. |
| RAN WG3 TS 38.423 [15] | Data Collection procedures | DATA COLLECTION RESPONSE | If NG-RAN node 2 is capable of providing all of the requested information, it shall initiate the information reporting as requested by NG-RAN node 1 and respond with the DATA COLLECTION RESPONSE message.  If NG-RAN node 2 is capable of providing some but not all of the requested information, it shall initiate the information reporting for the admitted requested information and include the Node Measurement Initiation Result List IE or the Cell Measurement Initiation Result List IE or both in the DATA COLLECTION RESPONSE message. |
|  |  | DATA COLLECTION FAILURE | If none of the requested information can be initiated, NG-RAN node 2 shall send the DATA COLLECTION FAILURE message with an appropriate cause value. |
|  |  | DATA COLLECTION UPDATE | NG-RAN node 2 shall include in the DATA COLLECTION UPDATE message one or more of the following IEs based on the request: SSB Area Radio Resource Status List IE, Predicted Radio Resource Status, Predicted Number of Active UEs, Predicted RRC Connections, Average UE Throughput DL, Average UE Throughput UL, Average Packet Delay, Average Packet Loss, Energy Cost and Measured UE Trajectory. These IEs are specified in Rel. 18 to support three AI/ML for NG-RAN use cases, i.e. Energy Saving, Load Balancing and Mobility Optimization. |

Editors' note: Some of the SA WG6 defined APIs in table above are defined in Rel-19 but are not complete yet.

\*\*\*\*\* END OF CHANGES \*\*\*\*\*