**3GPP TSG-SA Meeting #106SP-241842**

**10 - 13 December 2024, Madrid, Spain**

**Source: Nokia**

**Title: pCR TR 22.850 ML model inference analysis across 3GPP**

**Document for: Approval**

**Agenda Item: 7**

# 1 Decision/action requested

***The group is asked to discuss and agree on the proposal.***

# 2 References

[8] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[9] 3GPP TS 28.105: "Management and orchestration; Artificial Intelligence/ Machine Learning (AI/ML) management".

[33] 3GPP TS 23.436: "Functional architecture and information flows for Application Data Analytics Enablement Service".

# 3 Rationale

This pCR aims to capture ML model inference related aspects from Release 18 across 3GPP. It seeks to identify inconsistencies and misalignments among them.

# 4 Detailed proposal

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| **Start of modification** |

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 21.918: "Summary of Rel-18 Work Items".

[3] 3GPP TR 38.843: "Study on Artificial Intelligence (AI)/Machine Learning (ML) for NR air interface (Release 18)".

[4] 3GPP TR 23.700-84: "Study on Core Network Enhanced Support for Artificial Intelligence (AI) / Machine Learning (ML)".

[5] 3GPP TR 22.874: "5G System (5GS); Study on traffic characteristics and performance requirements for AI/ML model transfer".

[6] 3GPP TS 22.261: "Service requirements for the 5G system".

[7] 3GPP TR 23.700-82: "Study on application layer support for AI/ML services".

[8] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[9] 3GPP TS 28.105: "Management and orchestration; Artificial Intelligence/ Machine Learning (AI/ML) management".

[10] 3GPP TR 38.843: "Study on Artificial Intelligence (AI)/Machine Learning (ML) for NR air interface".

[11] 3GPP TS 38.300: "NR; NR and NG-RAN Overall description; Stage-2".

[12] 3GPP TR 26.927: "Study on Artificial Intelligence and Machine learning in 5G media services".

[13] 3GPP TS 38.401: "NG-RAN; Architecture description".

[14] 3GPP TS 38.420: "NG-RAN; Xn general aspects and principles".

[15] 3GPP TS 38.423: "NG-RAN; Xn Application Protocol (XnAP)".

[16] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".

[17] 3GPP TR 37.817: "Study on enhancement for data collection for NR and ENDC".

[18] 3GPP [TR 28.908](https://www.3gpp.org/ftp/Specs/archive/28_series/28.908/28908-i00.zip): "Study on Artificial Intelligence/Machine Learning (AI/ ML) management".

[19] 3GPP TR 28.858: "Study on Artificial Intelligence / Machine Learning (AI/ML) management; Phase 2".

[20] 3GPP TR 29.889: "Study on Protocol for AI Data Collection from UPF".

[21] 3GPP TR 22.876: "Study on AI/ML Model Transfer; Phase 2".

[22] 3GPP TS 23.501: "System architecture for the 5G System (5GS)".

[23] 3GPP TS 23.502: "Procedures for the 5G System (5GS)".

[24] 3GPP TS 23.503: "Policy and charging control framework for the 5G System (5GS); Stage 2".

[25] 3GPP TR 33.784: "Study on security aspects of core network enhanced support for Artificial Intelligence Machine Learning (AIML)".

[26] 3GPP TR 26.847: "Evaluation of Artificial Intelligence and Machine learning in 5G media services".

[27] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".

[28] 3GPP TS 32.425: "Telecommunication management; Performance Management (PM); Performance measurements Evolved Universal Terrestrial Radio Access Network (E-UTRAN)".

[29] 3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)".

[30] 3GPP TS 28.541: "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".

[31] 3GPP TS 32.254: "Telecommunication management; Charging management; Exposure function Northbound Application Program Interfaces (APIs) charging".

[32] 3GPP TS 32.291: "Telecommunication management; Charging management; 5G system, charging service; Stage 3".

[33] 3GPP TS 23.436: "Functional architecture and information flows for Application Data Analytics Enablement Service".

[34] 3GPP TS 23.482: "Functional architecture and information flows for AIML Enablement Service".

[35] 3GPP TS 23.434: "Service Enabler Architecture Layer for Verticals (SEAL); Functional architecture and information flows".

[36] 3GPP TS 23.558: "Architecture for enabling Edge Applications".

[37] 3GPP TS 29.122: "T8 reference point for Northbound APIs".

[38] 3GPP TS 29.513: "5G System; Policy and Charging Control signalling flows and QoS parameter mapping; Stage 3".

[39] 3GPP TS 29.514: "5G System; Policy Authorization Service; Stage 3".

[40] 3GPP TS 29.517: "5G System; Application Function Event Exposure Service; Stage 3".

[41] 3GPP TS 29.591: "5G System; Network Exposure Function Southbound Services; Stage 3".

[42] 3GPP TS 29.519: "5G System; Usage of the Unified Data Repository Service for Policy Data, Application Data and Structured Data for Exposure; Stage 3".

[43] 3GPP TS 29.520: "5G System; Network Data Analytics Services; Stage 3".

[44] 3GPP TS 29.521: "5G System; Binding Support Management Service; Stage 3".

[45] 3GPP TS 29.522: "5G System; Network Exposure Function Northbound APIs; Stage 3".

[46] 3GPP TS 29.523: "5G System; Policy Control Event Exposure Service; Stage 3".

[47] 3GPP TS 29.525: "5G System; UE Policy Control Service; Stage 3".

[48] 3GPP TS 29.508: "5G System; Session Management Event Exposure Service; Stage 3".

[49] 3GPP TS 29.551: "5G System; Packet Flow Description Management Service; Stage 3".

[50] 3GPP TS 29.552: "5G System; Network Data Analytics signalling flows; Stage 3".

[51] 3GPP TS 29.574: "5G System; Data Collection Coordination Services; Stage 3".

[52] 3GPP TS 29.575: "5G System; Analytics Data Repository Services; Stage 3".

[53] 3GPP TS 29.576: "5G System; Messaging Framework Adaptor Services; Stage 3".

[54] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[55] 3GPP TS 29.504: "5G System; Unified Data Repository Services; Stage 3".

[56] 3GPP TS 29.505: "5G System; Usage of the Unified Data Repository services for Subscription Data; Stage 3".

[57] 3GPP TS 29.510: "5G System; Network function repository services; Stage 3".

[58] 3GPP TS 29.564: "5G System; User Plane Function Services; Stage 3".

[59] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".

[60] 3GPP TS 29.536: "5G System; Network Slice Admission Control Services; Stage 3".

[61] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[62] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[63] 3GPP TS 38.215: "NR; Physical layer measurements".

[64] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[65] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[66] 3GPP TS 37.355: "LTE Positioning Protocol (LPP)".

[67] 3GPP TS 38.455: "NG-RAN; NR Positioning Protocol A (NRPPa)".

[68] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[69] 3GPP TR 38.743: "Study on enhancements for Artificial Intelligence (AI)/Machine Learning (ML) for NG-RAN".

[70] 3GPP TR 38.744: "Study on Artificial Intelligence (AI)/Machine Learning (ML) for mobility in NR".

[y] 3GPP TS 28.104: “Management Data Analytics (MDA)”

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| **Start of next change** |

# 6 Analysis on AI/ML across 3GPP

## 6.3 AI/ML related features

### 6.3.X Analysis on analytics related services

This clause focuses on the specifications from SA WG2, SA WG5 and SA WG6, considering these are the working groups defining services and operations related to ML model inference in 3GPP Release 18. SA WG1, SA WG3, SA WG4, RAN WG1, RAN WG2, and RAN WG3 have not defined any services or operations related to ML model inference.

Table 6.3.X-x 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 analytics services through a clear consumer-producer relationship. It defines several analytics types in TS 23.288 [8], each one supported by the NWDAF/RE-NWDAF AnLF and requested/subscribed by the NWDAF/RE-NWDAF AnLF consumer using the defined analytics services.
* SA WG5: Defines generic analytics services without specific consumer-producer relationship in 3GPP TS 28.105 [9] and 3GPP TS 28.104 [y]. It defines several analytics types in TS 28.104 [y], each one supported by an MnS producer and requested by the MnS consumer using the defined analytics services.
* SA WG6: Defines individual analytics services for each analytics type. It defines several analytics types in 3GPP TS 23.436 [33].

Editor’s note**:** This analysis is based on Release 18 and does not consider Release 19 for SA WG2 and SA WG5. Further analysis needs to be conducted as Release 19 matures and normative work progresses for these groups.

While SA WG2 and SA WG6 restrict the potential producers and consumers, SA WG5 emphasizes flexibility and adaptability. Moreover, SA WG2 and SA WG5 defines several analytics types that can be supported by an entity and requested by another entity using the defined ML model inference services. However, in SA WG6, individual services are defined for each analytics type, lacking a generic analytics service definition as seen in SA WG2 and SA WG5.

Editor’s note: Further investigation is required to determine if similar analytics (e.g., radio resource related analytics) are defined across SA WG2, SA WG5, and SA WG6.

Editor’s note: It is FFS whether analysis on ML model inference is needed.

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| ML Model inference |
| TSG (TS/TR) | Service/API Type | Service/API/IOC Name | Description [Consumer, Producer] |
| SA WG2 TS 23.288 [8] | Network Data Analytics Subscription Services | Nnwdaf\_AnalyticsSubscription\_Subscribe | The consumer subscribes for network data analytics and optionally its corresponding analytics accuracy information with specific parameters.*Consumer:* PCF, NSSF, AMF, SMF, NEF, AF, OAM, CEF, NWDAF, DCCF, LMF*Producer:* NWDAF AnLF |
| Nnwdaf\_AnalyticsSubscription\_Unsubscribe | The consumer unsubscribes for network data analytics.*Consumer:* PCF, NSSF, AMF, SMF, NEF, AF, OAM, CEF, NWDAF, DCCF, LMF*Producer:* NWDAF AnLF |
| Nnwdaf\_AnalyticsSubscription\_Notify | The NWDAF notifies the analytics and optionally Analytics Accuracy Information to the consumer which has subscribed to the NWDAF analytics subscription service.*Consumer:* PCF, NSSF, AMF, SMF, NEF, AF, OAM, CEF, NWDAF, DCCF, LMF*Producer:* NWDAF AnLF |
| Nnwdaf\_AnalyticsSubscription\_Transfer | The consumer NWDAF requests NWDAF for transferring analytics subscriptions from the consumer NWDAF.*Consumer:* NWDAF AnLF*Producer:* NWDAF AnLF |
| Network Data Analytics Information Services | Nnwdaf\_AnalyticsInfo\_Request | The consumer requests NWDAF operator specific analytics and optionally Analytics Accuracy Information with specific parameters.*Consumer:* PCF, NSSF, AMF, SMF, NEF, AF, OAM, CEF, NWDAF, DCCF, LMF*Producer:* NWDAF AnLF |
| Nnwdaf\_AnalyticsInfo\_ContextTransfer | The consumer NWDAF requests NWDAF to transfer context information related to analytics subscriptions.*Consumer:* NWDAF AnLF*Producer:* NWDAF AnLF |
| Network Data Roaming Analytics Services | Nnwdaf\_RoamingAnalytics\_Subscribe | The consumer subscribes for network data analytics related to roaming UEs.*Consumer:* H-RE-NWDAF, V-RE-NWDAF*Producer:* H-RE-NWDAF, V-RE-NWDAF |
| Nnwdaf\_RoamingAnalytics\_Unsubscribe | The consumer unsubscribes for network data analytics related to roaming UEs.*Consumer:* H-RE-NWDAF, V-RE-NWDAF*Producer:* H-RE-NWDAF, V-RE-NWDAF |
| Nnwdaf\_RoamingAnalytics\_Notify | The NWDAF notifies the analytics related to roaming UE(s) to the consumer which has subscribed to the NWDAF roaming analytics subscription service.*Consumer:* H-RE-NWDAF, V-RE-NWDAF*Producer:* H-RE-NWDAF, V-RE-NWDAF |
| Nnwdaf\_RoamingAnalytics\_Request | The consumer requests NWDAF operator specific related to roaming UEs.*Consumer:* H-RE-NWDAF, V-RE-NWDAF*Producer:* H-RE-NWDAF, V-RE-NWDAF |
| SA WG5 TS 28.105 [9] & SA WG5 TS 28.104 [y] | Management Data Analytics Services | MDARequest | It represents the management data analytics output request which is created by an MDA MnS consumer towards the MDA MnS producer.*Consumer:* Any authorized network function, any authorized management function, operator*Producer:* Any function that is capable of producing management data analytics |
| MDAReport | It represents the management data analytics report containing the outputs for one or more MDA types delivered to the MDA consumer who has requested for management data analytics.*Consumer:* Any authorized network function, any authorized management function, operator*Producer:* Any function that is capable of producing management data analytics |
| SA WG6 TS 23.436 [33] | SS\_ADAE\_VAL\_performance\_analytics | VAL\_performance\_analytics\_subscribe | The consumer subscribes for VAL performance analytics. *Consumer:* VAL server*Producer:* ADAE server |
| VAL\_performance\_analytics\_notify | The consumer is notified by ADAES on the VAL performance analytics.*Consumer:* VAL server*Producer:* ADAE server |
| SS\_ADAE\_slice\_performance\_analytics | slice\_performance\_analytics\_subscribe | The consumer subscribes for slice specific performance analytics.*Consumer:* VAL server*Producer:* ADAE server |
| slice\_performance\_analytics\_notify | The consumer is notified by ADAES on the slice specific performance analytics.*Consumer:* VAL server*Producer:* ADAE server |
| SS\_ADAE\_UE-to-UE\_performance\_analytics | UE-to-UE performance\_analytics\_subscribe | The consumer subscribes for UE-to-UE performance analytics. |
| UE-to-UE performance\_analytics\_notify | The consumer is notified by ADAES on the slice specific performance analytics.*Consumer:* VAL server*Producer:* ADAE server |
| SS\_ADAE\_server-to-server\_performance\_analytics | server-to-server\_performance\_analytics\_subscribe | The consumer subscribes to the ADAE server for Server-to-server performance analytics.*Consumer:* VAL server, EES*Producer:* ADAE server |
| server-to-server\_performance\_analytics\_notify | The consumer is notified by the ADAE server on the Server-to-server performance analytics.*Consumer:* VAL server, EES*Producer:* ADAE server |
| SS\_ADAE\_location\_accuracy\_analytics | Location\_accuracy\_analytics\_subscribe | The consumer subscribes for location accuracy analytics.*Consumer:* VAL server*Producer:* ADAE server |
| Location\_accuracy\_analytics\_notify | The consumer is notified by ADAES on the location accuracy analytics.*Consumer:* VAL server*Producer:* ADAE server |
| SS\_ADAE\_service\_API\_analytics | Service\_API\_analytics\_subscribe | The consumer subscribes for service API analytics.*Consumer:* VAL server, Subscriber, API invoker*Producer:* ADAE server |
| Service\_API\_analytics\_notify | The consumer is notified by ADAES on the location accuracy analytics.*Consumer:* VAL server, Subscriber, API invoker*Producer:* ADAE server |
| SS\_ADAE\_slice\_usage\_pattern\_analytics | slice\_usage\_pattern\_analytics\_subscribe | The consumer subscribes for slice usage pattern analytics.*Consumer:* VAL server, SEAL server*Producer:* ADAE server |
| slice\_usage\_pattern\_analytics\_notify | The consumer is notified by ADAES on the slice usage pattern analytics.*Consumer:* VAL server, SEAL server*Producer:* ADAE server |
| SS\_ADAE\_edge\_analytics | edge\_analytics\_subscribe | The consumer subscribes for edge load analytics.*Consumer:* VAL server, ECS, EES*Producer:* ADAE server |
| edge\_analytics\_notify | The consumer is notified by ADAES on the edge load analytics.*Consumer:* VAL server, ECS, EES*Producer:* ADAE server |
| edge\_analytics\_get | The consumer requests edge analytics data.*Consumer:* VAL server, ECS, EES*Producer:* ADAE server |
| SS\_ADAES\_slice\_usage\_stats | slice\_usage\_stats\_get | The consumer requests and receives slice usage statistics from ADAE server.*Consumer:* VAL server*Producer:* ADAE server |
| SS\_ADAES\_edge\_preparation\_analytics | edge\_preparation\_analytics\_subscribe | The consumer subscribes for edge computing preparation analytics.*Consumer:* VAL server, ECS, EES*Producer:* ADAE server |
| edge\_preparation\_analytics\_notify | The consumer is notified by the ADAE server on the edge computing preparation analytics.*Consumer:* VAL server, ECS, EES*Producer:* ADAE server |
| edge\_preparation\_analytics\_get | The consumer requests edge computing preparation analytics*Consumer:* VAL server, ECS, EES*Producer:* ADAE server |
| SS\_ADAE\_collision\_detection\_analytics | collision\_detection\_analytics\_subscribe | The consumer subscribes for collision detection analytics.*Consumer:* VAL server, LM server, UAE server, UAS application specific server*Producer:* ADAE server |
| collision\_detection\_analytics\_notify | The consumer is notified by the ADAE server on collision detection analytics.*Consumer:* VAL server, LM server, UAE server, UAS application specific server*Producer:* ADAE server |
| collision\_detection\_analytics\_get | The consumer requests collision detection analytics.*Consumer:* VAL server, LM server, UAE server, UAS application specific server*Producer:* ADAE server |
| SS\_ADAE\_location-related\_UE\_group\_analytics | location-related\_UE\_group\_analytics\_subscribe | The consumer subscribes for location-related UE group analytics.*Consumer:* LM server*Producer:* ADAE server |
| location-related\_UE\_group\_analytics\_notify | The consumer is notified by the ADAE server on location-related UE group analytics.*Consumer:* LM server*Producer:* ADAE server |
| location-related\_UE\_group\_analytics\_get | The consumer requests location-related UE group analytics.*Consumer:* LM server*Producer:* ADAE server |
| SS\_ ADAE\_AIML\_member\_capability\_analytics | AIML\_member\_capability\_analytics\_subscribe | The consumer subscribes for application layer AIML member capability analytics.*Consumer:* VAL server, AIMLE server*Producer:* ADAE server |
| AIML\_member\_capability\_analytics\_notify | The consumer is notified by the ADAE server on application layer AIML member capability analytics.*Consumer:* VAL server, AIMLE server*Producer:* ADAE server |
| AIML\_member\_capability\_analytics\_get | The consumer requests application layer AIML member capability analytics.*Consumer:* VAL server, AIMLE server*Producer:* ADAE server |

Table 6.3.X-x: Analytics related services and operations as specified across 3GPP WGs

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| **End of modifications** |