**3GPP TSG-CT WG3 Meeting #130C3-234062**

**Xiamen, China, 9 - 13 October, 2023 (revision of C3-233abc)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **29.520** | **CR** | **0783** | **rev** |  | **Current version:** | **18.3.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Define Nnwdaf\_MLModelMonitor API | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, Ericsson, Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | CT3 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | eNA\_Ph3 | | | | |  | ***Date:*** | | | 2023-09-26 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The Nnwdaf\_MLModelMonitor API was introduced in 23.288 to enable the consumer to subscribe/unsubscribe for ML model accuracy, provide Analytics feedback information for the analytics generated by an NWDAF and enable the NWDAF containing AnLF registers the use and monitoring capability for an ML model into the model provider NWDAF. This service needs to be defined in stage 3. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Define the resource structure and data models for Nnwdaf\_MLModelMonitor API. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Not supporting API definitions of stage 2 required Nnwdaf\_MLModelMonitor API. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.1, 5.6(new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | The CR does not impact any OpenAPI file. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

**Additional discussion(if needed):**

**Proposed changes:**

\*\*\* 1st Change \*\*\*

## 4.1 Introduction

The Nnwdaf services are used by the NWDAF to provide specific analytics information and ML models.

Analytics information is either statistical information of past events, or predictive information.

The following services are specified for the NWDAF:

Table 4.1-1: Services provided by NWDAF

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Service Name | Description | Service Operations | Operation  Semantics | Example Consumer(s) |
| Nnwdaf\_EventsSubscription  (NOTE 1) | This service enables the NF service consumers to subscribe to/unsubscribe from notifications for different analytics information from the NWDAF. It also enables the transfer of subscriptions between NWDAFs | Subscribe | Subscribe / Notify | PCF, NSSF, AMF, SMF, NEF, AF, LMF, OAM, CEF, NWDAF, DCCF |
| Unsubscribe |
| Notify |
| Transfer | Request / Response | NWDAF |
| Nnwdaf\_AnalyticsInfo | This service enables the NF service consumers to request and get specific analytics or context information related to analytics subscriptions from the NWDAF. | Request | Request / Response | PCF, NSSF, AMF, SMF, NEF, AF, LMF, OAM, NWDAF, DCCF |
| ContextTransfer | Request / Response | NWDAF |
| Nnwdaf\_DataManagement | This service enables the NF service consumers to subscribe to/unsubscribe from notifications when subscribed event(s) are detected or retrieve the subscribed data from the NWDAF. | Subscribe | Subscribe / Notify | NWDAF, DCCF, MFAF |
| Unsubscribe |
| Notify |
| Fetch | Request / Response | NWDAF, DCCF, MFAF |
| Nnwdaf\_MLModelProvision  (NOTE 2) | This service enables the NF service consumers to subscribe to/unsubscribe from notifications when a ML model matching the subscription parameters becomes available. | Subscribe | Subscribe / Notify | NWDAF |
| Unsubscribe |
| Notify |
| Nnwdaf\_MLModelTraining  (NOTE 3) | This service enables the NF service consumers to subscribe to/unsubscribe/modify from notifications for a ML model training. | Subscribe | Subscribe / Notify | NWDAF |
| Unsubscribe |
| Notify |
| Nnwdaf\_MLModelMonitor | This service enables the NF service consumer to subscribe/unsubscribe for ML model accuracy, provide Analytics feedback information for the analytics generated by an NWDAF and enable the NWDAF containing AnLF registers the use and monitoring capability for an ML model into the model provider NWDAF | Subscribe | Subscribe / Notify | NWDAF |
| Unsubscribe |
| Notify |
| Register | Request / Response |
| Deregister |
| NOTE 1: This service corresponds to the Nnwdaf\_AnalyticsSubscription service defined in 3GPP TS 23.288 [17].  NOTE 2: This service implements also the Nnwdaf\_MLModelInfo service as specified in 3GPP TS 23.288 [17] by using immediate and one-time reporting requirement.  NOTE 3: This service implements also the Nnwdaf\_MLModelTrainingInfo service as specified in 3GPP TS 23.288 [17] by using immediate and one-time reporting requirement. | | | | |

Table 4.1-2 summarizes the corresponding APIs defined in this specification.

Table 4.1-2: API Descriptions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Service Name | Clause | Description | OpenAPI Specification File | apiName | Annex |
| Nnwdaf\_EventsSubscription | 5.1 | Nnwdaf Events Subscription Service. | TS29520\_Nnwdaf\_EventsSubscription.yaml | nnwdaf-eventssubscription | A.2 |
| Nnwdaf\_AnalyticsInfo | 5.2 | Nnwdaf Analytics Information Service | TS29520\_Nnwdaf\_AnalyticsInfo.yaml | nnwdaf-analyticsinfo | A.3 |
| Nnwdaf\_DataManagement | 5.3 | NWDAF Data Management Service | TS29520\_Nnwdaf\_DataManagement.yaml | nnwdaf-datamanagement | A.4 |
| Nnwdaf\_MLModelProvision | 5.4 | NWDAF ML Model Provision Service | TS29520\_Nnwdaf\_MLModelProvision.yaml | nnwdaf-mlmodelprovision | A.5 |
| Nnwdaf\_MLModelTraining | 5.5 | NWDAF ML Model Training Service | TS29520\_Nnwdaf\_MLModelTraining.yaml | nnwdaf-mlmodeltraining | A.6 |

\*\*\* Next Change \*\*\*

## 5.6 Nnwdaf\_MLModelMonitor Service API

### 5.6.1 Introduction

The Nnwdaf\_MLModelMonitor service shall use the Nnwdaf\_MLModelMonitor API.

The API URI of the Nnwdaf\_MLModelMonitor API shall be:

{apiRoot}/<apiName>/<apiVersion>

The request URIs used in each HTTP requests from the NF service consumer towards the NWDAF shall have the Resource URI structure defined in clause 4.4.1 of 3GPP TS 29.501 [7], i.e.:

**{apiRoot}/<apiName>/<apiVersion>/<apiSpecificResourceUriPart>**

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [7].

- The<apiName>shall be "nnwdaf-mlmodelmonitor".

- The <apiVersion> shall be "v1".

- The <apiSpecificResourceUriPart> shall be set as described in clause 5.6.3.

### 5.6.2 Usage of HTTP

#### 5.6.2.1 General

HTTP/2, IETF RFC 9113 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [6].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [6].

The OpenAPI [11] specification of HTTP messages and content bodies for the Nnwdaf\_MLModelMonitor is contained in Annex A.

#### 5.6.2.2 HTTP standard headers

##### 5.6.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [6] for the usage of HTTP standard headers.

##### 5.6.2.2.2 Content type

JSON, IETF RFC 8259 [10], shall be used as content type of the HTTP bodies specified in the present specification as specified in clause 5.4 of 3GPP TS 29.500 [6]. The use of the JSON format shall be signalled by the content type "application/json".

"Problem Details" JSON object shall be used to indicate additional details of the error in a HTTP response body and shall be signalled by the content type "application/problem+json", as defined in IETF RFC 7807 [15].

#### 5.6.2.3 HTTP custom headers

The Nnwdaf\_MLModelMonitor service API shall support mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [6] and may support HTTP custom header fields specified in clause 5.2.3.3 of 3GPP TS 29.500 [6].

In this release of the specification, no specific custom headers are defined for the Nnwdaf\_MLModelMonitor service API.

### 5.6.3 Resources

#### 5.6.3.1 Resource Structure

This clause describes the structure for the Resource URIs, the resources and methods used for the service.

Figure 5.6.3.1-1 depicts the resource URIs structure for the Nnwdaf\_MLModelMonitor API.



Figure 5.6.3.1-1: Resource URI structure of the Nnwdaf\_MLModelMonitor API

Table 5.6.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 5.6.3.1-1: Resources and methods overview

|  |  |  |  |
| --- | --- | --- | --- |
| Resource name | Resource URI | HTTP method or custom operation | Description |
| NWDAF ML model monitoring registrations | /registrations | POST | Create a new Individual ML model monitoring registration resource on the NWDAF containing MTLF. |
| Individual NWDAF ML model monitoring registration | /registrations/{registrationsId} | DELETE | Delete an Individual ML model monitoring registration resource by {registrationsId} on the NWDAF containing MTLF. |
| NWDAF ML model monitoring Subscriptions | /subscriptions | POST | Create a new Individual ML model monitoring Subscription resource on the NWDAF containing AnLF. |
| Individual NWDAF ML model monitoring Subscription | /subscriptions/{subscriptionId} | PUT | Modifies an existing ML model monitoring Subscription resource on the NWDAF containing AnLF. |
| DELETE | Delete an individual ML model monitoring Subscription identified by {subscriptionId} on the NWDAF containing AnLF. |

#### 5.6.3.2 Resource: NWDAF ML model monitoring registrations

##### 5.6.3.2.1 Description

The NWDAF ML model monitoring registrations resource represents all registrations to the Nnwdaf\_MLModelMonitor Service at a given NWDAF containing MTLF. The resource allows an NF service consumer to create a new Individual NWDAF ML model monitoring registration resource.

##### 5.6.3.2.2 Resource Definition

Resource URI: **{apiRoot}/nnwdaf-mlmodelmonitor/<apiVersion>/registrations**

The <apiVersion> shall be set as described in clause 5.6.1.

This resource shall support the resource URI variables defined in table 5.6.3.2.2-1.

Table 5.6.3.2.2-1: Resource URI variables for this resource

|  |  |  |
| --- | --- | --- |
| Name | Data type | Definition |
| apiRoot | string | See clause 5.6.1 |

##### 5.6.3.2.3 Resource Standard Methods

###### 5.6.3.2.3.1 POST

This method shall support the URI query parameters specified in table 5.6.3.2.3.1-1.

Table 5.6.3.2.3.1-1: URI query parameters supported by the POST method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 5.6.3.2.3.1-2 and the response data structures and response codes specified in table 5.6.3.2.3.1-3.

Table 5.6.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| MLModelMonitorReg | M | 1 | Create a new Individual NWDAF ML model monitoring registration resource. |

Table 5.6.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| MLModelMonitorReg | M | 1 | 201 Created | The creation of an Individual NWDAF ML model monitoring registration resource is confirmed and a representation of that resource is returned. |
| NOTE 1: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.  NOTE 2: Failure cases are described in clause 5.6.7. | | | | |

Table 5.6.3.2.3.1-4: Headers supported by the 201 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains the URI of the newly created resource, according to the structure: {apiRoot}/nnwdaf-mlmodelmonitor/<apiVersion>/registrations/{registrationId} |

##### 5.6.3.2.4 Resource Custom Operations

None in this release of the specification.

#### 5.6.3.3 Resource: Individual NWDAF ML model monitoring registration

##### 5.6.3.3.1 Description

The Individual NWDAF ML model monitoring registration resource represents a single registration to the Nnwdaf\_MLModelMonitor Service at a given NWDAF containing MTLF.

##### 5.6.3.3.2 Resource definition

Resource URI: **{apiRoot}/nnwdaf-mlmodelmonitor/<apiVersion>/registrations/{registrationId}**

The <apiVersion> shall be set as described in clause 5.6.1.

This resource shall support the resource URI variables defined in table 5.6.3.3.2-1.

Table 5.6.3.3.2-1: Resource URI variables for this resource

|  |  |  |
| --- | --- | --- |
| Name | Data type | Definition |
| apiRoot | string | See clause 5.6.1. |
| registrationId | string | Identifies a registration to the Nnwdaf\_MLModelMonitor Service. |

##### 5.6.3.3.3 Resource Standard Methods

###### 5.6.3.3.3.1 DELETE

This method shall support the URI query parameters specified in table 5.6.3.3.3.1-1.

Table 5.6.3.3.3.1-1: URI query parameters supported by the DELETE method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 5.6.3.3.3.1-2 and the response data structures and response codes specified in table 5.6.3.3.3.1-3.

Table 5.6.3.3.3.1-2: Data structures supported by the DELETE Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 5.6.3.3.3.1-3: Data structures supported by the DELETE Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| n/a |  |  | 204 No Content | Successful case: The Individual NWDAF ML model monitoring registration resource matching the registrationId was deleted. |
| RedirectResponse | O | 0..1 | 307 Temporary Redirect | Temporary redirection, during Individual ML model monitoring registration deletion.  (NOTE 2) |
| RedirectResponse | O | 0..1 | 308 Permanent Redirect | Permanent redirection, during Individual ML model monitoring registration deletion.  (NOTE 2) |
| NOTE 1: The mandatory HTTP error status codes for the DELETE method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.  NOTE 2: The RedirectResponse data structure may be provided by an SCP (cf. clause 6.10.9.1 of 3GPP TS 29.500 [6]). | | | | |

Table 5.6.3.3.3.1-4: Headers supported by the 307 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI of the resource located in an alternative NWDAF (service) instance towards which the request is redirected.  For the case where the request is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NWDAF (service) instance towards which the request is redirected. |

Table 5.6.3.3.3.1-5: Headers supported by the 308 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI of the resource located in an alternative NWDAF (service) instance towards which the request is redirected  For the case where the request is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NWDAF (service) instance towards which the request is redirected. |

##### 5.6.3.3.4 Resource Custom Operations

None in this release of the specification.

#### 5.6.3.4 Resource: NWDAF ML model monitoring Subscriptions

##### 5.6.3.4.1 Description

The NWDAF ML model monitoring Subscriptions resource represents all subscriptions to the Nnwdaf\_MLModelMonitor Service at a given NWDAF containing AnLF. The resource allows an NF service consumer to create a new Individual NWDAF ML model monitoring subscription resource.

##### 5.6.3.4.2 Resource Definition

Resource URI: **{apiRoot}/nnwdaf-mlmodelmonitor/<apiVersion>/subscriptions**

The <apiVersion> shall be set as described in clause 5.6.1.

This resource shall support the resource URI variables defined in table 5.6.3.4.2-1.

Table 5.6.3.4.2-1: Resource URI variables for this resource

|  |  |  |
| --- | --- | --- |
| Name | Data type | Definition |
| apiRoot | string | See clause 5.6.1 |

##### 5.6.3.4.3 Resource Standard Methods

###### 5.6.3.4.3.1 POST

This method shall support the URI query parameters specified in table 5.6.3.4.3.1-1.

Table 5.6.3.4.3.1-1: URI query parameters supported by the POST method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 5.6.3.4.3.1-2 and the response data structures and response codes specified in table 5.6.3.4.3.1-3.

Table 5.6.3.4.3.1-2: Data structures supported by the POST Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| MLModelMonitorSub | M | 1 | Create a new Individual NWDAF ML model monitoring subscription resource. |

Table 5.6.3.4.3.1-3: Data structures supported by the POST Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| MLModelMonitorSub | M | 1 | 201 Created | The creation of an Individual NWDAF ML model monitoring subscription resource is confirmed and a representation of that resource is returned. |
| NOTE 1: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.  NOTE 2: Failure cases are described in clause 5.6.7. | | | | |

Table 5.6.3.4.3.1-4: Headers supported by the 201 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains the URI of the newly created resource, according to the structure: {apiRoot}/nnwdaf-mlmodelmonitor/<apiVersion>/subscriptions/{subscriptionId} |

##### 5.6.3.4.4 Resource Custom Operations

None in this release of the specification.

#### 5.6.3.5 Resource: Individual NWDAF ML model monitoring Subscription

##### 5.6.3.5.1 Description

The Individual NWDAF ML model monitoring Subscription resource represents a single subscription to the Nnwdaf\_MLModelMonitor Service at a given NWDAF containing AnLF.

##### 5.6.3.5.2 Resource definition

Resource URI: **{apiRoot}/nnwdaf-mlmodelmonitor/<apiVersion>/subscriptions/{subscriptionId}**

The <apiVersion> shall be set as described in clause 5.6.1.

This resource shall support the resource URI variables defined in table 5.6.3.5.2-1.

Table 5.6.3.5.2-1: Resource URI variables for this resource

|  |  |  |
| --- | --- | --- |
| Name | Data type | Definition |
| apiRoot | string | See clause 5.6.1. |
| subscriptionId | string | Identifies a subscription to the Nnwdaf\_MLModelMonitor Service. |

##### 5.6.3.5.3 Resource Standard Methods

###### 5.6.3.5.3.1 PUT

This method shall support the URI query parameters specified in table 5.6.3.5.3.1-1.

Table 5.6.3.5.3.1-1: URI query parameters supported by the PUT method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 5.6.3.5.3.1-2 and the response data structures and response codes specified in table 5.6.3.5.3.1-3.

Table 5.6.3.5.3.1-2: Data structures supported by the PUT Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| MLModelMonitorSub | M | 1 | Parameters to replace a subscription to NWDAF ML model monitoring subscription resource. |

Table 5.6.3.5.3.1-3: Data structures supported by the PUT Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response codes | Description |
| MLModelMonitorSub | M | 1 | 200 OK | The Individual NWDAF ML model monitoring subscription resource was modified successfully and a representation of that resource is returned. |
| n/a |  |  | 204 No Content | The Individual NWDAF ML model monitoring subscription resource was modified successfully. |
| RedirectResponse | O | 0..1 | 307 Temporary Redirect | Temporary redirection, during Individual NWDAF ML model monitoring subscription modification.  (NOTE 3) |
| RedirectResponse | O | 0..1 | 308 Permanent Redirect | Permanent redirection, during Individual NWDAF ML model monitoring subscription modification.  (NOTE 3) |
| NOTE 1: The mandatory HTTP error status codes for the PUT method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.  NOTE 2: Failure cases are described in clause 5.6.7.  NOTE 3: The RedirectResponse data structure may be provided by an SCP (cf. clause 6.10.9.1 of 3GPP TS 29.500 [6]). | | | | |

Table 5.6.3.5.3.1-4: Headers supported by the 307 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI of the resource located in an alternative NWDAF (service) instance towards which the request is redirected.  For the case where the request is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NWDAF (service) instance towards which the request is redirected. |

Table 5.6.3.5.3.1-5: Headers supported by the 308 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI of the resource located in an alternative NWDAF (service) instance towards which the request is redirected.  For the case where the request is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NWDAF (service) instance towards which the request is redirected. |

###### 5.6.3.5.3.2 DELETE

This method shall support the URI query parameters specified in table 5.6.3.5.3.2-1.

Table 5.6.3.5.3.2-1: URI query parameters supported by the DELETE method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 5.6.3.5.3.2-2 and the response data structures and response codes specified in table 5.6.3.5.3.2-3.

Table 5.6.3.5.3.2-2: Data structures supported by the DELETE Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 5.6.3.5.3.2-3: Data structures supported by the DELETE Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| n/a |  |  | 204 No Content | Successful case: The Individual NWDAF ML model monitoring subscription resource matching the subscriptionId was deleted. |
| RedirectResponse | O | 0..1 | 307 Temporary Redirect | Temporary redirection, during Individual ML model monitoring subscription deletion.  (NOTE 2) |
| RedirectResponse | O | 0..1 | 308 Permanent Redirect | Permanent redirection, during Individual ML model monitoring subscription deletion.  (NOTE 2) |
| NOTE 1: The mandatory HTTP error status codes for the DELETE method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.  NOTE 2: The RedirectResponse data structure may be provided by an SCP (cf. clause 6.10.9.1 of 3GPP TS 29.500 [6]). | | | | |

Table 5.6.3.5.3.2-4: Headers supported by the 307 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI of the resource located in an alternative NWDAF (service) instance towards which the request is redirected.  For the case where the request is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NWDAF (service) instance towards which the request is redirected. |

Table 5.6.3.5.3.2-5: Headers supported by the 308 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI of the resource located in an alternative NWDAF (service) instance towards which the request is redirected  For the case where the request is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NWDAF (service) instance towards which the request is redirected. |

##### 5.6.3.5.4 Resource Custom Operations

None in this release of the specification.

### 5.6.4 Custom Operations without associated resources

None in this release of the specification.

### 5.6.5 Notifications

#### 5.6.5.1 General

Notifications shall comply with clause 6.2 of 3GPP TS 29.500 [6] and clause 4.6.2.3 of 3GPP TS 29.501 [7].

Table 5.6.5.1-1: Notifications overview

|  |  |  |  |
| --- | --- | --- | --- |
| Notification | Callback URI | HTTP method or custom operation | Description (service operation) |
| Event Notification | {notificationUri} | POST | Report analytics feedback information. |

#### 5.6.5.2 Event Notification

##### 5.6.5.2.1 Description

The Event Notification is used by the NWDAF containing AnLF to report analytics feedback information to the NF service consumer that has subscribed to such Notifications.

##### 5.6.5.2.2 Operation Definition

Callback URI: **{notificationUri}**

The operation shall support the callback URI variables defined in Table 5.6.5.2.2-1, the request data structures specified in table 5.6.5.2.2-2 and the response data structure and response codes specified in Table 5.6.5.2.2-3.

Table 5.6.5.2.2-1: Callback URI variables

|  |  |  |
| --- | --- | --- |
| Name | Data type | Definition |
| notificationUri | Uri | The Notification Uri is assigned within the Individual NWDAF ML model monitoring Subscription Resource and described within the MLModelMonitorSub data type (see table 5.6.6.2.3-1). |

Table 5.6.5.2.2-2: Data structures supported by the POST Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| MLModelMonitorNotify | M | 1 | Provides analytics feedback information. |

Table 5.6.5.2.2-3: Data structures supported by the POST Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response codes | Description |
| n/a |  |  | 204 No Content | The receipt of the Notification is acknowledged. |
| RedirectResponse | O | 0..1 | 307 Temporary Redirect | Temporary redirection, during the event notification.  (NOTE 2) |
| RedirectResponse | O | 0..1 | 308 Permanent Redirect | Permanent redirection, during the event notification.  (NOTE 2) |
| NOTE 1: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.  NOTE 2: The RedirectResponse data structure may be provided by an SCP (cf. clause 6.10.9.1 of 3GPP TS 29.500 [6]). | | | | | |

Table 5.6.5.2.2-4: Headers supported by the 307 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI representing the end point of an alternative NF consumer (service) instance towards which the notification is redirected.  For the case where the notification is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NF (service) instance towards which the notification request is redirected. |

Table 5.6.5.2.2-5: Headers supported by the 308 Response Code on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | Contains an alternative URI representing the end point of an alternative NF consumer (service) instance towards which the notification is redirected.  For the case where the notification is redirected to the same target via a different SCP, refer to clause 6.10.9.1 of 3GPP TS 29.500 [6]. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NF (service) instance towards which the notification request is redirected. |

### 5.6.6 Data Model

#### 5.6.6.1 General

This clause specifies the application data model supported by the API.

Table 5.6.6.1-1 specifies the data types defined for the Nnwdaf\_MLModelMonitor service based interface protocol.

Table 5.6.6.1-1: Nnwdaf\_MLModelMonitor specific Data Types

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | Clause defined | Description | Applicability |
| AnalyticsFeedback | 5.6.6.2.6 |  |  |
| MLModelAccuracyInfo | 5.6.6.2.5 |  |  |
| MLModelMonitorNotify | 5.6.6.2.4 |  |  |
| MLModelMonitorReg | 5.6.6.2.2 |  |  |
| MLModelMonitorSub | 5.6.6.2.3 |  |  |

Table 5.6.6.1-2 specifies data types re-used by the Nnwdaf\_MLModelMonitor service based interface protocol from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Nnwdaf\_MLModelMonitor service based interface.

Table 5.6.6.1-2: Nnwdaf\_MLModelMonitor re-used Data Types

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | Reference | Comments | Applicability |
| DataSetTag | 3GPP TS 29.575 [27] | Contains an identifier and a description of associated data or analytics records. |  |
| DateTime | 3GPP TS 29.571 [8] | Identifies the time. |  |
| Float | 3GPP TS 29.571 [8] | Number with format "float" as defined in OpenAPI Specification [11]. |  |
| MLModelMetric | 5.4.6.3.4 | Indicates the ML Model Metric. |  |
| NfInstanceId | 3GPP TS 29.571 [8] | Identifies an NF instance |  |
| NfSetId | 3GPP TS 29.571 [8] | Identifies an NF Set instance. |  |
| NwdafEvent | 5.1.6.3.4 | Indicates the NWDAF events. |  |
| ReportingInformation | 3GPP TS 29.523 [20] | Represents the type of reporting the subscription requires. |  |
| SupportedFeatures | 3GPP TS 29.571 [8] | Used to negotiate the applicability of the optional features defined in table 5.1.8-1. |  |
| Uinteger | 3GPP TS 29.571 [8] | Unsigned Integer, i.e. only value 0 and integers above 0 are permissible. |  |
| Uri | 3GPP TS 29.571 [8] | Indicates the URI. |  |

#### 5.6.6.2 Structured data types

##### 5.6.6.2.1 Introduction

This clause defines the structures to be used in resource representations.

##### 5.6.6.2.2 Type MLModelMonitorReg

Table 5.6.6.2.2-1: Definition of type MLModelMonitorReg

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description | Applicability |
| consumerId | NfInstanceId | C | 0..1 | Indicates the NF instance ID of the consumer.  (NOTE) |  |
| consumerSetId | NfSetId | C | 0..1 | Indicates the NF set ID of the consumer.  (NOTE) |  |
| modelId | Uinteger | M | 1 | The ML model ID. |  |
| modelAccuInd | boolean | O | 0..1 | Indicates the ML Model accuracy transfer indication.  Set to "true" to indicate that the monitoring of the accuracy of the ML model is supported. Default value is "false" if omitted. |  |
| NOTE: One of "consumerId" and "consumerSetId" attributes shall be provided. | | | | | |

##### 5.6.6.2.3 Type MLModelMonitorSub

Table 5.6.6.2.3-1: Definition of type MLModelMonitorSub

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description | Applicability |
| modelIds | array(Uinteger) | M | 1..N | The ML model IDs. |  |
| notificationUri | Uri | M | 1 | Notification target address. |  |
| notifCorrId | string | M | 1 | Notification correlation identifier. |  |
| modelMetric | MLModelMetric | O | 0..1 | The ML model metrics to calculate the accuracy information. |  |
| accuThreshold | Uinteger | O | 0..1 | Accuracy reporting threshold. Indicates the threshold upon the crossing of which (in either ascending or descending direction) the accuracy information needs to be reported. |  |
| eventReportReq | ReportingInformation | O | 0..1 | Represents the reporting requirements of the event subscription.  If omitted, the default values within the ReportingInformation data type apply. |  |
| immReports | array(MLModelMonitorNotify) | O | 1..N | Immediately reported ML model Monitoring notifications. It may only be provided in the HTTP POST response of a subscription creation/update and only if the immediate reporting flag was set to "true" in the HTTP POST request. |  |
| suppFeat | SupportedFeatures | C | 0..1 | List of Supported features used as described in clause 5.1.8.  It shall be present in the POST request if at least one feature defined in clause 5.1.8 is supported, and it shall be present in the POST response if the NF service consumer included the"suppFeat" attribute in the POST request. |  |

##### 5.6.6.2.4 Type MLModelMonitorNotify

Table 5.6.6.2.4-1: Definition of type MLModelMonitorNotify

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description | Applicability |
| notifCorrId | string | M | 1 | Notification correlation identifier. |  |
| modelAccuInfos | array(MLModelAccuracyInfo) | C | 1..N | The accuracy related information of the ML model.  (NOTE 1) |  |
| anaFeedbacks | array(AnalyticsFeedback) | C | 1..N | The analytics feedback information.  (NOTE 1) |  |
| validPeriod | TimeWindow | O | 0..1 | Represents the period during which the monitoring information is valid.  (NOTE 2) |  |
| NOTE 1: At least one of "modelAccuInfos" and "anaFeedbacks" attributes shall be provided.  NOTE 2: If the "temporalGranSize" attribute is provided in the request, the duration indicated by the "validPeriod" attribute shall be greater than or equal to the value of the "temporalGranSize" attribute. | | | | | |

##### 5.6.6.2.5 Type MLModelAccuracyInfo

Table 5.6.6.2.5-1: Definition of type MLModelAccuracyInfo

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description | Applicability |
| modelId | Uinteger | M | 1 | The ML model ID. |  |
| deviation | Float | O | 0..1 | Indicates the deviation value of the predictions generated using the ML model from the ground truth data. |  |
| inferenceNum | Uinteger | O | 0..1 | The number of inferences that were performed during the time interval between Nnwdaf\_MLModelMonitor\_Register request and the Notify request or between the time of last Notification message and the time of the current Notification message. |  |
| adrfId | NfInstanceId | O | 0..1 | Identifier of the ADRF.  (NOTE) |  |
| adrfSetId | NfSetId | O | 0..1 | Identifier of the ADRF Set.  (NOTE) |  |
| dataSetTag | DataSetTag | O | 0..1 | Data set tag of the data stored in ADRF which can be used by MTLF. This attribute may be present if the "adrfId" or "adrfSetId" attribute is present. |  |
| modelMetric | MLModelMetric | O | 0..1 | The ML model metrics to calculate the accuracy information. |  |
| NOTE: "adrfId" and "adrfSetId" are mutually exclusive. | | | | | |

##### 5.6.6.2.6 Type AnalyticsFeedback

Table 5.6.6.2.6-1: Definition of type AnalyticsFeedback

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description | Applicability |
| events | array(NwdafEvent) | M | 1..N | Each element indicates the Analytics ID that was used to take this action. |  |
| modelIds | array(Uinteger) | M | 1..N | Each element indicate the ML Model identifier that was used to take this action. |  |
| groundDataImpactInd | boolean | O | 0..1 | Indication whether the action will affect on ground truth data.  Set to "true" to indicate that the action will affect on ground truth data. Otherwise, default value is "false" if omitted. |  |
| timeStamp | DateTime | O | 0..1 | Time stamp when the action was taken. |  |

### 5.6.7 Error handling

#### 5.6.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of TS 29.500 [6].

For the Nnwdaf\_MLModelMonitor API, HTTP error responses shall be supported as specified in clause 4.8 of TS 29.501 [7]. Protocol errors and application errors specified in table 5.2.7.2-1 of TS 29.500 [6] shall be supported for an HTTP method if the corresponding HTTP status codes are specified as mandatory for that HTTP method in table 5.2.7.1-1 of TS 29.500 [6]. In addition, the requirements in the following clauses shall apply.

#### 5.6.7.2 Protocol Errors

In this Release of the specification, there are no additional protocol errors applicable for the Nnwdaf\_MLModelMonitor API.

#### 5.6.7.3 Application Errors

The application errors defined for the Nnwdaf\_MLModelMonitor API are listed in table 5.6.7.3-1.

Table 5.6.7.3-1: Application errors

|  |  |  |
| --- | --- | --- |
| Application Error | HTTP status code | Description |
|  |  |  |

### 5.6.8 Feature negotiation

The optional features in table 5.6.8-1 are defined for the Nnwdaf\_MLModelMonitor API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [6].

Table 5.6.8-1: Supported Features

|  |  |  |
| --- | --- | --- |
| Feature number | Feature Name | Description |
|  |  |  |

### 5.6.9 Security

As indicated in TS 33.501 [13] and TS 29.500 [6], the access to the Nnwdaf\_MLModelMonitor API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [14]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see TS 29.510 [12]) plays the role of the authorization server.

If OAuth2 is used, an NF service consumer, prior to consuming services offered by the Nnwdaf\_MLModelMonitor API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in TS 29.510 [12], clause 5.4.2.2.

NOTE: When multiple NRFs are deployed in a network, the NRF used as authorization server is the same NRF that the NF service consumer used for discovering the Nnwdaf\_MLModelMonitor service.

The Nnwdaf\_MLModelMonitor API defines a single scope "nnwdaf-mlmodelmonitor" for the entire service, and it does not define any additional scopes at resource or operation level.

\*\*\* End of Changes \*\*\*