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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

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shall not indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

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should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

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can indicates that something is possible

cannot indicates that something is impossible

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will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document specifies the stage 3 protocol and data model for the Naf Service Based Interface. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the AF.

The 5G System stage 2 architecture and procedures are specified in 3GPP TS 23.288 [14], 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3].

The Technical Realization of the Service Based Architecture and the Principles and Guidelines for Services Definition are specified in 3GPP TS 29.500 [4] and 3GPP TS 29.501 [5].

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 TS 23.501: "System Architecture for the 5G System; Stage 2".

[3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[5] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".

[6] OpenAPI: "OpenAPI Specification Version 3.0.0", https://spec.openapis.org/oas/v3.0.0.

[7] 3GPP TR 21.900: "Technical Specification Group working methods".

[8] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[9] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".

[10] 3GPP TS 29.510: "5G System; Network Function Repository Services; Stage 3".

[11] IETF RFC 9113: "HTTP/2".

[12] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".

[13] IETF RFC 9457: "Problem Details for HTTP APIs".

[14] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[15] 3GPP TS 29.552: "5G System; Network Data Analytics signalling flows; Stage 3".

[16] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[17] 3GPP TS 29.523: "5G System; Policy Control Event Exposure Service; Stage 3".

[18] 3GPP TS 29.520: "5G System; Network Data Analytics Services; Stage 3".

[19] IETF RFC 9112: "HTTP/1.1".

[20] IETF RFC 9110: "HTTP Semantics".

[21] IETF RFC 9111: "HTTP Caching".

[22] 3GPP TS 29.122: "T8 reference point for Northbound APIs".

[23] 3GPP TS 29.554: "5G System; Background Data Transfer Policy Control Service; Stage 3".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

For the purpose of the present document, the terms and definitions given in clause 3 of 3GPP TS 23.288 [14] also apply, including the ones referencing other specifications.

3.2 Symbols

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

AF	Application Function
AI/ML	Artificial Intelligence/Machine Learning
GPSI	Generic Public Subscription Identifier
NEF	Network Exposure Function
NWDAF	Network Data Analytics Function
REST	Representational State Transfer
VFL	Vertical Federated Learning

4 Overview

The Application Function Artificial Intelligence/Machine Learning (AI/ML) Services, as defined in 3GPP TS 23.288 [14], are provided by the Application Function (AF).

The following AI/ML services are specified for the AF:

Table 4.1-1: AI/ML Services provided by AF

Service Name	Description	Service Operations	Operation Semantics	Example Consumer(s)
Naf_VFLTraining	This service is provided by an AF acting as VFL client and enables an NF service consumer to request the AF to participate in VFL model training as VFL client and train a local model.	Subscribe(NOTE 1) Unsubscribe Notify	Subscribe / Notify	NWDAF, NEF

Naf_VFLInference	This service is provided by AF acting as VFL client and enables an NF service consumer to subscribe/unsubscribe for a VFL inference.	Subscribe(NOTE 2) Unsubscribe Notify	Subscribe / Notify	NWDAF, NEF
Naf_Inference	This service is provided by AF acting as VFL server and enables an NF service consumer to subscribe/unsubscribe for a VFL inference.	Subscribe(NOTE 3) Unsubscribe Notify	Subscribe / Notify	NWDAF, NEF
Naf_Training	This service is provided by AF acting as VFL server and enables an NF service consumer to subscribe/unsubscribe for a VFL training.	Subscribe Unsubscribe Notify	Subscribe / Notify	NWDAF, NEF
NOTE 1: This service implements also the Naf_VFLTraining_Request as specified in 3GPP TS 23.288 [14] by using immediate and one-time reporting requirement. NOTE 2: This service implements also the Naf_VFLInference_Request as specified in 3GPP TS 23.288 [14] by using immediate and one-time reporting requirement. NOTE 3: This service implements also the Naf_Inference_Request as specified in 3GPP TS 23.288 [14] by using immediate and one-time reporting requirement.				

5 Services offered by the AF

5.1 Introduction

The AF offers to other NFs the following services:

- Naf_VFLTraining;
- Naf_VFLInference;
- Naf_Training;
- Naf_Inference.

Table 5.1-1 summarizes the corresponding APIs defined for this specification.

Table 5.1-1: API Descriptions

Service Name	Clause	Description	OpenAPI Specification File	apiName	Annex
Naf_VFLTraining	5.2	AF VFL Training service	TS29530_Naf_VFLTraining.yaml	naf-vfl-train	A.2
Naf_VFLInference	5.3	AF VFL Inference service	TS29530_Naf_VFLInference.yaml	naf-vflinference	A.3
Naf_Training	5.4	AF training service	TS29530_Naf_Training.yaml	naf-train	A.4
Naf_Inference	5.5	AF Inference service	TS29530_Naf_Inference.yaml	naf-inference	A.5

5.2 Naf_VFLTraining Service

5.2.1 Service Description

5.2.1.1 Overview

The Naf_VFLTraining service exposed by the AF acting as VFL client enables an NF service consumer to:

- request the creation/update of a VFL Training Subscription; and

- receive VFL Training related event(s) reporting.

5.2.1.2 Service Architecture

The 5G System Architecture is defined in 3GPP TS 23.501 [2]. The Network Data Analytics Exposure architecture is defined in 3GPP TS 23.288 [14]. The VFL signalling flows are defined in 3GPP TS 29.552 [15].

The Naf_VFLTraining service is part of the Naf service-based interface exhibited by the trusted Application Function (AF) or untrusted Application Function (AF).

Known consumers of the Naf_VFLTraining service are:

- Network Data Analytics Function (NWDAF) when the AF is trusted.
- Network Exposure Function (NEF) when the AF is untrusted.

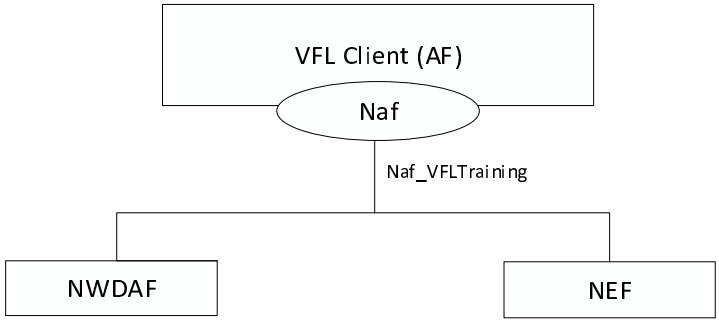

Figure 5.2.1.2-1: Reference Architecture for the Naf_VFLTraining service; SBI representation

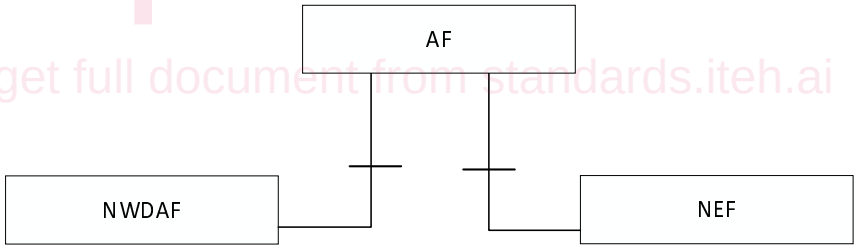

Figure 5.2.1.2-2: Reference Architecture for the Naf_VFLTraining service: reference point representation

5.2.1.3 Network Functions

5.2.1.3.1 Application Function (AF)

The Application Function (AF) acting as VFL client provides VFL training for different analytics events to NF service consumers.

The Application Function (AF) acting as VFL client allows NF service consumers to subscribe to and unsubscribe from VFL training event notifications.

5.2.1.3.2 NF Service Consumers

The Network Data Analytics Function (NWDAF) and Network Exposure Function (NEF) support (un)subscription to the notification of different VFL training events.

5.2.2 Service Operations

5.2.2.1 Introduction

The service operations defined for the Naf_VFLTraining service are shown in table 5.2.2.1-1.

Table 5.2.2.1-1: Naf_VFLTraining Service Operations

Service Operation Name	Description	Initiated by
Naf_VFLTraining_Subscribe	This service operation enables the NF service consumer to request the creation/update of a VFL Training Subscription.	e.g., NWDAF, NEF
Naf_VFLTraining_Unsubscribe	This service operation enables the NF service consumer to request the deletion of a VFL Training Subscription.	e.g., NWDAF, NEF
Naf_VFLTraining_Notify	This service operation enables the NF service consumer to receive VFL Training related event(s) reporting.	AF

5.2.2.2 Naf_VFLTraining_Subscribe

5.2.2.2.1 General

This service operation is used by an NF service consumer to request the creation/update of a VFL Training Subscription at the AF.

The following procedures are supported by the "Naf_VFLTraining_Subscribe" service operation:

- VFL Training Subscription Creation.
- VFL Training Subscription Update.

5.2.2.2.2 VFL Training Subscription Creation

Figure 5.2.2.2.2-1 depicts a scenario where an NF service consumer sends a request to the AF to request the creation of a VFL Training Subscription (see also clause 6.2H of 3GPP°TS°23.288°[14]).

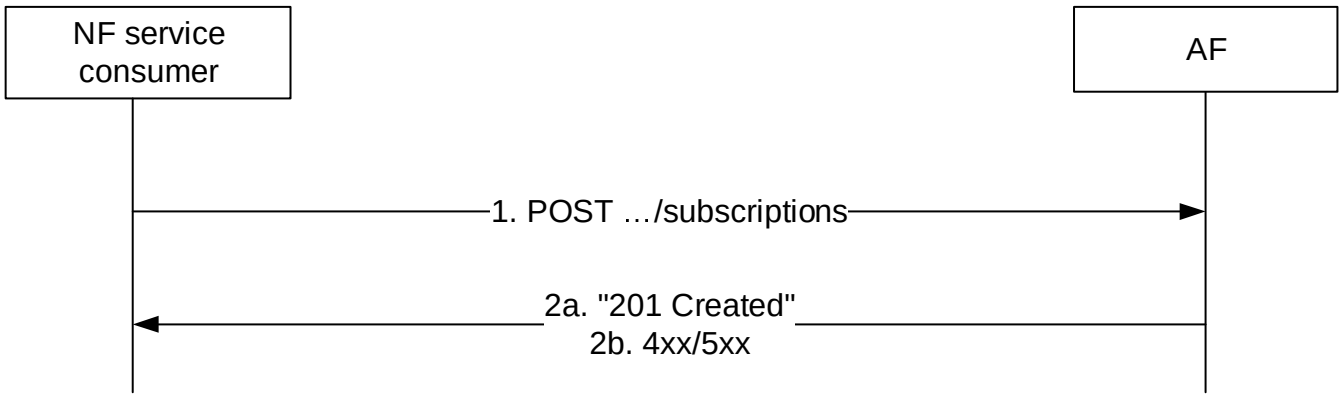

Figure 5.2.2.2.2-1: Procedure for VFL Training Subscription Creation

1. In order to subscribe to VFL Training, the NF service consumer shall send an HTTP POST request to the AF targeting the URI of the "VFL Training Subscriptions" collection resource, with the request body including the VflTrainingSubs data structure.

2a. Upon success, the AF shall respond with an HTTP "201 Created" status code with the response body containing a representation of the created "Individual VFL Training Subscription" resource within the VflTrainingSubs data structure, and an HTTP "Location" header field containing the URI of the created resource.