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Contents

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1 Scope

The present document specifies the stage 3 protocol and data model for Vs interface between the V2X application specific server and VAE server and VAE-E interface between VAE servers. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the VAE server. The Vs, VAE-E interfaces and the related stage 2 functional requirements are defined in 3GPP TS 23.286 [4].

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 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

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

[4]   3GPP TS 23.286: "Application layer support for Vehicle-to-Everything (V2X) services; Functional architecture and information flows".

[5]   IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2)".

[6]   OpenAPI: "OpenAPI 3.0.0 Specification", https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md.

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

[8]   3GPP TR 21.900: "Technical Specification Group working methods".

[11]   3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[12]   IETF RFC 7230: "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing".

[13]   IETF RFC 7231: "Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content".

[14]   IETF RFC 7232: "Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests".

[15]   IETF RFC 7233: "Hypertext Transfer Protocol (HTTP/1.1): Range Requests".

[16]   IETF RFC 7234: "Hypertext Transfer Protocol (HTTP/1.1): Caching".

[17]   IETF RFC 7235: "Hypertext Transfer Protocol (HTTP/1.1): Authentication".

[18]   IETF RFC 5246, "The Transport Layer Security (TLS) Protocol Version 1.2".

[19]   3GPP TS 29.116: "Representational state transfer over xMB reference point between Content Provider and BM-SC".

[20]   3GPP TS 29.572: "5G System; Location Management Services; Stage 3".

[21]   IETF RFC 6455: "The Websocket Protocol".

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

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

[24]   IETF RFC 5246, "The Transport Layer Security (TLS) Protocol Version 1.2".

3   Definitions of terms, symbols and abbreviations

3.1   Terms

For the purposes of the present document, the terms 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].

Void

3.2   Symbols

For the purposes of the present document, the following symbols apply:

Void

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].

V2X   Vehicle-to-Everything
VAE   V2X Application Enabler

4   Overview

The Vs interface is between the V2X application specific server and the VAE Server. It specifies RESTful APIs that allow the V2X application specific server to access the services and capabilities provided by VAE Server.

The stage 2 level requirements and signalling flows for the Vs interface are defined in 3GPP TS 23.286 [4].

The Vs interface supports the following APIs:

-   VAE_MessageDelivery

-   VAE_FileDistribution

-   VAE_ApplicationRequirement

-   VAE_DynamicGroup

The VAE-E interface is between VAE Servers. It specifies RESTful APIs that allow the VAE server to access the services and capabilities provided by other VAE Server.

The stage 2 level requirements and signalling flows for the VAE-E interface are defined in 3GPP TS 23.286 [4].

The VAE-E interface supports the following APIs:

-   VAE_ServiceContinuity

5 Services offered by the V2X Application Enabler

5.1 Introduction

The table 5.1-1 shows the services provided by the VAE server and corresponding Service Operations:

Table 5.1-1 List of services provided by the VAE Server

Service Name	Service Operations	Operation Semantics	Example Consumer(s)
VAE_MessageDelivery	Deliver_DL_Message	Request/Response	V2X application specific server
	Deliver_UL_Message	Subscribe/Notify	V2X application specific server
	V2X_MessageDelivery_Subscribe		V2X application specific server
	V2X_MessageDelivery_Unsubscribe		V2X application specific server
VAE_FileDistribution	Distribute_File	Request/ Response	V2X application specific server
VAE_ApplicationRequirement	Reserve_NetworkResource Notify_NetworkResource	Subscribe/Notify	V2X application specific server
VAE_DynamicGroup	Configure_DynamicGroup	Subscribe/Notify	V2X application specific server
VAE_ServiceContinuity	Query_ServiceContinuity	Request/Response	VAE server

Table 5.1-2 summarizes the corresponding APIs defined in this specification.

Table 5.1-2: API Descriptions

Service Name	Clause	Description	OpenAPI Specification File	apiName	Annex
VAE_MessageDelivery	6.1	VAE Message Delivery Service	TS29486_VAE_MessageDelivery.yaml	vae-message-delivery	A.2
VAE_FileDistribution	6.2	VAE File Distribution Service	TS29486_VAE_FileDistribution.yaml	vae-file-distribution	A.3
VAE_ApplicationRequirement	6.3	VAE Application Requirement Provision Service	TS29486_VAE_ApplicationRequirement.yaml	vae-app-req	A.4
VAE_DynamicGroup	6.4	VAE Configure Dynamic Group Information Service	TS29486_VAE_DynamicGroup.yaml	vae-dynamic-group	A.5
VAE_ServiceContinuity	6.5	VAE Service Continuity Service	TS29486_VAE_ServiceContinuity.yaml	vae-service-continuity	A.6

5.2 VAE_MessageDelivery Service

5.2.1 Service Description

This service enables a NF service consumer to communicate with the VAE server to exchange V2X messages with the V2X UEs.

5.2.2 Service Operations

5.2.2.1 Introduction

The VAE_MessageDelivery service supports following service operations:

- V2X_MessageDelivery_Subscribe;

- V2X_MessageDelivery_Unsubscribe;

- Deliver_DL_Message; and

- Deliver_UL_Message.

5.2.2.2 V2X_MessageDelivery_Subscribe

5.2.2.2.1 General

The V2X_MessageDelivery_Subscribe service operation is used to create a subscription for V2X messages delivery between the V2X application specific server and VAE server.

5.2.2.2.2 Message Delivery Subscribe
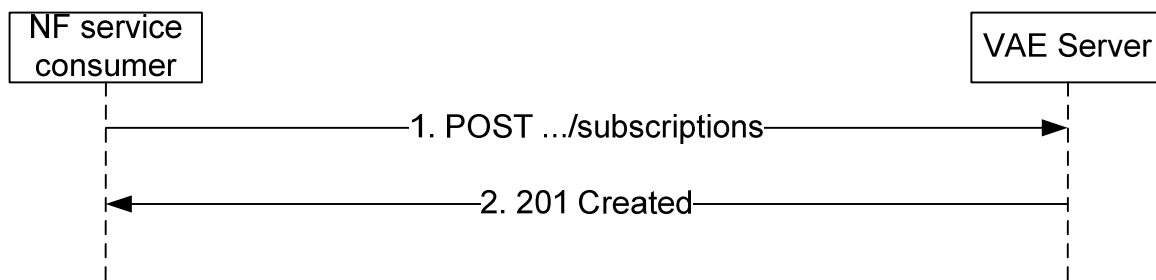
Figure 5.2.2.2.2-1: Message delivery subscribe

When the NF service consumer (e.g. V2X application specific server) needs to receive the message from the V2X UE and/or send the message to the V2X UE, the NF service consumer shall send the POST method as step 1of the figure 5.2.2.2.2-1 to request to create an "Individual Message Delivery Subscription".

The NF service consumer shall include MessageDeliverySubscriptionData data structure in the payload body of the HTTP POST to request a creation of representation of the "Individual Message Delivery Subscription" resource. The "Individual Message Delivery Subscription" resource is created as described below.

The NF service consumer within MessageDeliverySubscriptionData data structure shall include:

- The identity of the V2X application specific server within the "appSerId" attribute;

- The V2X service ID within the "serviceId" attribute;

- The notification URI within the "notifUri" attribute; and

- The supported features with the "suppFeat" attribute;

and may include

- The geographical area identifier within the "geoId" attribute.

When the VAE Server receives the HTTP POST request from the NF service consumer, the VAE server shall make an authorization based on the information received from the NF service consumer. If the authorization is successful, the VAE Server shall create a new resource, which represents "Individual Message Delivery Subscription", addressed by a URI as defined in clause 6.1.3.3.2 and contains a VAE Server created resource identifier. The VAE Server shall respond

to the NF service consumer with a 201 Created message, including Location header field containing the URI for the created resource.

If errors occur when processing the HTTP POST request, the VAE server shall apply error handling procedures as specified in subclause 6.1.7.

The NF service consumer shall use the URI received in the Location header in subsequent requests to the VAE Server to refer to the "Individual Message Delivery Subscription".

5.2.2.3 V2X_MessageDelivery_Unsubscribe

5.2.2.3.1 General

The V2X_MessageDelivery_Unsubscribe service operation is used to remove the V2X messages delivery subscription.

5.2.2.3.2 Message Delivery Unsubscribe
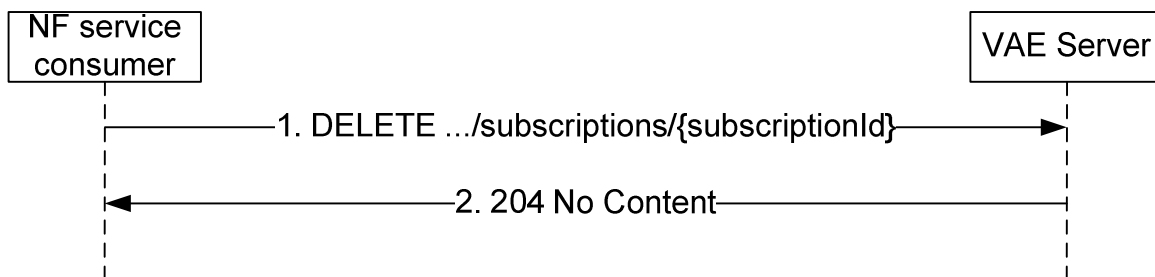
Figure 5.2.2.3.2-1: message delivery unsubscribe

When the NF service consumer (e.g. V2X application specific server) needs to remove an existing subscription for receiving the message from the V2X UE or sending the message to the V2X UE, the NF service consumer shall send the DELETE method as step 1of the figure 5.2.2.3.2-1 to request to delete an "Individual Message Delivery Subscription".

Upon the reception of the HTTP DELETE request, if the VAE Server successfully processed and accepted the received HTTP DELETE request, the VAE Server shall:

- remove the corresponding subscription; and

- send an HTTP "204 No Content" response.

If errors occur when processing the HTTP POST request, the VAE Server shall send an HTTP error response as specified in subclause 6.1.7.

5.2.2.4 Deliver_DL_Message

5.2.2.4.1 General

The Deliver_DL_Message service operation is used to deliver the V2X messages to the V2X UEs.

5.2.2.4.2　　　Deliver Downlink Message
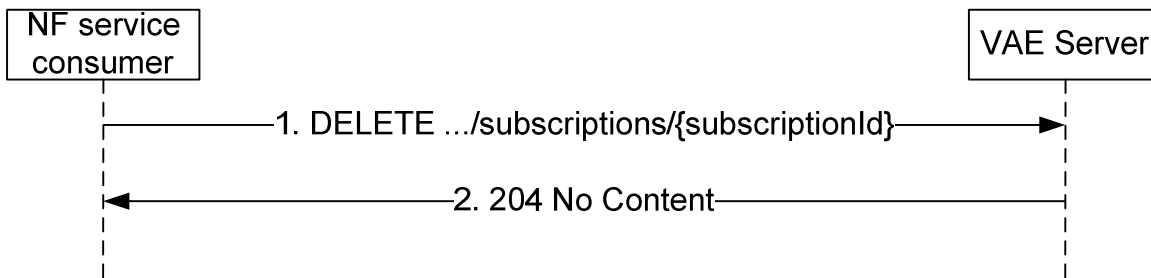
Figure 5.2.2.4.2-1: V2X message delivery

When the NF service consumer (e.g. V2X application specific server) needs to send the message to the V2X UE, the NF service consumer shall send the POST method as step 1of the figure 5.2.2.4.2-1 to request to create an "Individual Downlink Message Delivery".

The NF service consumer shall include DownlinkMessageDeliveryData data structure in the payload body of the HTTP POST to request a creation of representation of the "Individual Downlink Message Delivery" resource. The "Individual Downlink Message Delivery" resource is created as described below.

The NF service consumer within the DownlinkMessageDeliveryData data structure shall include:

- Either the V2X UE ID within the "ueId" attribute or the V2X Group ID within the "groupId" attribute;

- V2X message payload carried by the V2X message within the "payload" attribute;

and may include:

- The duration within the "duration" attribute; and

- The geographical area identifier within the "geoId" attribute.

When the VAE Server receives the HTTP POST request from the NF service consumer, the VAE server shall make an authorization based on the information received from the NF service consumer. If the authorization is successful, the VAE Server shall create a new resource, which represents "Individual Downlink Message Delivery", addressed by a URI as defined in clause 6.1.3.5.2 and contains a VAE Server created resource identifier. The VAE Server shall respond to the NF service consumer with a 201 Created message, including Location header field containing the URI for the created resource.

The NF service consumer shall use the URI received in the Location header in subsequent requests to the VAE Server to refer to the "Individual Downlink Message Delivery".

Upon receipt of the HTTP DELETE message from the NF service consumer, the VAE Server shall check if the Individual Message Delivery resource identified by the URI already exists. If the resource exists, the VAE Server shall delete the resource and respond to the NF service consumer with a 204 No Content success message.

When the message delivery duration expires, the VAE server may remove the associated Individual Message Delivery resource locally.

If errors occur when processing the HTTP POST or DELETE request, the VAE Server shall apply error handling procedures as specified in subclause 6.1.7.

5.2.2.5　　　Deliver_UL_Message

5.2.2.5.1　　　General

The Deliver_UL_Message service operation is used to deliver the uplink message to the NF service consumer (e.g. V2X application specific server).

5.2.2.5.2 Deliver Uplink Message
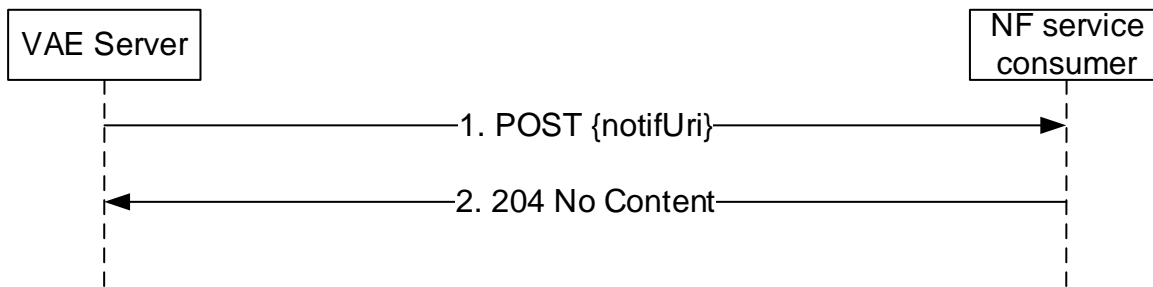
Figure 5.2.2.5.2-1: Deliver Uplink Message

If the VAE Server receives the uplink message for a V2X UE which an NF service consumer has subscribed to or a V2X UE belongs to a V2X group which the NF service consumer has subscribed to, the VAE Server shall send an HTTP POST request with "{notifUri}" as previously provided by the NF service consumer within the corresponding subscription as URI and UplinkMessageDeliveryData data structure as request body that shall include:

- resource URI of the individual Message Delivery Subscription related to the notification within the "resourceUri" attribute;

- The V2X UE ID within the "ueId" attribute;

- V2X message payload carried by the V2X message within the "payload" attribute; and

- The geographical area identifier within the "geoId" attribute if available.

Upon the reception of the HTTP POST message, if the NF service consumer successfully processed and accepted the received HTTP POST request, the NF service consumer shall send an "204 No Content" HTTP response for a succesfull processing.

If errors occur when processing the HTTP POST request, the NF service consumer shall send an HTTP error response as specified in subclause 6.1.7.

5.3 VAE_FileDistribution Service

5.3.1 Service Description

This API enables the V2X application specific server to communicate with the VAE server to initiate file distribution to the V2X UEs.

5.3.2 Service Operations

5.3.2.1 Introduction

The VAE_FileDistribution service supports following service operations:

- Distribute_File

5.3.2.2 Distribute_File

5.3.2.2.1 General

The Distribute_File service operation is used to distribute files to the V2X UEs.

5.3.2.2.2   Distribute File
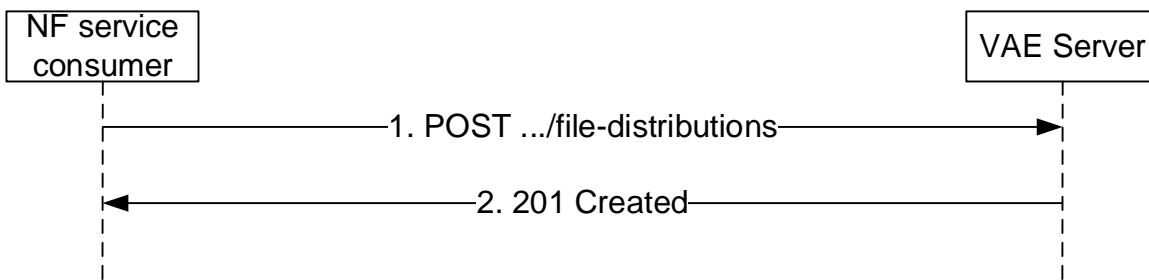
Figure 5.3.2.2.2-1: Distribute File

When the NF service consumer (e.g. V2X application specific server) needs to distribute the file to the V2X UEs, the NF service consumer shall send the POST method as step 1 of the figure 5.3.2.2.2-1 to request to create an "Individual File Distribution".

The NF service consumer shall include FileDistributionData data structure in the payload body of the HTTP POST to request a creation of representation of the "Individual File Distribution" resource. The "Individual File Distribution" resource is created as described below.

The NF service consumer within the FileDistributionData data structure shall include:

- The file lists within the "fileLists" attribute;

- The geographical area within the "geoArea" attribute;

- maximum bitrate for the V2X application within the "maxBitrate" attribute; and

- maximum delay for the V2X application within the "maxDelay" attribute;

and may include:

- The V2X Group ID within the "groupId" attribute;

- The serving class within the "serviceClass" attribute; and

- The duration within the "duration" attribute.

When the VAE Server receives the HTTP POST request from the NF service consumer, the VAE server shall make an authorization based on the information received from the NF service consumer. If the authorization is successful, the VAE Server shall create a new resource, which represents "Individual File Distribution", addressed by a URI as defined in clause 6.2.3.3.2 and contains a VAE Server created resource identifier. The VAE Server shall respond to the NF service consumer with a 201 Created message, including Location header field containing the URI for the created resource.

The VAE Server shall use the URI received in the Location header in subsequent requests to the VAE Server to refer to the "Individual File Distribution".

Upon receipt of the HTTP DELETE message from the NF service consumer, the VAE Server shall check if the Individual File Distribution resource identified by the URI already exists. If the resource exists, the VAE Server shall delete the resource and respond to the NF service consumer with a 204 No Content success message.

If errors occur when processing the HTTP POST or DELETE request, the VAE Server shall apply error handling procedures as specified in subclause 6.2.7.

When the message delivery duration expires, the VAE server may remove the associated Individual Message Delivery resource locally.

The VAE server makes use of the xMB procedures as defined 3GPP TS 29.116 [19] to create MBMS sessions whose type is set to "files" and to request the delivery of files over these sessions. Before provisioning files to the BM-SC, the VAE server prepares the file for distribution, which may include partition of large files into smaller files or encryption.

The VAE server is responsible for translating the parameters related to the V2X application triggering the file delivery into corresponding xMB parameters. Table 5.3.2.2.2-1 describes the mapping between the VAE_FileDistribution API attribute and the xMB API properties specified in 3GPP TS 29.116 [19].

Table 5.3.2.2.2-1: Mapping between VAE_FileDistribution API and xMB API

V2X parameter	Corresponding xMB API property
serviceClass	service-class
fileLists	file-list
geoArea	geographical-area
maxBitrate	max-bitrate
maxDelay	max-delay

NOTE: The list of V2X parameters needed for file delivery is not exhaustive and can be updated based on the specific V2X application requirements.

5.4 VAE_ApplicationRequirement Service

5.4.1 Service Description

This API enables the V2X application specific server to communicate with the VAE server to provide V2X application requirement to the underlying 3GPP network.

5.4.2 Service Operations

5.4.2.1 Introduction

The VAE_ApplicationRequirement service supports following service operations:

- Reserve_NetworkResource

- Notify_NetworkResource

5.4.2.2 Reserve_NetworkResource

5.4.2.2.1 General

The Reserve_NetworkResource service operation is used to provide V2X application requirement to underlying 3GPP network.

5.4.2.2.2 Reserve Network Resource
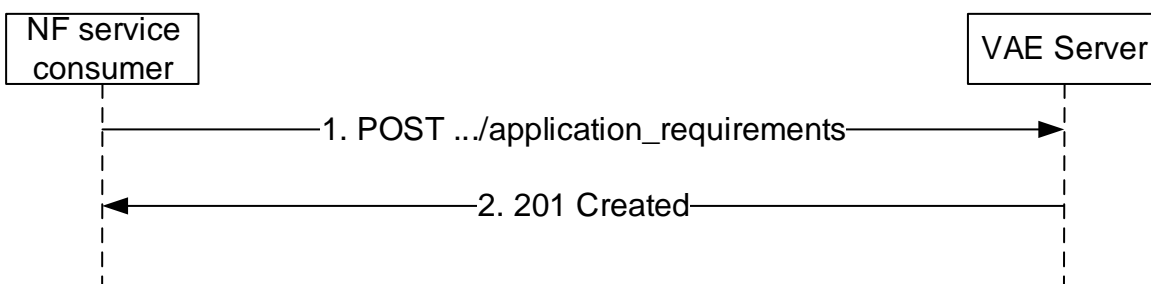
Figure 5.4.2.2.2-1: Reserve Network Resource

When the NF service consumer (e.g. V2X application specific server) needs to provide V2X application requirement to the underlying 3GPP network, the NF service consumer shall send the POST method as step 1 of the figure 5.4.2.2.2-1 to request to create an "Individual Application Requirement".

The NF service consumer shall include ApplicationRequirementData data structure in the payload body of the HTTP POST to request a creation of representation of the "Individual Application Requirement" resource. The "Individual Application Requirement" resource is created as described below.

The NF service consumer within the ApplicationRequirementData data structure shall include:

- Either the V2X Group ID within the "groupId" attribute or the V2X UE ID within the "ueId" attribute;

- notification URI within the "notifUri" attribute;

- The service Id within the "serviceId" attribute; and

- V2X application requirement within the "appRequirement" attribute;

and may include:

- The duration within the "duration" attribute.

When the VAE Server receives the HTTP POST request from the NF service consumer, the VAE server shall make an authorization based on the information received from the NF service consumer. If the authorization is successful, the VAE Server shall create a new resource, which represents "Individual Application Requirement", addressed by a URI as defined in clause 6.3.3.3.2 and contains a VAE Server created resource identifier. The VAE Server shall respond to the NF service consumer with a 201 Created message, including Location header field containing the URI for the created resource.

The NF service consumer shall use the URI received in the Location header in subsequent requests to the VAE Server to refer to the "Individual Application Requirement".

Upon receipt of the HTTP DELETE message from the NF service consumer, the VAE Server shall check if the Individual Application Requirement resource identified by the URI already exists. If the resource exists, the VAE Server shall delete the resource and respond to the NF service consumer with a 204 No Content success message.

If errors occur when processing the HTTP POST or DELETE request, the VAE Server shall apply error handling procedures as specified in subclause 6.3.7.

When the message delivery duration expires, the VAE server may remove the associated Individual Application Requirement resource locally.

5.4.2.3 Notify_NetworkResource

5.4.2.3.1 General

The Notify_NetworkResource service operation is used to notify the result of network resource adaptation corresponding to the V2X application requirement.

5.4.2.3.2 Notify Network Resource
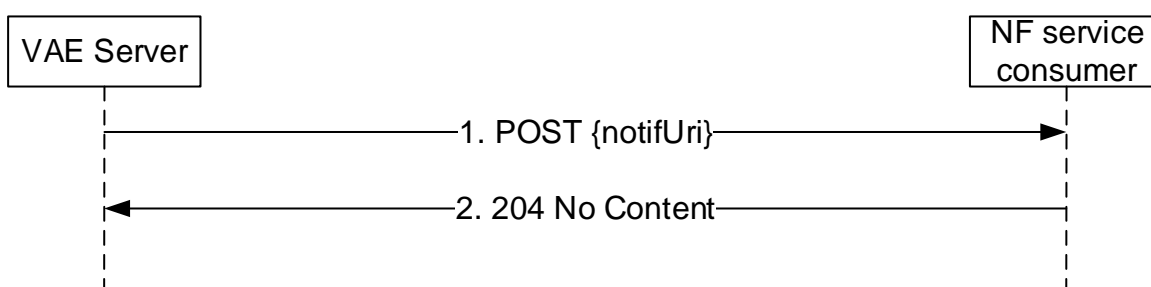
Figure 5.4.2.3.2-1: Notify Network Resource

If the VAE Server receives the result of network resource adaptation corresponding to the V2X application requirement, the VAE Server shall send an HTTP POST request with "{notifUri}" as previously provided by the NF service

consumer within the corresponding subscription as URI and AppReqNotification data structure as request body that shall include:

- resource URI of the individual Application Requirement related to the notification within the "resourceUri" attribute;

- the result of the network resource adaptation corresponding to the V2X application requirement within the "result" attribute.

Upon the reception of the HTTP POST message, if the NF service consumer successfully processed and accepted the received HTTP POST request, the NF service consumer shall send an "204 No Content" HTTP response for a succesfull processing.

If errors occur when processing the HTTP POST request, the VAE Server shall send an HTTP error response as specified in subclause 6.3.7.

5.5 VAE_DynamicGroup Service

5.5.1 Service Description

This API enables the V2X application specific server to communicate with the VAE server to configure dynamic group information.

5.5.2 Service Operations

5.5.2.1 Introduction

The VAE_DynamicGroup service supports following service operations:

- Configure_DynamicGroup

- Notify_DynamicGroup

5.5.2.2 Configure_DynamicGroup

5.5.2.2.1 General

The Configure_DynamicGroup service operation is used to configures the dynamic group information at the VAE server.

5.5.2.2.2 Configure Dynamic Group
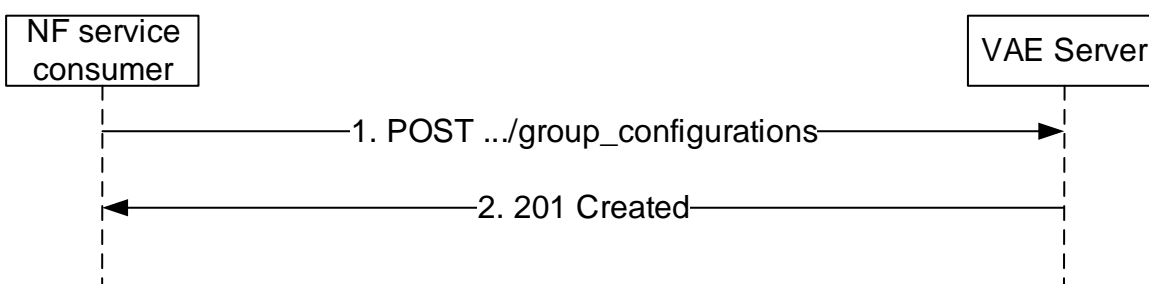
Figure 5.5.2.2.2-1: Configure Dynamic Group

When the NF service consumer (e.g. V2X application specific server) needs to configures the dynamic group information at the VAE server, the NF service consumer shall send the POST method as step 1 of the figure 5.5.2.2.2-1 to request to create an "Individual Group Configuration".

The NF service consumer shall include GroupConfigurationData data structure in the payload body of the HTTP POST to request a creation of representation of the "Individual Group Configuration" resource. The "Individual Group Configuration" resource is created as described below.

The NF service consumer within GroupConfigurationData data structure shall include:

- The dynamic Group ID within the "groupId" attribute;

- The group definition within the "definition" attribute;

- The group leader Id within the "leaderId" attribute; and

- The notification URI within the "notifUri" attribute.

and may include:

- The duration within the "duration" attribute.

When the VAE Server receives the HTTP POST request from the NF service consumer, the VAE server shall make an authorization based on the information received from the NF service consumer. If the authorization is successful, the VAE Server shall create a new resource, which represents "Individual Group Configuration", addressed by a URI as defined in clause 6.4.3.2.2 and contains a VAE Server created resource identifier. The VAE Server shall respond to the NF service consumer with a 201 Created message, including Location header field containing the URI for the created resource.

The NF service consumer shall use the URI received in the Location header in subsequent requests to the VAE Server to refer to the "Individual Group Configuration".

Upon receipt of the HTTP DELETE message from the NF service consumer, the VAE Server shall check if the Individual Message Delivery resource identified by the URI already exists. If the resource exists, the VAE Server shall delete the resource and respond to the NF service consumer with a 204 No Content success message.

If errors occur when processing the HTTP POST or DELETE request, the VAE Server shall apply error handling procedures as specified in subclause 6.4.7.

When the message delivery duration expires, the VAE server may remove the associated Individual Message Delivery resource locally.

5.5.2.3 Notify_DynamicGroup

5.5.2.3.1 General

The Notify_DynamicGroup service operation is used to notify the dynamic group information (i.e. group member joins or leaves) at the VAE server.

5.5.2.3.2 Notify Dynamic Group
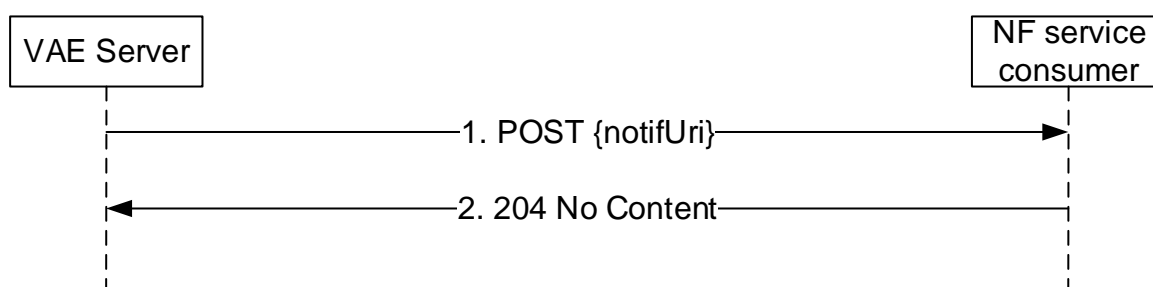
Figure 5.5.2.3.2-1: Notify Dynamic Group

If the VAE Server receives the dynamic group information (i.e. group member joins or leaves), the VAE Server shall send an HTTP POST request with "{notifUri}" as previously provided by the NF service consumer within the corresponding subscription as URI and DynamicGroupNotification data structure as request body that shall include:

- resource URI of the individual Application Requirement related to the notification within the "resourceUri" attribute;

- one or more joined group member within the "joinedUeIds" attribute if available; and

- one or more left group member within the "leftUeIds" attribute if available.

Upon the reception of the HTTP POST message, the NF service consumer shall send an "204 No Content" HTTP response for a succesfull processing.

If errors occur when processing the HTTP POST request, the NF service consumer shall send an HTTP error response as specified in subclause 6.4.7.

5.6 VAE_ServiceContinuity Service

5.6.1 Service Description

This service provided by the VAE server enables exposing information to facilitate the V2X service continuity.

5.6.2 Service Operations

5.6.2.1 Introduction

The VAE_ServiceContinuity service supports following service operations:

- Query_ServiceContinuity

5.6.2.2 Query_ServiceContinuity

5.6.2.2.1 General

The Query_ServiceContinuity service operation is used to query the VAE server whether it can support the desired V2X service in the designated geographical area.

5.6.2.2.2 Query service continuity
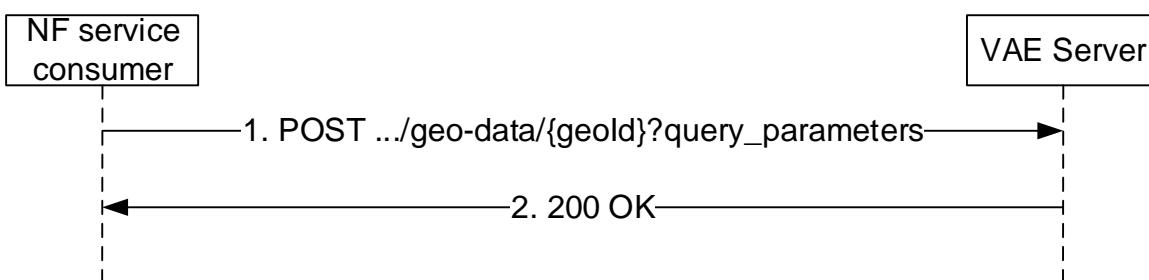
Figure 5.6.2.2.2-1: Query service continuity

When the NF service consumer (e.g. V2X server) needs to query service continuity information, the NF service consumer shall send an HTTP GET request as step 1 of the figure 5.6.2.2.2-1 to the "Individual Geographical Area" resource with query parameter V2X service id in "service-id". When the VAE Server receives the HTTP GET request from the NF service consumer, the VAE Server shall perform the query.

On success, "200 OK" shall be returned as step 2 of the figure 5.6.2.2.2-1 to indicate that the VAE server can support the desired V2X service for the target "Individual Geographical Area" resource. The response body shall contain the "Individual Geographical Area" resource including the requested V2X service id.

If errors occur when processing the HTTP POST request, the VAE Server shall apply error handling procedures as specified in subclause 6.5.7.

6 API Definitions

6.1 VAE_MessageDelivery Service API

6.1.1 Introduction

The VAE_MessageDelivery shall use the VAE_MessageDelivery API.

The API URI of the VAE_MessageDelivery shall be:

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

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

All resource URIs of this API shall have the following root:

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

with the following components:

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

-   The <apiName> shall be "vae-message-delivery".

-   The <apiVersion> shall be "v1".

-   The <apiSpecificResourceUriPart> shall be set as described in clause 6.1.3.

6.1.2 Usage of HTTP

6.1.2.1 General

Support of HTTP/1.1 (IETF RFC 7230 [12], IETF RFC 7231 [13], IETF RFC 7232 [14], IETF RFC 7233 [15], IETF RFC 7234 [16] and IETF RFC 7235 [17]) over TLS (IETF RFC 5246 [18]) is mandatory and support of HTTP/2 as specified in clause 5 of 3GPP TS 29.500 [2] is recommended. A V2X application specific server desiring to use HTTP/2 shall use the HTTP upgrade mechanism to negotiate applicable HTTP version as described in IETF RFC 7540 [5].

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

An OpenAPI [6] specification of HTTP messages and content bodies for the VAE_MessageDelivery is contained in Annex A.2.

6.1.2.2 HTTP standard headers

6.1.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [2] for the usage of HTTP standard headers.

6.1.2.2.2   Content type

JSON, IETF RFC 8259 [7], 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 [2]. The use of the JSON format shall be signalled by the content type "application/json".

6.1.2.3   HTTP custom headers

6.1.2.3.1   General

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [2] shall be applicable.

6.1.3   Resources

6.1.3.1   Overview
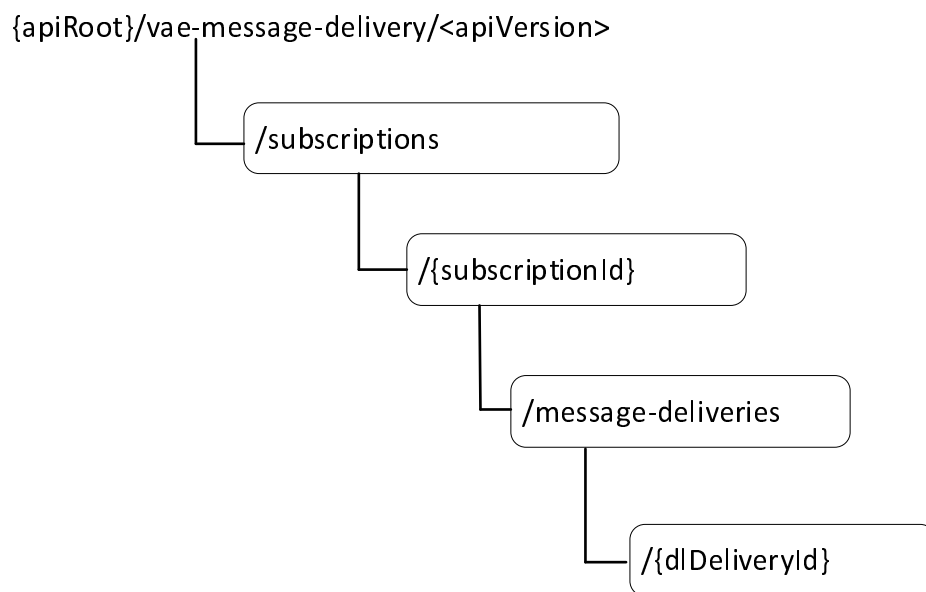
Figure 6.1.3.1-1: Resource URI structure of the VAE_MessageDelivery API

Table 6.1.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.1.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
Message Delivery Subscriptions	/subscriptions	POST	Create a new Individual Message Delivery Subscription resource.
Individual Message Delivery Subscription	/subscriptions/{subscriptionId}	GET	Read an Individual Message Delivery Subscription resource.
		DELETE	Delete an Individual Message Delivery Subscription resource.
Downlink Message Deliveries	/subscriptions/{subscriptionId}/message-deliveries	POST	Create a new Individual Downlink Message Delivery resource for a V2X UE ID or V2X group ID.
Individual Downlink Message Delivery	/subscriptions/{subscriptionId}/message-deliveries/{dlDeliveryId}	GET	Read the Individual Downlink Message Delivery resource.
		DELETE	Delete the Individual Downlink Message Delivery resource.

6.1.3.2   Resource: Message Delivery Subscriptions

6.1.3.2.1   Description

This resource represents the collection of the Individual Message Delivery Subscription resources created in the VAE Server.

6.1.3.2.2   Resource Definition

Resource URI: **{apiRoot}/vae-message-delivery/<apiVersion>/subscriptions**

This resource shall support the resource URI variables defined in table 6.1.3.2.2-1.

Table 6.1.3.2.2-1: Resource URI variables for this resource

Name	Data Type	Definition
apiRoot	string	See clause 6.1.1
apiVersion	string	See clause 6.1.1

6.1.3.2.3   Resource Standard Methods

6.1.3.2.3.1   POST

This method shall support the URI query parameters specified in table 6.1.3.2.3.1-1.

Table 6.1.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.1.3.2.3.1-2 and the response data structures and response codes specified in table 6.1.3.2.3.1-3.

Table 6.1.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
MessageDelivery SubscriptionData	M	1	Parameters to create an Individual Message Delivery Subscription resources.

Table 6.1.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
MessageDelivery SubscriptionData	O	0..1	201 Created	An Individual Message Delivery Subscription resource for the V2X UE ID or V2X group ID is created successfully.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

Table 6.1.3.2.3.1-4: 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}/vae-message-delivery/<apiVersion>/subscriptions/{subscriptionId}

6.1.3.2.4 Resource Custom Operations

None.

6.1.3.3 Resource: Individual Message Delivery Subscription

6.1.3.3.1 Description

The Individual Message Subscription resource represents an Individual Message Delivery Subscription created in the VAE Server and associated with the V2X UE ID or V2X group ID.

6.1.3.3.2 Resource definition

Resource URI: **{apiRoot}/vae-message-delivery/<apiVersion>/subscriptions/{subscriptionId}**

This resource shall support the resource URI variables defined in table 6.1.3.3.2-1.

Table 6.1.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.1.1
apiVersion	string	See clause 6.1.1
subscriptionId	string	Unique identifier of the individual Message Delivery Subscription resource for the V2X UE ID or V2X group ID.

6.1.3.3.3 Resource Standard Methods

6.1.3.3.3.1 GET

This method shall support the URI query parameters specified in table 6.1.3.3.3.1-1.

Table 6.1.3.3.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.1.3.3.3.1-2 and the response data structures and response codes specified in table 6.1.3.3.3.1-3.

Table 6.1.3.3.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.1.3.3.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
MessageDeliverySubscriptionData	M	1	200 OK	An individual Message Delivery Subscription resource for the V2X UE ID or V2X group ID is returned successfully.
NOTE: The mandatory HTTP error status codes for the GET method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

6.1.3.3.3.2 DELETE

This method shall support the URI query parameters specified in table 6.1.3.3.3.2-1.

Table 6.1.3.3.3.2-1: 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 6.1.3.3.3.2-2 and the response data structures and response codes specified in table 6.1.3.3.3.2-3.

Table 6.1.3.3.3.2-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.1.3.3.3.2-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Individual Message Delivery Subscription was successfully deleted.
NOTE: The mandatory HTTP error status codes for the DELETE method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [5] also apply.				

6.1.3.3.4 Resource Custom Operations

None.

6.1.3.4 Resource: Downlink Message Deliveries

6.1.3.4.1 Description

This resource represents the collection of the individual Downlink Message Delivery resources created in the VAE Server.

6.1.3.4.2 Resource Definition

Resource URI: **{apiRoot}/vae-message-delivery/<apiVersion>/subscriptions/{subscriptionId}/message-deliveries**

This resource shall support the resource URI variables defined in table 6.1.3.4.2-1.

Table 6.1.3.4.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.1.1
apiVersion	string	See clause 6.1.1
subscriptionId	string	Unique identifier of the individual Message Delivery Subscription resource for the V2X UE ID or V2X group ID.

6.1.3.4.3 Resource Standard Methods

6.1.3.4.3.1 POST

This method shall support the URI query parameters specified in table 6.1.3.4.3.1-1.

Table 6.1.3.4.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.1.3.4.3.1-2 and the response data structures and response codes specified in table 6.1.3.4.3.1-3.

Table 6.1.3.4.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
DownlinkMessage DeliveryData	M	1	Parameters to create an Individual Downlink Message Delivery resources.

Table 6.1.3.4.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
DownlinkMessag eDeliveryData	O	0..1	201 Created	An Individual Downlink Message Delivery resource for the V2X UE ID **or** V2X group ID is created successfully.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

Table 6.1.3.4.3.1-4: 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}/vae-message-delivery/<apiVersion>/subscriptions/{subscriptionId}/message-deliveries/{dlDeliveryId}

6.1.3.4.4 Resource Custom Operations

None.

6.1.3.5 Resource: Individual Downlink Message Delivery

6.1.3.3.1 Description

The Individual Downlink Message Delivery resource represents an Individual Downlink Message Delivery created in the VAE Server and associated with the V2X UE ID or V2X group ID.

6.1.3.5.2 Resource definition

Resource URI: **{apiRoot}/vae-message-delivery/<apiVersion>/subscriptions/{subscriptionId}/message-deliveries/{dlDeliveryId}**

This resource shall support the resource URI variables defined in table 6.1.3.5.2-1.

Table 6.1.3.5.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.1.1
apiVersion	string	See clause 6.1.1
subscriptionId	string	Unique identifier of the individual Message Delivery Subscription resource for the V2X UE ID or V2X group ID.
dlDeliveryId	string	Unique identifier of the Individual Downlink Message Delivery resource for the V2X UE ID or V2X group ID.

6.1.3.5.3 Resource Standard Methods

6.1.3.5.3.1 GET

This method shall support the URI query parameters specified in table 6.1.3.5.3.1-1.

Table 6.1.3.5.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.1.3.5.3.1-2 and the response data structures and response codes specified in table 5.1.3.5.3.1-3.

Table 6.1.3.5.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.1.3.5.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
DownlinkMessageDeliveryData	M	1	200 OK	An individual Downlink Message Delivery resource for the V2X UE ID **or** V2X group ID is returned successfully.
NOTE: The mandatory HTTP error status codes for the GET method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

6.1.3.5.3.2 DELETE

This method shall support the URI query parameters specified in table 6.1.3.5.3.2-1.

Table 6.1.3.5.3.2-1: 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 6.1.3.5.3.2-2 and the response data structures and response codes specified in table 6.1.3.5.3.2-3.

Table 6.1.3.5.3.2-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.1.3.5.3.2-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Individual Downlink Message Delivery resource was successfully deleted.
NOTE: The mandatory HTTP error status codes for the DELETE method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [5] also apply.				

6.1.3.3.4 Resource Custom Operations

None.

6.1.4 Custom Operations without associated resources

There are no custom operations without associated resources supported on VAE_MessageDelivery.

6.1.5 Notifications

6.1.5.1 General

The VAE server and NF service consumer shall support the delivery of Notifications using a separate HTTP connection towards an address as assigned the NF service consumer described in clause 6.1.5.2.

A VAE server and NF service consumer may support testing a notification connection as described in clause 6.1.5.3. A VAE server and NF service consumer may support the delivery of Notification using Websocket (IETF RFC 6455 [21]) as described in clause 6.1.5.4.

6.1.5.2 Notification Delivery using a separate HTTP connection

The descriptions in clause 5.2.5.2 of 3GPP TS 29.122 [22] apply with following differences:

- description of SCS/AS applies to the NF service consumer;

- description of SCEF applies to the VAE server; and

- "notificationDestination" attribute is replaced by the "notifUri" attribute.

6.1.5.3 Notification Test Event

The descriptions in clause 5.2.5.3 of 3GPP TS 29.122 [22] apply with following differences:

- description of SCS/AS applies to the NF service consumer; and

- description of SCEF applies to the VAE server.

6.1.5.4 Notification Delivery using Websocket

The descriptions in clause 5.2.5.4 of 3GPP TS 29.122 [22] apply with following differences:

- description of SCS/AS applies to the NF service consumer; and

- description of SCEF applies to the VAE server.

6.1.5.5 Methods

Table 6.1.5.5-1: Notifications

Callback URI	HTTP method or custom operation	Description (service operation)
{notifUri}	POST	Uplink Message Delivery.

6.1.5.6 Uplink Message Delivery

6.1.5.6.1 Description

This notification is used by the VAE Server to deliver the uplink message to the update the policy.

6.1.5.6.2 Operation Definition

This operation shall support the request data structures specified in table 6.1.5.6.2-1 and the response data structure and response codes specified in table 6.1.5.6.2-2.

Table 6.1.5.6.2-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
UplinkMessageDeliveryData	M	1	Contains the uplink message delivery data

Table 6.1.5.6.2-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	The uplink message is delivery successfully.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [4] shall also apply.				

6.1.6 Data Model

6.1.6.1 General

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

Table 6.1.6.1-1 specifies the data types defined for the VAE_MessageDelivery API.

Table 6.1.6.1-1: VAE_MessageDelivery specific Data Types

Data type	Section defined	Description	Applicability
AppServerId	6.1.6.3.2	Identity of the V2X application specific server.	
DownlinkMessageDeliveryData	6.1.6.2.2	Contains the downlink V2X message delivery data	
GeoId	6.1.6.3.2	Geographical area identifier	
UplinkMessageDeliveryData	6.1.6.2.4	Contains the uplink V2X message delivery data	
MessageDeliverySubscriptionData	6.1.6.2.3	Contains the V2X message delivery subscription data	
V2xGroupId	6.1.6.3.2	The group ID for which the V2X message is addressed	
V2xServiceID	6.1.6.3.2	The V2X service ID to which the V2X message belongs to	
V2xUeId	6.1.6.3.2	Identifier of the destination V2X UE	
V2xMessagePayload	6.1.6.3.2	V2X message payload carried by the V2X message	

Table 6.1.6.1-2 specifies data types re-used by the VAE_MessageDelivery 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 VAE_MessageDelivery service based interface.

Table 6.1.6.1-2: VAE_MessageDelivery re-used Data Types

Data type	Reference	Comments	Applicability
Bytes	3GPP TS 29.571 [11]	String with format "byte" as defined in OpenAPI Specification [6], i.e, base64-encoded characters	
DateTime	3GPP TS 29.571 [11]	String with format "date-time" as defined in OpenAPI Specification [6].	
SupportedFeatures	3GPP TS 29.571 [11]		
TestNotification	3GPP TS 29.122 [22]	Represents a notification that can be sent to test whether a chosen notification mechanism works.	Notification_test_event
Uri	3GPP TS 29.571 [11]		
WebsockNotifConfig	3GPP TS 29.122 [22]	Pepresents configuration for the delivery of notifications over Websockets.	Notification_websocket

6.1.6.2 Structured data types

6.1.6.2.1 Introduction

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

6.1.6.2.2 Type: DownlinkMessageDeliveryData

Table 6.1.6.2.2-1: Definition of type DownlinkMessageDeliveryData

Attribute name	Data type	P	Cardinality	Description	Applicability
ueId	V2xUeId	O	0..1	Indicates an identifier of the V2X UE.	
groupId	V2xGroupId	O	0..1	Indicates a group ID for which the V2X message is addressed.	
geoId	GeoId	O	0..1	Indicates a geographical area identifier.	
payload	V2xMessagePayload	M	1	Constains the V2X message payload carried by the V2X message	
duration	DateTime	O	0..1	Identifies the absolute time at which the related Individual Downlink Message Delivery resource is considered to expire. When omitted in the request, it indicates the resource is requested to be valid forever by the NF service consumer. When omitted in the response, it indicates the resource is set to valid forever by the VAE server	
NOTE: Either "ueId" attribute or "groupId" attribute shall be included.					

6.1.6.2.3 Type: MessageDeliverySubscriptionData

Table 6.1.6.2.3-1: Definition of type MessageDeliverySubscriptionData

Attribute name	Data type	P	Cardinality	Description	Applicability
appSerId	AppServerId	M	1	Identity of the V2X application specific server.	
serviceId	V2xServiceId	M	1	Indicates a V2X service ID to which the V2X message belongs to.	
geoId	GeoId	O	0..1	Indicates a geographical area identifier.	
notifUri	Uri	M	1	Contains the notification URI。	
requestTestNotification	boolean	O	0..1	Set to true by the NF service consumer to request the VAE server to send a test notification as defined in clause 6.1.5.3. Set to false or omitted otherwise.	Notification_test_event
websockNotifConfig	WebsockNotifConfig	O	0..1	Configuration parameters to set up notification delivery over Websocket protocol as defined in clause 6.1.5.4.	Notification_websocket
suppFeat	SupportedFeatures	C	0..1	Indicates the features supported by the service consumer and VAE server. It shall be included in the request and response of the creation of individual Message Delivery Subscription resource.	

6.1.6.2.4   Type: UplinkMessageDeliveryData

Table 6.1.6.2.4-1: Definition of type UplinkMessageDeliveryData

Attribute name	Data type	P	Cardinality	Description	Applicability
resourceUri	Uri	M	1	The resource URI of the individual Uplink Message Delivery Subscription related to the notification.	
ueId	V2xUeId	M	1	Indicates an identifier of the V2X UE.	
geoId	GeoId	O	0..1	Indicates a geographical area identifier.	
payload	V2xMessagePayload	M	1	Contains the V2X message payload carried by the V2X message	

6.1.6.3   Simple data types and enumerations

6.1.6.3.1   Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.1.6.3.2   Simple data types

The simple data types defined in table 6.1.6.3.2-1 shall be supported.

Table 6.1.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability
AppServerId	string	Identity of the V2X application specific server	
GeoId	string	Defines a geographical area identifier.	
V2xGroupId	string	Defines a group ID for which the V2X message is addressed.	
V2xServiceId	string	Defines a V2X service ID to which the V2X message belongs to	
V2xUeId	string	Identifier of the V2X UE	
V2xMessagePayload	Bytes	V2X message payload carried by the V2X message.	

6.1.7   Error Handling

6.1.7.1   General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [2].

For the VAE_MessageDelivery Service API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [3].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [2] 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 3GPP TS 29.500 [2].

In addition, the requirements in the following subclauses are applicable for the VAE_MessageDelivery Service API.

6.1.7.2   Protocol Errors

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

6.1.7.3 Application Errors

The application errors defined for the VAE_MessageDelivery service are listed in Table 6.1.7.3-1.

Table 6.1.7.3-1: Application errors

Application Error	HTTP status code	Description

6.1.8 Feature negotiation

The optional features in table 6.1.8-1 are defined for the VAE_MessageDelivery API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [2].

Table 6.1.8-1: Supported Features

Feature number	Feature Name	Description
1	Notification_test_event	The testing of notification connection is supported according to clause 6.1.5.3.
2	Notification_websocket	The delivery of notifications over Websocket is supported according to clause 6.1.5.4. This feature requires that the Notification_test_event feature is also supported.

6.2 VAE_FileDistribution Service API

6.2.1 Introduction

The VAE_FileDistribution shall use the VAE_FileDistribution API.

The API URI of the VAE_FileDistribution shall be:

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

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

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

with the following components:

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

- The <apiName> shall be "vae-file-distribution".

- The <apiVersion> shall be "v1".

- The <apiSpecificResourceUriPart> shall be set as described in clause 6.2.3.

6.2.2 Usage of HTTP

6.2.2.1 General

Support of HTTP/1.1 (IETF RFC 7230 [12], IETF RFC 7231 [13], IETF RFC 7232 [14], IETF RFC 7233 [15], IETF RFC 7234 [16] and IETF RFC 7235 [17]) over TLS (IETF RFC 5246 [18]) is mandatory and support of HTTP/2 as specified in clause 5 of 3GPP TS 29.500 [2] is recommended. A V2X application specific server desiring to use HTTP/2 shall use the HTTP upgrade mechanism to negotiate applicable HTTP version as described in IETF RFC 7540 [5].

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

An OpenAPI [6] specification of HTTP messages and content bodies for the VAE_FileDistribution is contained in Annex A.3.

6.2.2.2   HTTP standard headers

6.2.2.2.1   General

See clause 5.2.2 of 3GPP TS 29.500 [2] for the usage of HTTP standard headers.

6.2.2.2.2   Content type

JSON, IETF RFC 8259 [7], 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 [2]. The use of the JSON format shall be signalled by the content type "application/json".

6.2.2.3   HTTP custom headers

6.2.2.3.1   General

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [2] shall be applicable.

6.2.3   Resources

6.2.3.1   Overview

{apiRoot}/vae-file-distribution/<apiVersion>

/file-distributions
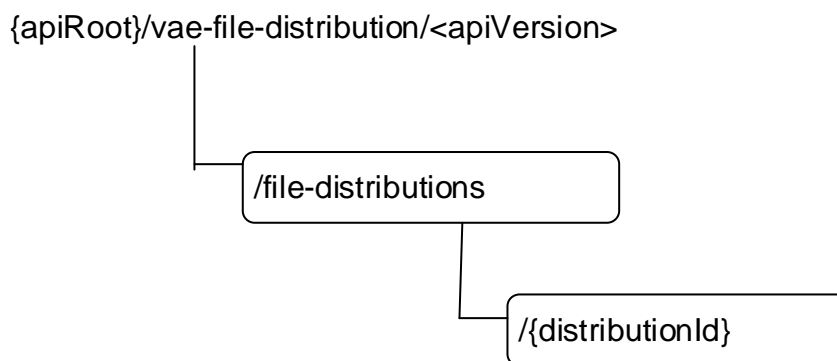
/{distributionId}

Figure 6.2.3.1-1: Resource URI structure of the VAE_FileDistribution API

Table 6.2.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.2.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
File Distributions	/file-distributions	POST	Create a new Individual File Distribution resource for a V2X group ID.
Individual File Distribution	/file-distributions/{distributionId}	GET	Read an Individual File Distribution resource.
		DELETE	Delete an Individual File Distribution resource.

6.2.3.2 Resource: File Distributions

6.2.3.2.1 Description

This resource represents the collection of the individual File Distribution resources created in the VAE Server.

6.2.3.2.2 Resource Definition

Resource URI: **{apiRoot}/vae-file-distribution/<apiVersion>/file-distributions**

This resource shall support the resource URI variables defined in table 6.2.3.2.2-1.

Table 6.2.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.2.1
apiVersion	string	See clause 6.2.1

6.2.3.2.3 Resource Standard Methods

6.2.3.2.3.1 POST

This method shall support the URI query parameters specified in table 6.2.3.2.3.1-1.

Table 6.2.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.2.3.2.3.1-2 and the response data structures and response codes specified in table 6.2.3.2.3.1-3.

Table 6.2.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
FileDistributionData	M	1	Parameters to create an individual File Distribution resource.

Table 6.2.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
FileDistributionData	O	0..1	201 Created	An individual File Distribution resource for the V2X group ID is created successfully.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

Table 6.2.3.2.3.1-4: 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}/vae-file-distribution/<apiVersion>/file-distributions/{distributionId}

6.2.3.2.4 Resource Custom Operations

None.

6.2.3.3 Resource: Individual File Distribution

6.2.3.3.1 Description

The individual File Distribution resource represents an individual File Distribution created in the VAE Server and associated with the V2X group ID.

6.2.3.3.2 Resource definition

Resource URI: **{apiRoot}/vae-file-distribution/<apiVersion>/file-distributions/{distributionId}**

This resource shall support the resource URI variables defined in table 6.2.3.3-1.

Table 6.2.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.2.1
apiVersion	string	See clause 6.2.1
distributionId	string	Unique identifier of the individual File Distribution resource for the V2X group ID.

6.2.3.3.3 Resource Standard Methods

6.2.3.3.3.1 GET

This method shall support the URI query parameters specified in table 6.2.3.3.3.1-1.

Table 6.2.3.3.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.2.3.3.3.1-2 and the response data structures and response codes specified in table 6.2.3.3.3.1-3.

Table 6.2.3.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.2.3.3.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
FileDistributionData	M	1	200 OK	An individual File Distribution resource for the V2X group ID is returned successfully.
NOTE: The mandatory HTTP error status codes for the GET method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

6.2.3.3.3.2 DELETE

This method shall support the URI query parameters specified in table 6.2.3.3.3.2-1.

Table 6.2.3.3.3.2-1: 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 6.2.3.3.3.2-2 and the response data structures and response codes specified in table 6.2.3.3.3.2-3.

Table 6.2.3.3.3.2-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.2.3.3.3.2-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Individual File Distribution resource was successfully deleted.
NOTE:	The mandatory HTTP error status code for the DELETE method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [2] also apply.			

6.2.3.4 Resource Custom Operations

None.

6.2.4 Custom Operations without associated resources

There are no custom operations without associated resources supported on VAE_FileDistribution.

6.2.5 Notifications

N/A

6.2.6 Data Model

6.2.6.1 General

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

Table 6.2.6.1-1 specifies the data types defined for the VAE_FileDistribution API.

Table 6.2.6.1-1: VAE_FileDistribution specific Data Types

Data type	Section defined	Description	Applicability
FileStatus	6.2.6.3.3		
FileDistributionData	6.2.6.2.2		
Filelist	6.2.6.2.3		

Table 6.1.6.1-2 specifies data types re-used by the VAE_FileDistribution 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 VAE_FileDistribution service based interface.

Table 6.2.6.1-2: VAE_FileDistribution re-used Data Types

Data type	Reference	Comments	Applicability
BitRate	3GPP TS 29.571 [11]		
DateTime	3GPP TS 29.571 [11]		
DurationSec	3GPP TS 29.571 [11]		
GeographicArea	3GPP TS 29.572 [20]		
SupportedFeatures	3GPP TS 29.571 [11]		
Uinteger	3GPP TS 29.571 [11]		
V2xGroupId	6.1.6.3.2		

6.2.6.2   Structured data types

6.2.6.2.1   Introduction

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

6.2.6.2.2   Type: FileDistributionData

Table 6.2.6.2.2-1: Definition of type FileDistributionData

Attribute name	Data type	P	Cardinality	Description	Applicability
groupId	V2xGroupId	O	0..1	Indicates a group ID for which the V2X message is addressed.	
fileLists	array(FileList)	M	1..N	File lists.	
serviceClass	string	O	0..1	Information about the V2X application (e.g., software update, HD map download)	
geoArea	GeographicArea	M	1	Target geographical area for the V2X Ues	
maxBitrate	BitRate	M	1	Maximum bitrate for the V2X application.	
maxDelay	Uinteger	M	1	Unsigned integer identifying a maximum delay in units of milliseconds for the V2X application.	
duration	DateTime	O	0..1	Identifies the absolute time at which the related Individual File Distribution Data resource is considered to expire. When omitted in the request, it indicates the resource is requested to be valid forever by the NF service consumer. When omitted in the response, it indicates the resource is set to valid forever by the VAE server	
suppFeat	SupportedFeatures	C	0..1	Indicates the features supported by the service consumer and VAE server. It shall be included in the request and response of the Creation of Individual File Distribution Data resource..	

6.2.6.2.3   Type: FileList

Table 6.2.6.2.4-1: Definition of type FileList

Attribute name	Data type	P	Cardinality	Description	Applicability
fileUri	Uri	M	1		
fileDisplayUri	Uri	M	1		
fileEarFetchTime	DateTime	M	1		
fileLatFetchTime	DateTime	M	1		
fileSize	Uinteger	O	0..1		
fileStatus	FileStatus	M	1		
completionTime	DateTime	M	1		
keepUpdateInterval	DurationSec	M	1		
uniAvailability	Boolean	O	0..1		
fileRepetition	Uinteger	O	0..1		

6.2.6.3   Simple data types and enumerations

6.2.6.3.1   Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.2.6.3.2   Simple data types

The simple data types defined in table 6.1.6.3.2-1 shall be supported.

Table 6.2.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

6.2.6.3.3   Enumeration: FileStatus

Table 6.2.6.3.3-1: Enumeration FileStatus

Enumeration value	Description	Applicability
PENDING	The file is pending.	
FETCHED	The file is fetched	
PREPARED	The file is prepared	
TRANSMITTING	The file is transmitting	
SENT	The file is sent.	

6.2.7   Error Handling

6.2.7.1   General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [2].

For the VAE_FileDistribution Service API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [3].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [2] 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 3GPP TS 29.500 [2].

In addition, the requirements in the following subclauses are applicable for the VAE_FileDistribution Service API.

6.2.7.2 Protocol Errors

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

6.2.7.3 Application Errors

The application errors defined for the VAE_FileDistribution service are listed in Table 6.2.7.3-1.

Table 6.2.7.3-1: Application errors

Application Error	HTTP status code	Description

6.2.8 Feature negotiation

The optional features in table 6.1.8-1 are defined for the VAE_FileDistribution API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [2].

Table 6.1.8-1: Supported Features

Feature number	Feature Name	Description

6.3 VAE_ApplicationRequirement API

6.3.1 Introduction

The VAE_ApplicationRequirement Service shall use the VAE_ApplicationRequirement API.

The API URI of the VAE_ApplicationRequirement API shall be:

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

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

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

with the following components:

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

-   The <apiName> shall be "vae-app-req".

-   The <apiVersion> shall be "v1".

-   The <apiSpecificResourceUriPart> shall be set as described in clause 6.3.3.

6.3.2 Usage of HTTP

6.3.2.1 General

Support of HTTP/1.1 (IETF RFC 7230 [12], IETF RFC 7231 [13], IETF RFC 7232 [14], IETF RFC 7233 [15], IETF RFC 7234 [16] and IETF RFC 7235 [17]) over TLS (IETF RFC 5246 [18]) is mandatory and support of HTTP/2 as specified in clause 5 of 3GPP TS 29.500 [2] is recommended. A V2X application specific server desiring to use HTTP/2 shall use the HTTP upgrade mechanism to negotiate applicable HTTP version as described in IETF RFC 7540 [5].

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

An OpenAPI [6] specification of HTTP messages and content bodies for the VAE_ApplicationRequirement is contained in Annex A.4.

6.3.2.2 HTTP standard headers

6.3.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [2] for the usage of HTTP standard headers.

6.3.2.2.2 Content type

JSON, IETF RFC 8259 [7], 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 [2]. The use of the JSON format shall be signalled by the content type "application/json".

6.3.2.3 HTTP custom headers

6.3.2.3.1 General

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [2] shall be applicable.

6.3.3 Resources

6.3.3.1 Overview
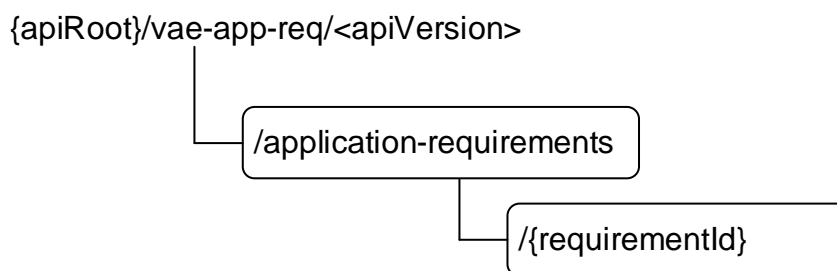
Figure 6.3.3.1-1: Resource URI structure of the VAE_ApplicationRequirement API

Table 6.3.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.3.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
Application Requirements	/application-requirements	POST	Create a new Individual Application Requirement resource for a V2X UE or V2X group ID.
Individual Application Requirement	/application-requirements /{requirementId}	GET	Read an Individual Application Requirement resource.
		DELETE	Delete an Individual Application Requirement resource.

6.3.3.2 Resource: Application Requirements

6.3.3.2.1 Description

This resource represents the collection of the individual Application Requirement resources created in the VAE Server.

6.3.3.2.2 Resource Definition

Resource URI: **{apiRoot}/vae-app-req/<apiVersion>/application-requirements**

This resource shall support the resource URI variables defined in table 6.3.3.2.2-1.

Table 6.3.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.3.1
apiVersion	string	See clause 6.3.1

6.3.3.2.3 Resource Standard Methods

6.3.3.2.3.1 POST

This method shall support the URI query parameters specified in table 6.3.3.2.3.1-1.

Table 6.3.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.3.3.2.3.1-2 and the response data structures and response codes specified in table 6.3.3.2.3.1-3.

Table 6.3.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
ApplicationRequirementData	M	1	Parameters to create an individual Application Requirement resource.

Table 6.3.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
ApplicationRequirementData	O	0..1	201 Created	An individual Application Requirement resource for the V2X UE ID or the V2X group ID is created successfully.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

Table 6.3.3.2.3.1-4: 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}/vae-app-req/<apiVersion>/application-requirements/{requirementId}

6.3.3.2.4 Resource Custom Operations

None.

6.3.3.3 Resource: Individual Application Requirement

6.3.3.3.1 Description

The individual Application Requirement resource represents an individual Application Requirement created in the VAE Server and associated with the V2X UE ID or V2X group ID.

6.3.3.3.2 Resource definition

Resource URI: **{apiRoot}/vae-app-req/<apiVersion>/application-requirements/{requirementId}**

This resource shall support the resource URI variables defined in table 6.2.3.3-1.

Table 6.3.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.3.1
apiVersion	string	See clause 6.3.1
requirementId	string	Unique identifier of the individual Application Requirement resource for the V2X UE ID or the V2X group ID.

6.3.3.3.3 Resource Standard Methods

6.3.3.3.3.1 GET

This method shall support the URI query parameters specified in table 6.3.3.3.3.1-1.

Table 6.3.3.3.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.3.3.3.3.1-2 and the response data structures and response codes specified in table 6.3.3.3.3.1-3.

Table 6.3.3.3.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.3.3.3.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
ApplicationRequirementData	M	1	200 OK	An individual Application Requirement resource for the V2X UE ID or V2X group ID is returned successfully.
NOTE: The mandatory HTTP error status codes for the GET method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

6.3.3.3.3.2 DELETE

This method shall support the URI query parameters specified in table 6.3.3.3.3.2-1.

Table 6.3.3.3.3.2-1: 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 6.3.3.3.3.2-2 and the response data structures and response codes specified in table 6.3.3.3.3.2-3.

Table 6.3.3.3.3.2-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.3.3.3.3.2-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Individual Application Requirement resource was successfully deleted
NOTE: The mandatory HTTP error status code for the DELETE method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [5] also apply.				

6.3.3.4 Resource Custom Operations

None.

6.3.4 Custom Operations without associated resources

There are no custom operations without associated resources supported on VAE_ApplicationRequirement.

6.3.5 Notifications

6.3.5.1 General

The VAE server and NF service consumer shall support the delivery of Notifications using a separate HTTP connection towards an address as assigned the NF service consumer described in clause 6.3.5.2.

A VAE server and NF service consumer may support testing a notification connection as described in clause 6.3.5.3. A VAE server and NF service consumer may support the delivery of Notification using Websocket (IETF RFC 6455 [21]) as described in clause 6.1.5.4.

6.3.5.2 Notification Delivery using a separate HTTP connection

The descriptions in clause 5.2.5.2 of 3GPP TS 29.122 [22] apply with following differences:

- description of SCS/AS applies to the NF service consumer;

- description of SCEF applies to the VAE server; and

- "notificationDestination" attribute is replaced by the "notifUri" attribute.

6.3.5.3 Notification Test Event

The descriptions in clause 5.2.5.3 of 3GPP TS 29.122 [22] apply with following differences:

- description of SCS/AS applies to the NF service consumer; and

- description of SCEF applies to the VAE server.

6.3.5.4 Notification Delivery using Websocket

The descriptions in clause 5.2.5.4 of 3GPP TS 29.122 [22] apply with following differences:

- description of SCS/AS applies to the NF service consumer; and

- description of SCEF applies to the VAE server.

6.3.5.5 Methods

Table 6.3.5.5-1: Methods

Callback URI	HTTP method or custom operation	Description (service operation)
{notifUri}	POST	Notify the result of the network resource adaptation corresponding to the V2X application requirement.

6.3.5.6 Notify Network Resource

6.3.5.6.1 Description

This notification is used by the VAE Server to notify the result of the network resource adaptation corresponding to the V2X application requirement.

6.3.5.6.2 Operation Definition

This operation shall support the request data structures specified in table 6.3.5.6.2-1 and the response data structure and response codes specified in table 6.3.5.6.2-2.

Table 6.3.5.6.2-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
AppReqNotification	M	1	Notify the result of the network resource adaptation corresponding to the V2X application requirement.

Table 6.3.5.6.2-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	.
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 [4] shall also apply.				

6.3.6 Data Model

6.3.6.1 General

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

Table 6.3.6.1-1 specifies the data types defined for the VAE_ApplicationRequirement API.

Table 6.3.6.1-1: VAE_ApplicationRequirement specific Data Types

Data type	Section defined	Description	Applicability
ApplicationRequirement	6.3.6.2.3		
AppReqNotification	6.3.6.2.4		
ApplicationRequirementData	6.3.6.2.2		
ReservationResult	6.3.6.3.4		
ServiceLevel	6.3.6.3.3		

Table 6.3.6.1-2 specifies data types re-used by the VAE_ApplicationRequirement 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 VAE_ApplicationRequirement service based interface.

Table 6.3.6.1-2: VAE_ApplicationRequirement re-used Data Types

Data type	Reference	Comments	Applicability
DateTime	3GPP TS 29.571 [11]		
SupportedFeatures	3GPP TS 29.571 [11]		
TestNotification	3GPP TS 29.122 [22]	Represents a notification that can be sent to test whether a chosen notification mechanism works.	Notification_test_event
Uri	3GPP TS 29.571 [11]	URI.	
V2xGroupId	6.1.6.3.2		
V2xServiceID	6.1.6.3.2	The V2X service ID to which the V2X message belongs to	
V2xUeId	6.1.6.3.2	Identifier of the destination V2X UE	
WebsockNotifConfig	3GPP TS 29.122 [22]	Pepresents configuration for the delivery of notifications over Websockets.	Notification_websocket

6.3.6.2 Structured data types

6.3.6.2.1 Introduction

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

6.3.6.2.2 Type: ApplicationRequirementData

Table 6.3.6.2.2-1: Definition of type ApplicationRequirementData

Attribute name	Data type	P	Cardinality	Description	Applicability
ueId	V2xUeId	O	0..1	Indicates a UE ID for which the V2X message is addressed. (NOTE)	
groupId	V2xGroupId	O	0..1	Indicates a group ID for which the V2X message is addressed. (NOTE)	
serviceId	V2xServiceId	M	1	The V2X service ID for which application requirement corresponds to.	
appRequirement	ApplicationReq uirement	M	1	The requirement for application change. E.g. service levels for application service.	
notifUri	Uri	M	1	Identifies the recipient of V2X application requirement notification sent by the VAE server.	
duration	DateTime	O	0..1	Identifies the absolute time at which the related Individual Application Requirement resource is considered to expire. When omitted in the request, it indicates the resource is requested to be valid forever by the NF service consumer. When omitted in the response, it indicates the resource is set to valid forever by the VAE server	
requestTestNotifica tion	boolean	O	0..1	Set to true by the NF service consumer to request the VAE server to send a test notification as defined in clause 6.3.5.3. Set to false or omitted otherwise.	Notification_test_event
websockNotifConfi g	WebsockNotifC onfig	O	0..1	Configuration parameters to set up notification delivery over Websocket protocol as defined in clause 6.3.5.4.	Notification_websocket
suppFeat	SupportedFeatu res	C	0..1	Indicates the features supported by the service consumer. It shall be included in the first interaction.	
NOTE: Either the "ueId" attribute or "groupId" attribute shall be included.					

6.3.6.2.3 Type: ApplicationRequirement

Table 6.3.6.2.3-1: Definition of type ApplicationRequirement

Attribute name	Data type	P	Cardinality	Description	Applicability
serviceLevel	ServiceLevel	O	0..1	Indicates a service level for application service.	

6.3.6.2.4 Type: AppReqNotification

Table 6.3.6.2.4-1: Definition of type AppReqNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
resourceUri	Uri	M	1	The resource URI of the individual Application Requirement related to the notification.	
result	ReservationResult	M	1	The result of the network resource adaptation corresponding to the V2X application requirement.	

6.3.6.3 Simple data types and enumerations

6.3.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.3.6.3.2 Simple data types

The simple data types defined in table 6.3.6.3.2-1 shall be supported.

Table 6.3.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

6.3.6.3.3 Enumeration: ServiceLevel

Table 6.3.6.3.3-1: Enumeration ServiceLevel

Enumeration value	Description	Applicability
HIGH	Service level is high.	
MEDIUM	Service level is medium.	
LOW	Service level is low.	

6.3.6.3.4 Enumeration: ReservationResult

Table 6.3.6.3.4-1: Enumeration ReservationResult

Enumeration value	Description	Applicability
SUCCESSFUL	The resource reservation is successful.	
FAILURE	The resource reservation is failure.	

6.3.7 Error Handling

6.3.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [2].

For the VAE_ApplicationRequirement Service API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [3].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [2] 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 3GPP TS 29.500 [2].

In addition, the requirements in the following subclauses are applicable for the VAE_ApplicationRequirement Service API.

6.3.7.2 Protocol Errors

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

6.3.7.3 Application Errors

The application errors defined for the VAE_ApplicationRequirement service are listed in Table 6.3.7.3-1.

Table 6.3.7.3-1: Application errors

Application Error	HTTP status code	Description

6.3.8 Feature negotiation

The optional features in table 6.3.8-1 are defined for the VAE_ApplicationRequirement API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [2].

Table 6.3.8-1: Supported Features

Feature number	Feature Name	Description
1	Notification_test_event	The testing of notification connection is supported according to clause 6.3.5.3.
2	Notification_websocket	The delivery of notifications over Websocket is supported according to clause 6.3.5.4. This feature requires that the Notification_test_event feature is also supported.

6.4 VAE_DynamicGroup API

6.4.1 Introduction

The VAE_DynamicGroup service shall use the VAE_DynamicGroup API.

The API URI of the VAE_DynamicGroup API shall be:

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

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

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

with the following components:

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

- The <apiName> shall be "vae-dynamic-group".

- The <apiVersion> shall be "v1".

- The <apiSpecificResourceUriPart> shall be set as described in clause 6.4.3.

6.4.2 Usage of HTTP

6.4.2.1 General

Support of HTTP/1.1 (IETF RFC 7230 [12], IETF RFC 7231 [13], IETF RFC 7232 [14], IETF RFC 7233 [15], IETF RFC 7234 [16] and IETF RFC 7235 [17]) over TLS (IETF RFC 5246 [18]) is mandatory and support of HTTP/2 as specified in clause 5 of 3GPP TS 29.500 [2] is recommended. A V2X application specific server desiring to use HTTP/2 shall use the HTTP upgrade mechanism to negotiate applicable HTTP version as described in IETF RFC 7540 [5].

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

An OpenAPI [6] specification of HTTP messages and content bodies for the VAE_DynamicGroup is contained in Annex A.5.

6.4.2.2 HTTP standard headers

6.4.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [2] for the usage of HTTP standard headers.

6.4.2.2.2 Content type

JSON, IETF RFC 8259 [7], 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 [2]. The use of the JSON format shall be signalled by the content type "application/json".

6.4.2.3 HTTP custom headers

6.4.2.3.1 General

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [2] shall be applicable.

6.4.3 Resources

6.4.3.1 Overview
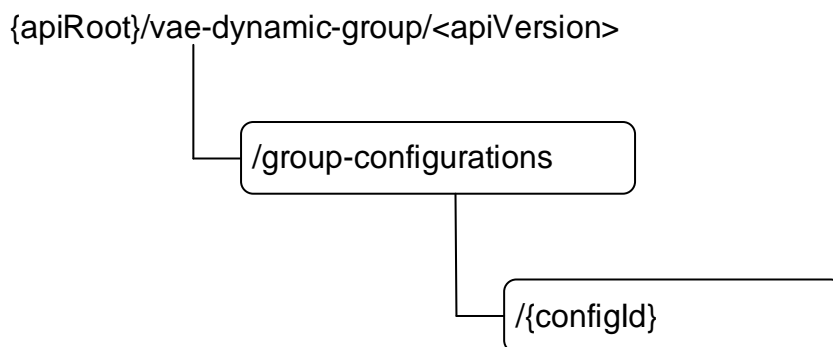
Figure 6.4.3.1-1: Resource URI structure of the VAE_DynamicGroup API

Table 6.4.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.4.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
Group Configurations	/group-configurations	POST	Create a new Individual Group Configuration resource for a V2X group ID.
Individual Group Configuration	/group-configurations/{configId}	GET	Read an Individual Group Configuration resource.
		DELETE	Delete an Individual Group Configuration resource.

6.4.3.2   Resource: Group Configurations

6.4.3.2.1   Description

This resource represents the collection of the individual Application Requirement resources created in the VAE Server.

6.4.3.2.2   Resource Definition

Resource URI: **{apiRoot}/vae-dynamic-group/<apiVersion>/group-configuration**s

This resource shall support the resource URI variables defined in table 6.4.3.2.2-1.

Table 6.4.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.4.1
apiVersion	string	See clause 6.4.1

6.4.3.2.3   Resource Standard Methods

6.4.3.2.3.1   POST

This method shall support the URI query parameters specified in table 6.4.3.2.3.1-1.

Table 6.4.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.4.3.2.3.1-2 and the response data structures and response codes specified in table 6.4.3.2.3.1-3.

Table 6.4.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
GroupConfigurationData	M	1	Parameters to create an individual Group Configuration resource.

Table 6.3.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
GroupConfigurationData	O	0..1	201 Created	An individual Group Configuration resource for the V2X group ID is created successfully.
NOTE:	The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.			

Table 6.4.3.2.3.1-4: 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}/vae-dynamic-group/<apiVersion>/group-configurations/{configId}

6.4.3.2.4 Resource Custom Operations

None.

6.4.3.3 Resource: Individual Group Configuration

6.4.3.3.1 Description

The individual Group Configuration resource represents an individual Group Configuration created in the VAE Server and associated with the V2X group ID.

6.4.3.3.2 Resource definition

Resource URI: **{apiRoot}/vae-dynamic-group/<apiVersion>/group-configuration**s**/{configId}**

This resource shall support the resource URI variables defined in table 6.2.3.3-1.

Table 6.4.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.4.1.
apiVersion	string	See clause 6.4.1
configId	string	Unique identifier of the individual group configuration resource for the V2X group ID.

6.4.3.3.3 Resource Standard Methods

6.4.3.3.3.1 GET

This method shall support the URI query parameters specified in table 6.4.3.3.3.1-1.

Table 6.4.3.3.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.4.3.3.3.1-2 and the response data structures and response codes specified in table 6.4.3.3.3.1-3.

Table 6.4.3.3.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.4.3.3.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
GroupConfigurationData	M	1	200 OK	An individual Group Configuration resource for the V2X group ID is returned successfully.
NOTE: The mandatory HTTP error status codes for the GET method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

6.4.3.3.3.2 DELETE

This method shall support the URI query parameters specified in table 6.4.3.3.3.2-1.

Table 6.4.3.3.3.2-1: 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 6.4.3.3.3.2-2 and the response data structures and response codes specified in table 6.4.3.3.3.2-3.

Table 6.4.3.3.3.2-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.4.3.3.3.2-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	
NOTE: The mandatory HTTP error status codes for the DELETE method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

6.4.3.4 Resource Custom Operations

None.

6.4.4 Custom Operations without associated resources

There are no custom operations without associated resources supported on VAE_DynamicGroup API.

6.4.5 Notifications

6.4.5.1 General

The VAE server and NF service consumer shall support the on-network dynamic group notifications using a separate HTTP connection towards an address as assigned the NF service consumer described in clause 6.4.5.2.

A VAE server and NF service consumer may support testing a notification connection as described in clause 6.4.5.3. A VAE server and NF service consumer may support the delivery of Notification using Websocket (IETF RFC 6455 [21]) as described in clause 6.4.5.4.

6.4.5.2   Notification Delivery using a separate HTTP connection

The descriptions in clause 5.2.5.2 of 3GPP TS 29.122 [22] apply with following differences:

-    description of SCS/AS applies to the NF service consumer;

-    description of SCEF applies to the VAE server; and

-    "notificationDestination" attribute is replaced by the "notifUri" attribute.

6.4.5.3   Notification Test Event

The descriptions in clause 5.2.5.3 of 3GPP TS 29.122 [22] apply with following differences:

-    description of SCS/AS applies to the NF service consumer; and

-    description of SCEF applies to the VAE server.

6.4.5.4   Notification Delivery using Websocket

The descriptions in clause 5.2.5.4 of 3GPP TS 29.122 [22] apply with following differences:

-    description of SCS/AS applies to the NF service consumer; and

-    description of SCEF applies to the VAE server.

6.4.5.5   Methods

Table 6.4.5.5-1: Methods

Callback URI	HTTP method or custom operation	Description (service operation)
{notifUri}	POST	Notify the dynamic group information (i.e. group member joins or leaves).

6.4.5.6   Notify Dynamic Group

6.4.5.6.1   Description

This notification is used by the VAE Server to notify the dynamic group information (i.e. group member joins or leaves).

6.4.5.6.2   Operation Definition

This operation shall support the request data structures specified in table 6.4.5.6.2-1 and the response data structure and response codes specified in table 6.4.5.6.2-2.

Table 6.4.5.6.2-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
DynamicGroupNotification	M	1	Notify the dynamic group information (i.e. group member joins or leaves).

Table 6.3.5.6.2-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	.
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 [4] shall also apply.				

6.4.6 Data Model

6.4.6.1 General

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

Table 6.4.6.1-1 specifies the data types defined for the VAE_DynamicGroup API.

Table 6.4.6.1-1: VAE_DynamicGroup specific Data Types

Data type	Section defined	Description	Applicability
DynamicGroupNotification	6.3.6.2.3		
GroupConfigurationData	6.3.6.2.2		

Table 6.4.6.1-2 specifies data types re-used by the VAE_DynamicGroup 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 VAE_DynamicGroup service based interface.

Table 6.4.6.1-2: VAE_DynamicGroup re-used Data Types

Data type	Reference	Comments	Applicability
DateTime	3GPP TS 29.571 [11]	String with format "date-time" as defined in OpenAPI Specification [6].	
SupportedFeatures	3GPP TS 29.571 [11]		
TestNotification	3GPP TS 29.122 [22]	Represents a notification that can be sent to test whether a chosen notification mechanism works.	Notification_test_event
V2xGroupId	6.1.6.3.2		
V2xUeId	6.1.6.3.2	Identifier of the destination V2X UE	
WebsockNotifConfig	3GPP TS 29.122 [22]	Pepresents configuration for the delivery of notifications over Websockets.	Notification_websocket

6.4.6.2 Structured data types

6.4.6.2.1 Introduction

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

6.4.6.2.2   Type: GroupConfigurationData

Table 6.4.6.2.2-1: Definition of type GroupConfigurationData

Attribute name	Data type	P	Cardinality	Description	Applicability
groupId	V2xGroupId	M	1	Indicates a group ID to be used for the V2X group.	
definition	string	M	1	Information about the V2X group.	
leaderId	V2xUeId	M	1	Indicates a UE ID to be used for user controlled group join.	
duration	DateTime	O	0..1	Identifies the absolute time at which the related Individual Group Configuration resource is considered to expire. When omitted in the request, it indicates the resource is requested to be valid forever by the NF service consumer. When omitted in the response, it indicates the resource is set to valid forever by the VAE server	
notifUri	Uri	M	1	Identifies the recipient of V2X dynamic group notification sent by the VAE server.	
requestTestNotification	boolean	O	0..1	Set to true by the NF service consumer to request the VAE server to send a test notification as defined in clause 6.1.5.3. Set to false or omitted otherwise.	Notification_test_event
websockNotifConfig	WebsockNotifConfig	O	0..1	Configuration parameters to set up notification delivery over Websocket protocol as defined in clause 6.1.5.4.	Notification_websocket
suppFeat	SupportedFeatures	C	0..1	Indicates the features supported by the service consumer and VAE server. It shall be included in the request and response of the Creation of Individual Group Configuration resource.	

6.4.6.2.3   Type: DynamicGroupNotification

Table 6.4.6.2.2-1: Definition of type DynamicGroupNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
resourceUri	Uri	M	1	The resource URI of the individual Group Configuration related to the notification.	
joinedUeIds	array(V2xUeId)	O	1..N	The joined group member(s).	
leftUeIds	array(V2xUeId)	O	1..N	The left group member(s).	

6.4.6.3   Simple data types and enumerations

6.4.6.3.1   Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.4.6.3.2   Simple data types

The simple data types defined in table 6.4.6.3.2-1 shall be supported.

Table 6.4.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

6.4.7   Error Handling

6.4.7.1   General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [2].

For the VAE_DynamicGroup Service API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [3].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [2] 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 3GPP TS 29.500 [2].

If the "Redirect3XX" feature is supported, an HTTP redirect response, i.e. 307 Temporary Redirect or 308 Permanent Redirect, shall be supported.

In addition, the requirements in the following subclauses are applicable for the VAE_DynamicGroup Service API.

6.4.7.2   Protocol Errors

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

6.4.7.3   Application Errors

The application errors defined for the VAE_DynamicGroup service are listed in Table 6.4.7.3-1.

Table 6.4.7.3-1: Application errors

Application Error	HTTP status code	Description

6.4.8   Feature negotiation

The optional features in table 6.4.8-1 are defined for the VAE_DynamicGroup API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [2].

Table 6.4.8-1: Supported Features

Feature number	Feature Name	Description
1	Notification_test_event	The testing of notification connection is supported according to clause 6.4.5.3.
2	Notification_websocket	The delivery of notifications over Websocket is supported according to clause 6.4.5.4. This feature requires that the Notification_test_event feature is also supported.

6.5 VAE_ServiceContinuity Service API

6.5.1 Introduction

The VAE_ServiceContinuity shall use the VAE_ServiceContinuity API.

The API URI of the VAE_ServiceContinuity API shall be:

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

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

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

with the following components:

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

- The <apiName> shall be "vae-service-continuity".

- The <apiVersion> shall be "v1".

- The <apiSpecificResourceUriPart> shall be set as described in clause 6.5.3.

6.5.2 Usage of HTTP

6.5.2.1 General

Support of HTTP/1.1 (IETF RFC 7230 [12], IETF RFC 7231 [13], IETF RFC 7232 [14], IETF RFC 7233 [15], IETF RFC 7234 [16] and IETF RFC 7235 [17]) over TLS (IETF RFC 5246 [18]) is mandatory and support of HTTP/2 as specified in clause 5 of 3GPP TS 29.500 [2] is recommended. A V2X application specific server desiring to use HTTP/2 shall use the HTTP upgrade mechanism to negotiate applicable HTTP version as described in IETF RFC 7540 [5].

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

An OpenAPI [6] specification of HTTP messages and content bodies for the VAE_ServiceContinuity is contained in Annex A.6.

6.5.2.2 HTTP standard headers

6.5.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [2] for the usage of HTTP standard headers.

6.5.2.2.2 Content type

JSON, IETF RFC 8259 [7], 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 [2]. The use of the JSON format shall be signalled by the content type "application/json".

6.5.2.3 HTTP custom headers

6.5.2.3.1 General

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [2] shall be applicable.

6.5.3 Resources

6.5.3.1 Overview
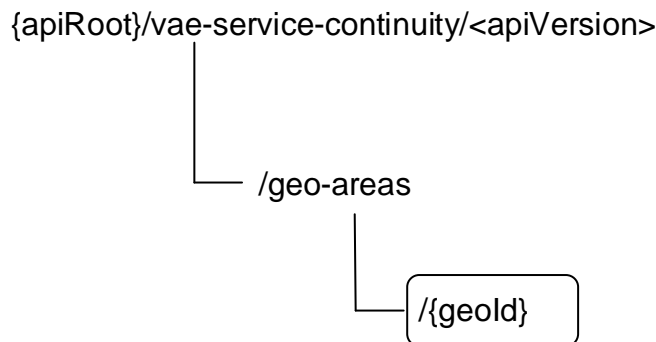
Figure 6.5.3.1-1: Resource URI structure of the VAE_ServiceContinuity API

Table 6.5.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.5.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
Individual Geographical Area	/geo-areas/{geoId}	GET	Query the Individual Geographical Area resource.

6.5.3.2 Resource: Individual Geographical Area

6.5.3.2.1 Description

This resource represents the individual geographical area resource in the VAE Server.

6.5.3.2.2 Resource Definition

Resource URI: **{apiRoot}/vae-service-continuity/<apiVersion>/geo-areas/{geoId}**

This resource shall support the resource URI variables defined in table 6.5.3.2.2-1.

Table 6.5.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.5.1
apiVersion	string	See clause 6.5.1
geoId	string	Geographical area id.

6.5.3.2.3 Resource Standard Methods

6.5.3.2.3.1 GET

This method shall support the URI query parameters specified in table 6.5.3.2.3.1-1.

Table 6.5.3.2.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description	Applicability
service-id	V2xServiceId	M	1	V2X service id	
supp-feat	SupportedFeatures	O	0..1	To filter irrelevant responses related to unsupported features.	

This method shall support the request data structures specified in table 6.5.3.2.3.1-2 and the response data structures and response codes specified in table 6.5.3.2.3.1-3.

Table 6.5.3.2.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.5.3.2.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
V2xServiceInfo	M	1	200 OK	An individual geographical area resource including the designated V2X service id is returned successfully.
NOTE: The mandatory HTTP error status codes for the GET method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [2] shall also apply.				

6.5.3.2.4 Resource Custom Operations

None.

6.5.4 Custom Operations without associated resources

There are no custom operations without associated resources supported on VAE_ServiceContinuity.

6.5.5 Notifications

Notifications are not applicable for the current Release.

6.5.6 Data Model

6.5.6.1 General

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

Table 6.5.6.1-1 specifies the data types defined for the VAE_ServiceContinuity API.

Table 6.5.6.1-1: VAE_ServiceContinuity specific Data Types

Data type	Section defined	Description	Applicability
V2xServiceInfo	6.5.6.2.2		

Table 6.5.6.1-2 specifies data types re-used by the VAE_ServiceContinuity 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 VAE_ServiceContinuity service based interface.

Table 6.5.6.1-2: VAE_ServiceContinuity re-used Data Types

Data type	Reference	Comments	Applicability
V2xServiceId	6.1.6.3.2	Defines a V2X service ID.	

6.5.6.2 Structured data types

6.5.6.2.1 Introduction

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

6.5.6.2.2 Type: V2xServiceInfo

Table 6.5.6.2.2-1: Definition of type V2xServiceInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
serviceIds	array(V2xServiceId)	M	1..N	Indicates a list of supported V2X service identifiers.	
suppFeat	SupportedFeatures	C	0..1	Indicates the features supported by the service consumer and VAE server. It shall be included if the query request includes supported features.	

6.5.6.3 Simple data types and enumerations

6.5.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.5.6.3.2 Simple data types

The simple data types defined in table 6.5.6.3.2-1 shall be supported.

Table 6.5.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

6.5.7 Error Handling

6.5.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [2].

For the VAE_ServiceContinuity Service API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [3].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [2] 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 3GPP TS 29.500 [2].

In addition, the requirements in the following subclauses are applicable for the VAE_ServiceContinuity Service API.

6.5.7.2 Protocol Errors

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

6.5.7.3 Application Errors

The application errors defined for the VAE_ServiceContinuity service are listed in Table 6.5.7.3-1.

Table 6.5.7.3-1: Application errors

Application Error	HTTP status code	Description

6.5.8 Feature negotiation

The optional features in table 6.5.8-1 are defined for the VAE_ServiceContinuity API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [2].

Table 6.5.8-1: Supported Features

Feature number	Feature Name	Description

7 Security

TLS (IETF RFC 5246 [24]) shall be used to support the security communication between the VAE server and the V2X application specific server over Vs interface, and also between different VAE servers over VAE-E interface. The access to the VAE service APIs shall be authorized by means of OAuth2 protocol (see IETF RFC 6749 [23]), based on local configuration, using the "Client Credentials" authorization grant. If OAuth2 is used, a client, prior to consuming services offered by the VAE service APIs, shall obtain a "token" from the authorization server.

Annex A (normative): OpenAPI specification

A.1 General

This Annex is based on the OpenAPI 3.0.0 specification [6] and provides corresponding representations of all APIs defined in the present specification.

> NOTE 1: An OpenAPIs representation embeds JSON Schema representations of HTTP message bodies.

This Annex shall take precedence when being discrepant to other parts of the specification with respect to the encoding of information elements and methods within the API(s).

> NOTE 2: The semantics and procedures, as well as conditions, e.g. for the applicability and allowed combinations of attributes or values, not expressed in the OpenAPI definitions but defined in other parts of the specification also apply.

Informative copies of the OpenAPI specification files contained in this 3GPP Technical Specification are available on a Git-based repository, that uses the GitLab software version control system (see clause 5B of the 3GPP TS 21.900 [8] and clause 5.3.1 of the 3GPP TS 29.501 [3] for further information).

A.2 VAE_MessageDelivery API

```
openapi: 3.0.0
info:
  version: 1.0.0
  title: VAE_MessageDelivery
  description: |
    API for VAE Message Delivery Service
    © 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 29.486 V16.1.0 V2X Application Enabler (VAE) Services
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.486/'
security:
  - {}
  - oAuth2ClientCredentials: []
servers:
  - url: '{apiRoot}/vae-message-delivery/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501
paths:
  /subscriptions:
    post:
      summary: Create a new Individual Message Delivery Data Subscription resource
      operationId: CreateIndividualMessageDeliveryDataSubscription
      tags:
        - Message Delivery Data Subscriptions (Collection)
      requestBody:
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/MessageDeliverySubscriptionData'
      responses:
        '201':
          description: The subscription was created successfully.
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/MessageDeliverySubscriptionData'
          headers:
            Location:
              description: 'Contains the URI of the newly created resource'
              required: true
```

```
              schema:
                type: string
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '411':
          $ref: 'TS29571_CommonData.yaml#/components/responses/411'
        '413':
          $ref: 'TS29571_CommonData.yaml#/components/responses/413'
        '415':
          $ref: 'TS29571_CommonData.yaml#/components/responses/415'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29571_CommonData.yaml#/components/responses/default'
      callbacks:
        uplinkMessageDelivery:
          '{$request.body#/notifUri}':
            post:
              requestBody:
                required: true
                content:
                  application/json:
                    schema:
                      $ref: '#/components/schemas/UplinkMessageDeliveryData'
              responses:
                '204':
                  description: No Content, Notification was successful
                '400':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/400'
                '401':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/401'
                '403':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/403'
                '404':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/404'
                '411':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/411'
                '413':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/413'
                '415':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/415'
                '429':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/429'
                '500':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/500'
                '503':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/503'
                default:
                  $ref: 'TS29571_CommonData.yaml#/components/responses/default'

  /subscriptions/{subscriptionId}:
    get:
      summary: Get an existing individual Message Delivery Subscription resource
      operationId: ReadIndividualMessageDeliverySubscription
      tags:
        - Individual Message Delivery Subscription (Document)
      parameters:
        - name: subscriptionId
          in: path
          description: String identifying a subscription to the Individual Message Delivery
Subscription
          required: true
          schema:
            type: string
      responses:
        '200':
          description: The subscription information is returned.
          content:
```

```
                  application/json:
                    schema:
                      $ref: '#/components/schemas/MessageDeliverySubscriptionData'
              '400':
                $ref: 'TS29571_CommonData.yaml#/components/responses/400'
              '401':
                $ref: 'TS29571_CommonData.yaml#/components/responses/401'
              '403':
                $ref: 'TS29571_CommonData.yaml#/components/responses/403'
              '404':
                $ref: 'TS29571_CommonData.yaml#/components/responses/404'
              '406':
                $ref: 'TS29571_CommonData.yaml#/components/responses/406'
              '429':
                $ref: 'TS29571_CommonData.yaml#/components/responses/429'
              '500':
                $ref: 'TS29571_CommonData.yaml#/components/responses/500'
              '503':
                $ref: 'TS29571_CommonData.yaml#/components/responses/503'
              default:
                $ref: 'TS29571_CommonData.yaml#/components/responses/default'
        delete:
          summary: Delete an individual Message Delivery Subscription resource
          operationId: DeleteMessageDeliverySubscription
          tags:
            - Individual Message Delivery Subscription (Document)
          parameters:
            - name: subscriptionId
              in: path
              description: String identifying a subscription to the Individual Message Delivery
Subscription
              required: true
              schema:
                type: string
          responses:
            '204':
              description: The subscription was terminated successfully.
            '400':
              $ref: 'TS29571_CommonData.yaml#/components/responses/400'
            '401':
              $ref: 'TS29571_CommonData.yaml#/components/responses/401'
            '403':
              $ref: 'TS29571_CommonData.yaml#/components/responses/403'
            '404':
              $ref: 'TS29571_CommonData.yaml#/components/responses/404'
            '429':
              $ref: 'TS29571_CommonData.yaml#/components/responses/429'
            '500':
              $ref: 'TS29571_CommonData.yaml#/components/responses/500'
            '503':
              $ref: 'TS29571_CommonData.yaml#/components/responses/503'
            default:
              $ref: 'TS29571_CommonData.yaml#/components/responses/default'


  /subscriptions/{subscriptionId}/message-deliveries:
    post:
      summary: VAE Message delivery resource create service Operation
      tags:
        - message deliveries collection (Collection)
      operationId: CreateDownlinkMessageDelivery
      parameters:
        - name: subscriptionId
          in: path
          description: String identifying a subscription to the Individual Message Delivery
Subscription
          required: true
          schema:
            type: string
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/DownlinkMessageDeliveryData'
        required: true
      responses:
        '201':
          description: Downlink Message Delivery Resource Created
```

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```
            headers:
              Location:
                description: 'Contains the URI of the newly created resource'
                required: true
                schema:
                  type: string
            content:
              application/json:
                schema:
                  $ref: '#/components/schemas/DownlinkMessageDeliveryData'
          '400':
            $ref: 'TS29571_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29571_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29571_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29571_CommonData.yaml#/components/responses/404'
          '411':
            $ref: 'TS29571_CommonData.yaml#/components/responses/411'
          '413':
            $ref: 'TS29571_CommonData.yaml#/components/responses/413'
          '415':
            $ref: 'TS29571_CommonData.yaml#/components/responses/415'
          '429':
            $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          default:
            description: Unexpected error
  /subscriptions/{subscriptionId}/message-deliveries/{dlDeliveryId}:
    get:
      summary: VAE Message delivery resource Read service Operation
      tags:
        - Individual downlink message delivery (Document)
      operationId: ReadIndividualDownlinkMessageDelivery
      parameters:
        - name: subscriptionId
          in: path
          description: String identifying a subscription to the Individual Message Delivery
Subscription
          required: true
          schema:
            type: string
        - name: dlDeliveryId
          in: path
          description: Identifier of a downlink messge delivery resource
          required: true
          schema:
            type: string
      responses:
        '200':
          description: OK. Resource representation is returned
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/DownlinkMessageDeliveryData'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29571_CommonData.yaml#/components/responses/406'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
      default:
        $ref: 'TS29571_CommonData.yaml#/components/responses/default'
    delete:
```

```
        summary: VAE Message delivery resource delete service Operation
        tags:
          - Individual message delivery (Document)
        operationId: DeleteMessageDelivery
        parameters:
          - name: subscriptionId
            in: path
            description: String identifying a subscription to the Individual Message Delivery
Subscription
            required: true
            schema:
              type: string
          - name: dlDeliveryId
            in: path
            required: true
            description: Unique ID of the message delivery to be deleted
            schema:
              type: string
        responses:
          '204':
            description: No Content (Successful deletion of the existing subscription)
          '400':
            $ref: 'TS29571_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29571_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29571_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29571_CommonData.yaml#/components/responses/404'
          '429':
            $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          default:
            description: Unexpected error
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{tokenUrl}'
          scopes: {}
  schemas:
    DownlinkMessageDeliveryData:
      type: object
      properties:
        ueId:
          $ref: '#/components/schemas/V2xUeId'
        groupId:
          $ref: '#/components/schemas/V2xGroupId'
        duration:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        geoId:
          $ref: '#/components/schemas/GeoId'
        payload:
          $ref: '#/components/schemas/V2xMessagePayload'
      required:
        - payload
    MessageDeliverySubscriptionData:
      type: object
      properties:
        appSerId:
          $ref: '#/components/schemas/AppServerId'
        serviceId:
          $ref: '#/components/schemas/V2xServiceId'
        geoId:
          $ref: '#/components/schemas/GeoId'
        notifUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        requestTestNotification:
          type: boolean
          description: Set to true by the NF service consumer to request the VAE server to send a
test notification as defined in clause 6.1.5.3. Set to false or omitted otherwise.
        websockNotifConfig:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/WebsockNotifConfig'
```

```
        suppFeat:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      required:
        - appSerId
        - serviceId
        - notifUri
    UplinkMessageDeliveryData:
      type: object
      properties:
        resourceUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        ueId:
          $ref: '#/components/schemas/V2xUeId'
        geoId:
          $ref: '#/components/schemas/GeoId'
        payload:
          $ref: '#/components/schemas/V2xMessagePayload'
      required:
        - resourceUri
        - ueId
        - payload
    AppServerId:
      type: string
    V2xUeId:
      type: string
    V2xGroupId:
      type: string
    V2xServiceId:
      type: string
    GeoId:
      type: string
    V2xMessagePayload:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Bytes'
```

A.3 VAE_FileDistribution API

```
openapi: 3.0.0
info:
  version: 1.0.0
  title: VAE_FileDistribution
  description: |
    API for VAE File Distribution Service
    © 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 29.486 V16.1.0 V2X Application Enabler (VAE) Services
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.486/'
security:
  - {}
  - oAuth2ClientCredentials: []
servers:
  - url: '{apiRoot}/vae-file-distribution/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501
paths:
  /file-distributions:
    post:
      summary: VAE File Distributions resource create service Operation
      tags:
        - file distributions collection (Document)
      operationId: CreateFileDistributions
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/FileDistributionData'
        required: true
      responses:
        '201':
          description: File Distribution Resource Created
          headers:
            Location:
              description: 'Contains the URI of the newly created resource'
              required: true
```

```
                schema:
                  type: string
            content:
              application/json:
                schema:
                  $ref: '#/components/schemas/FileDistributionData'
          '400':
            $ref: 'TS29571_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29122_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29571_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29122_CommonData.yaml#/components/responses/404'
          '411':
            $ref: 'TS29571_CommonData.yaml#/components/responses/411'
          '413':
            $ref: 'TS29571_CommonData.yaml#/components/responses/413'
          '415':
            $ref: 'TS29571_CommonData.yaml#/components/responses/415'
          '429':
            $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          default:
            description: Unexpected error
  /file-distributions/{distributionId}:
    get:
      summary: Get an existing individual file distribution resource
      operationId: ReadIndividualFileDistribution
      tags:
        - Individual File Distribution (Document)
      parameters:
        - name: distributionId
          in: path
          description: Identifier of a file distribution resource
          required: true
          schema:
            type: string
      responses:
        '200':
          description: OK. Resource representation is returned
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/FileDistributionData'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29571_CommonData.yaml#/components/responses/406'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
      default:
        $ref: 'TS29571_CommonData.yaml#/components/responses/default'
    delete:
      summary: VAE File Distribution resource delete service Operation
      tags:
        - Individual file distribution (Document)
      operationId: DeleteFileDistribution
      parameters:
        - name: distributionId
          in: path
          required: true
          description: Unique ID of the file distribution to be deleted
          schema:
            type: string
```

```
      responses:
        '204':
          description: The subscription was terminated successfully.
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{tokenUrl}'
          scopes: {}
  schemas:
    FileDistributionData:
      type: object
      properties:
        groupId:
          $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xGroupId'
        fileLists:
          type: array
          items:
            $ref: '#/components/schemas/FileList'
          minItems: 1
        serviceClass:
          type: string
        geoArea:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GeographicArea'
        maxBitrate:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
        maxDelay:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
        suppFeat:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      required:
        - fileLists
        - geoArea
        - maxBitrate
        - maxDelay
    FileList:
      type: object
      properties:
        fileUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        fileDisplayUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        fileEarFetchTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        fileLatFetchTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        fileSize:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
        fileStatus:
          $ref: '#/components/schemas/FileStatus'
        completionTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        keepUpdateInterval:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
        uniAvailability:
          type: boolean
        fileRepetition:
          type: integer
      required:
        - fileUri
```

```
                - fileDisplayUri
                - fileEarFetchTime
                - fileLatFetchTime
                - fileStatus
                - completionTime
                - keepUpdateInterval

        FileStatus:
          anyOf:
          - type: string
            enum:
                - PENDING
                - FETCHED
                - PREPARED
                - TRANSMITTING
                - SENT
          - type: string
```

A.4   VAE_ApplicationRequirement API

```
openapi: 3.0.0
info:
  version: 1.0.1
  title: VAE_ApplicationRequirement
  description: |
    API for VAE Application Requirement Service
    © 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 29.486 V16.4.0 V2X Application Enabler (VAE) Services
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.486/'
security:
  - {}
  - oAuth2ClientCredentials: []
servers:
  - url: '{apiRoot}/vae-app-req/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501
paths:
  /application-requirements:
    post:
      summary: VAE_Application_Requirements resource create service Operation
      tags:
        - application requirements collection (Document)
      operationId: CreateApplicationRequirement
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/ApplicationRequirementData'
        required: true
      responses:
        '201':
          description: Application Requirement Resource Created
          headers:
            Location:
              description: 'Contains the URI of the newly created resource'
              required: true
              schema:
                type: string
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/ApplicationRequirementData'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '411':
          $ref: 'TS29571_CommonData.yaml#/components/responses/411'
```

```yaml
          '413':
            $ref: 'TS29571_CommonData.yaml#/components/responses/413'
          '415':
            $ref: 'TS29571_CommonData.yaml#/components/responses/415'
          '429':
            $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          default:
            $ref: 'TS29571_CommonData.yaml#/components/responses/default'
      callbacks:
        NotifyNetworkResource:
          '{$request.body#/notifUri}':
            post:
              requestBody:
                required: true
                content:
                  application/json:
                    schema:
                      $ref: '#/components/schemas/AppReqNotification'
              responses:
                '204':
                  description: No Content, Notification was succesfull
                '400':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/400'
                '401':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/401'
                '403':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/403'
                '404':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/404'
                '411':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/411'
                '413':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/413'
                '415':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/415'
                '429':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/429'
                '500':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/500'
                '503':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/503'
                default:
                  $ref: 'TS29571_CommonData.yaml#/components/responses/default'
  /application-requirements/{requirementId}:
    get:
      summary: VAE Application Requirement resource read service Operation
      tags:
        - Individual application requirement (Document)
      operationId: ReadApplicationRequirement
      parameters:
        - name: requirementId
          in: path
          description: Identifier of an application requirement resource
          required: true
          schema:
            type: string
      responses:
        '200':
          description: OK. Resource representation is returned
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/ApplicationRequirementData'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29571_CommonData.yaml#/components/responses/406'
        '429':
```

```
                  $ref: 'TS29571_CommonData.yaml#/components/responses/429'
              '500':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/500'
              '503':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/503'
              default:
                  $ref: 'TS29571_CommonData.yaml#/components/responses/default'
      delete:
        summary: VAE Application Requirement resource delete service Operation
        tags:
          - Individual application requirement (Document)
        operationId: DeleteApplicationRequirement
        parameters:
          - name: requirementId
            in: path
            required: true
            description: Unique ID of the application requirement to be deleted
            schema:
                type: string
        responses:
          '204':
            description: The subscription was terminated successfully.
          '400':
              $ref: 'TS29571_CommonData.yaml#/components/responses/400'
          '401':
              $ref: 'TS29571_CommonData.yaml#/components/responses/401'
          '403':
              $ref: 'TS29571_CommonData.yaml#/components/responses/403'
          '404':
              $ref: 'TS29571_CommonData.yaml#/components/responses/404'
          '429':
              $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
              $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
              $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          default:
              $ref: 'TS29571_CommonData.yaml#/components/responses/default'
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{tokenUrl}'
          scopes: {}
  schemas:
    ApplicationRequirementData:
      type: object
      properties:
        ueId:
          $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xUeId'
        groupId:
          $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xGroupId'
        duration:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        serviceId:
          $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xServiceId'
        appRequirement:
          $ref: '#/components/schemas/ApplicationRequirement'
        notifUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        requestTestNotification:
          type: boolean
          description: Set to true by the NF service consumer to request the VAE server to send a
test notification as defined in clause 6.3.5.3. Set to false or omitted otherwise.
        websockNotifConfig:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/WebsockNotifConfig'
        suppFeat:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      required:
        - serviceId
        - appRequirement
        - notifUri
    ApplicationRequirement:
      type: object
      properties:
        serviceLevel:
```

```
              $ref: '#/components/schemas/ServiceLevel'
      AppReqNotification:
        type: object
        properties:
          resourceUri:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
          result:
            $ref: '#/components/schemas/ReservationResult'
        required:
          - resourceUri
          - result
      ServiceLevel:
        anyOf:
        - type: string
          enum:
            - HIGH
            - MEDIUM
            - LOW
        - type: string
      ReservationResult:
        anyOf:
        - type: string
          enum:
            - SUCCESSFUL
            - FAILURE
        - type: string
```

A.5 VAE_DynamicGroup API

```
openapi: 3.0.0
info:
  version: 1.0.1
  title: VAE_DynamicGroup
  description: |
    VAE_Dynamic_Group Service
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    All rights reserved.
externalDocs:
  description: 3GPP TS 29.486 V16.4.0 V2X Application Enabler (VAE) Services
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.486/'
security:
  - {}
  - oAuth2ClientCredentials: []
servers:
  - url: '{apiRoot}/vae-dynamic-group/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause clause 4.4 of 3GPP TS 29.501
paths:
  /group-configurations:
    post:
      summary: VAE_Dynamice_Group resource create service Operation
      tags:
        - application requirements collection (Document)
      operationId: CreateGroupConfiguration
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/GroupConfigurationData'
        required: true
      responses:
        '201':
          description: Application Requirement Resource Created
          headers:
            Location:
              description: 'Contains the URI of the newly created resource'
              required: true
              schema:
                type: string
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/GroupConfigurationData'
```

```
                  '400':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/400'
                  '401':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/401'
                  '403':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/403'
                  '404':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/404'
                  '411':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/411'
                  '413':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/413'
                  '415':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/415'
                  '429':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/429'
                  '500':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/500'
                  '503':
                    $ref: 'TS29571_CommonData.yaml#/components/responses/503'
                default:
                    $ref: 'TS29571_CommonData.yaml#/components/responses/default'
      callbacks:
        NotifyDynamicGroup:
          '{$request.body#/notifUri}':
            post:
              requestBody:
                required: true
                content:
                  application/json:
                    schema:
                      $ref: '#/components/schemas/DynamicGroupNotification'
              responses:
                '204':
                  description: No Content, Notification was succesfull
                '400':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/400'
                '401':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/401'
                '403':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/403'
                '404':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/404'
                '411':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/411'
                '413':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/413'
                '415':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/415'
                '429':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/429'
                '500':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/500'
                '503':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/503'
                default:
                  $ref: 'TS29571_CommonData.yaml#/components/responses/default'
  /group-configurations/{configId}:
    get:
      summary: VAE Group Configuration resource read service Operation
      tags:
        - Individual Group Configuration(Document)
      operationId: ReadDynamicGroupConfiguration
      parameters:
        - name: configId
          in: path
          description: Identifier of an group configuration resource
          required: true
          schema:
            type: string
      responses:
        '200':
          description: OK. Resource representation is returned
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/GroupConfigurationData'
        '400':
```

```
              $ref: 'TS29571_CommonData.yaml#/components/responses/400'
            '401':
              $ref: 'TS29571_CommonData.yaml#/components/responses/401'
            '403':
              $ref: 'TS29571_CommonData.yaml#/components/responses/403'
            '404':
              $ref: 'TS29571_CommonData.yaml#/components/responses/404'
            '406':
              $ref: 'TS29571_CommonData.yaml#/components/responses/406'
            '429':
              $ref: 'TS29571_CommonData.yaml#/components/responses/429'
            '500':
              $ref: 'TS29571_CommonData.yaml#/components/responses/500'
            '503':
              $ref: 'TS29571_CommonData.yaml#/components/responses/503'
            default:
              $ref: 'TS29571_CommonData.yaml#/components/responses/default'
      delete:
        summary: VAE Group Configuration resource delete service Operation
        tags:
          - Individual group configuration (Document)
        operationId: DeleteGroupConfiguration
        parameters:
          - name: configId
            in: path
            required: true
            description: Unique ID of the group configuration to be deleted
            schema:
              type: string
        responses:
          '204':
            description: The subscription was terminated successfully.
          '400':
            $ref: 'TS29571_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29571_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29571_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29571_CommonData.yaml#/components/responses/404'
          '429':
            $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          default:
            $ref: 'TS29571_CommonData.yaml#/components/responses/default'
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{tokenUrl}'
          scopes: {}
  schemas:
    GroupConfigurationData:
      type: object
      properties:
        groupId:
          $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xGroupId'
        definition:
          type: string
        leaderId:
          $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xUeId'
        notifUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        duration:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        requestTestNotification:
          type: boolean
          description: Set to true by the NF service consumer to request the VAE server to send a
test notification as defined in clause 6.4.5.3. Set to false or omitted otherwise.
        websockNotifConfig:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/WebsockNotifConfig'
        suppFeat:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
```

```
        required:
          - groupId
          - definition
          - leaderId
          - notifUri
    DynamicGroupNotification:
      type: object
      properties:
        resourceUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        joinedUeIds:
          type: array
          items:
            $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xUeId'
          minItems: 1
        leftUeIds:
          type: array
          items:
            $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xUeId'
          minItems: 1
      required:
        - resourceUri
```

A.6 VAE_ServiceContinuity API

```
openapi: 3.0.0
info:
  version: 1.0.0
  title: VAE_Service Continuity
  description: |
    API for VAE Service Continuity Service
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    All rights reserved.
externalDocs:
  description: 3GPP TS 29.486 V16.1.0 V2X Application Enabler (VAE) Services
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.486/'
security:
  - {}
  - oAuth2ClientCredentials: []
servers:
  - url: '{apiRoot}/vae-service-continuity/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501
paths:
  /geo-areas/{geoId}:
    get:
      summary: VAE service continuity query service operation
      tags:
        - Individual geographical area (Document)
      operationId: QueryServiceContinuity
      parameters:
        - name: geoId
          in: path
          description: Identifier of a geographical area
          required: true
          schema:
            type: string
        - name: service-id
          in: query
          description: Identifier of a V2X service
          required: true
          schema:
            $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xServiceId'
        - name: supp-feat
          in: query
          description: To filter irrelevant responses related to unsupported features
          schema:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      responses:
        '200':
          description: OK. Resource representation is returned
          content:
            application/json:
              schema:
```

```
                 $ref: '#/components/schemas/V2xServiceInfo'
          '400':
            $ref: 'TS29571_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29571_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29571_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29571_CommonData.yaml#/components/responses/404'
          '406':
            $ref: 'TS29571_CommonData.yaml#/components/responses/406'
          '429':
            $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          default:
            $ref: 'TS29571_CommonData.yaml#/components/responses/default'
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{tokenUrl}'
          scopes: {}
  schemas:
    V2xServiceInfo:
      type: object
      properties:
        serviceIds:
          type: array
          items:
            $ref: 'TS29486_VAE_MessageDelivery.yaml#/components/schemas/V2xServiceId'
          minItems: 1
        suppFeat:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      required:
        - serviceIds
```

Annex B (informative):
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2019-06						TS skeleton of V2X Application Enabler (VAE) Services	0.0.0
2019-09	CT3#105					Inclusion of C3-193499, C3-193310, C3-193501, C3-193603, C3-193604 and editorial changes from Rapporteur	0.1.0
2019-10	CT3#106					Inclusion of C3-193142, C3-194143, C3-194309, C3-194417, C3-194311 and editorial changes from Rapporteur	0.2.0
2019-11	CT3#107					Inclusion of C3-195320, C3-195102, C3-195321, C3-195322, C3-195323, C3-195407 and editorial changes from Rapporteur	0.3.0
2020-02	CT3#108e					Inclusion of C3-201341, C3-201342, C3-201343, C3-201344, C3-201345, C3-201453, C3-201454, C3-201455 and editorial changes from Rapporteur	0.4.0
2020-03	CT#87e	CP-200186				TS sent to plenary for approval	1.0.0
2020-03	CT#87e	CP-200186				TS approved by plenary	16.0.0
2020-06	CT#88e	CP-201251	0001	1	B	Apiversion of VAE_FileDistribution API	16.1.0
2020-06	CT#88e	CP-201251	0003	-	F	Correction to DELETE method of VAE_FileDistribution API	16.1.0
2020-06	CT#88e	CP-201251	0004	1	F	Editoral corrections of 29.486	16.1.0
2020-06	CT#88e	CP-201251	0005	1	F	Storage of YAML files	16.1.0
2020-06	CT#88e	CP-201256	0006	1	F	URI of the VAE APIs	16.1.0
2020-06	CT#88e	CP-201251	0007	1	F	Correct resource tree and service	16.1.0
2020-06	CT#88e	CP-201251	0009	1	F	Corrections to apiVersion	16.1.0
2020-06	CT#88e	CP-201251	0010	1	F	Supported headers, Resource Data type and yaml mapping	16.1.0
2020-06	CT#88e	CP-201255	0011	-	F	Update of OpenAPI version and TS version in externalDocs field	16.1.0
2020-12	CT#90e	CP-203139	0012	1	F	Essential corrections and alignments	16.2.0
2020-12	CT#90e	CP-203139	0013	-	F	Storage of YAML files in 3GPP Forge	16.2.0
2021-03	CT#91e	CP-210245	0015	-	F	Error handling of 29.486	16.3.0
2021-06	CT#92e	CP-211260	0028	-	F	Correct referenced datatype for VAE_MessageDelivery	16.4.0
2021-06	CT#92e	CP-211260	0030	-	F	Correct resourceUri used in Message Delivery procedures	16.4.0
2021-06	CT#92e	CP-211260	0032	-	F	Correction of Individual Downlink Message Delivery resource name	16.4.0
2021-06	CT#92e	CP-211260	0034	-	F	Correct service operation name for VAE_FileDistribution	16.4.0
2021-06	CT#92e	CP-211260	0036	-	F	Correct serivce name and resourceUri for VAE_ApplicationRequirement	16.4.0
2021-06	CT#92e	CP-211260	0038	-	F	Correct service name and resourceUri for VAE_DynamicGroup	16.4.0
2021-06	CT#92e	CP-211260	0042	1	F	Correction of resource name in File Distribution termination procedure	16.4.0
2021-06	CT#92e	CP-211260	0046	1	F	Correction of resource name in Dynamic Group Configuration procedure	16.4.0
2021-06	CT#92e	CP-211264	0057	-	F	Update of OpenAPI version and TS version in externalDocs field	16.4.0

History

Document history		
V16.1.0	August 2020	Publication
V16.2.0	January 2021	Publication
V16.3.0	April 2021	Publication
V16.4.0	August 2021	Publication