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Stage 3
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 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

In drafting the TS/TR, pay particular attention to the use of modal auxiliary verbs! TRs shall not contain any normative provisions.

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

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

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

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

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

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

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

In addition:

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

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

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

1 Scope

The present document specifies the protocols for application layer support for V2X services as specified in 3GPP TS 23.286 [4] for:

- a) V2X application communication among UEs (over the V5-AE interface); and
- b) V2X application communication between the UE and the V2X application server (over the V1-AE interface).

The present specification defines the associated procedures for V2X application communication between the UE and the V2X application server and among UEs.

The present specification defines the usage and interactions of the VAE layer with SEAL services.

The present specification also defines the message format, message contents, error handling and system parameters applied by the protocols for the VAE layer.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.003: "Numbering, addressing and identification".
- [3] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".
- [4] 3GPP TS 23.286: "Application layer support for V2X services; Functional architecture and information flows".
- [5] 3GPP TS 23.434: "Service Enabler Architecture Layer for Verticals (SEAL); Functional architecture and information flows".
- [6] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3".
- [7] 3GPP TS 24.385: "V2X services Management Object (MO)".
- [8] 3GPP TS 24.386: "User Equipment (UE) to V2X control function; protocol aspects; Stage 3".
- [9] 3GPP TS 24.544: "Group Management - Service Enabler Architecture Layer for Verticals (SEAL); Protocol specification".
- [10] 3GPP TS 24.545: "Location Management - Service Enabler Architecture Layer for Verticals (SEAL); Protocol specification".
- [11] 3GPP TS 24.546: "Configuration Management - Service Enabler Architecture Layer for Verticals (SEAL); Protocol specification".
- [12] 3GPP TS 24.547: "Identity Management - Service Enabler Architecture Layer for Verticals (SEAL); Protocol specification".

- [13] 3GPP TS 24.548: "Network Resource Management - Service Enabler Architecture Layer for Verticals (SEAL); Protocol specification".
- [14] 3GPP TS 26.348: "Northbound Application Programming Interface (API) for Multimedia Broadcast/Multicast Service (MBMS) at the xMB reference point".
- [15] 3GPP TS 29.468: "Group Communication System Enablers for LTE (GCSE_LTE); MB2 Reference Point; Stage 3".
- [16] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRAN); Overall description; Stage 2".
- [17] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) protocol specification".
- [18] ETSI TS 102 965: "Intelligent Transport Systems (ITS); Application Object Identifier (ITS-AID); Registration".
- [19] IETF RFC 7231: "Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content".
- [20] ISO TS 17419: "Intelligent Transport Systems - Cooperative systems - Classification and management of ITS applications in a global context".
- [21] 3GPP TS 23.285: "Architecture enhancements for V2X services".
- [22] 3GPP TS 29.486: "V2X Application Enabler (VAE) Services; Stage 3".
- [23] ETSI TS 102 894-2 (V1.2.1): "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs".
- [24] IETF RFC 7230: "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing".

3 Definitions of terms 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].

V2X application enabler client: An entity that provides the client side functionalities corresponding to the V2X application enabler layer.

V2X application enabler server: An entity that provides the server side functionalities corresponding to the V2X application enabler layer.

V2X service identifier: An identifier of a V2X service, e.g. PSID or ITS-AIDs of the V2X application.

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.286 [4] apply:

V2X group
V2X dynamic group
V2X service

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.434 [5] apply:

SEAL service

3.2 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].

AS	Application Server
SEAL	Service Enabler Architecture Layer for Verticals
USD	User Service Description
V2X	Vehicle-to-Everything
VAE	V2X Application Enabler
VAE-C	V2X Application Enabler Client
VAE-S	V2X Application Enabler Server

4 General description

The UE can contain a VAE client (VAE-C). The VAE-C communicates with the VAE server (VAE-S) over the V1-AE interface (see 3GPP TS 23.286 [4]). Furthermore, the VAE-C of a UE can communicate with the VAE-C of another UE over the V5-AE interface (see 3GPP TS 23.286 [4]). Both the VAE-C and the VAE-S can act as an HTTP client or an HTTP server (see IETF RFC 7230 [24]). The HTTP protocol interactions are described in detail in clause 6 and 7.

The VAE layer supports UEs in the LTE-Uu communication range assigning a ProSe Layer-2 Group ID for application layer V2X dynamic group formation (on-network dynamic group creation procedure as defined in clause 6.10).

Additionally, the VAE layer supports UEs in assigning a ProSe Layer-2 Group ID for application layer V2X dynamic group formation (off-network dynamic group creation procedure as defined in clause 6.10).

By means of using the V1-AE interface:

- a) V2X UE registration and de-registration towards the VAE-S can be provided as defined by clause 6.2 and 6.3;
- b) application level location tracking can be provided as defined by clause 6.4;
- c) V2X message delivery can be provided as defined by clause 6.5;
- d) V2X service discovery information can be provided as defined by clause 6.6;
- e) V2X service continuity can be provided as defined by clause 6.7;
- f) dynamic local service information for V2X service continuity can be obtained as defined by clause 6.8;
- g) network monitoring by the V2X UE can be provided as defined by clause 6.9;
- h) V2X USD provisioning can be provided as defined by clause 7.2; and
- i) PC5 parameters provisioning can be provided as defined by clause 7.3.

5 SEAL services

The VAE layer utilizes SEAL services to support V2X services. The SEAL services are specified in 3GPP TS 24.544 [9], 3GPP TS 24.545 [10], 3GPP TS 24.546 [11], 3GPP TS 24.547 [12] and 3GPP TS 24.548 [13]. Interactions between the VAE layer and the SEAL services are described in detail in clause 6.

6 VAE procedures

6.1 General

6.2 V2X UE registration procedure

6.2.1 Client procedure

Upon receiving a request from a V2X application to register for receiving V2X messages from the V2X AS, the VAE-C shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response message for V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <registration-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE which requests the registration;
 - 2) shall include a <reception-uri> element set to the URI for subsequent messages to the VAE-C; and
 - 3) shall include one or more <V2X-service-id> element(s), each element set to the V2X service ID which the V2X UE is interested in receiving; and
- d) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19].

6.2.2 Server procedure

Upon reception of an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <registration-info> element in the <VAE-info> root element

the VAE-S:

- a) shall store the received registration information;
- b) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
 - 2) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <VAE-info> root element:
 - i) shall include a <registration-info> element with a <result> child element set to the value "success" or "failure" indicating success or failure of the registration; and
 - ii) if success and if the V2X service IDs as present in the <registration-info> element of the received HTTP POST request is not fully acceptable to the VAE-S, the VAE-S may change the V2X service IDs to a subset and shall include one or more <V2X-service-id> child elements set to the identities of the new V2X service IDs; and
- c) shall send the HTTP 200 (OK) response towards the VAE-C.

6.3 V2X UE de-registration procedure

6.3.1 Client procedure

Upon receiving a request from a V2X application to de-register for receiving certain V2X service-IDs from the V2X AS, the VAE-C shall send an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response message for V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <de-registration-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of a UE which requests the de-registration; and
 - 2) shall include one or more <V2X-service-id> child element(s), each element set to the V2X service ID that the UE is no longer interested in receiving; and
- d) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19].

6.3.2 Server procedure

Upon reception of an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <de-registration-info> element in the <VAE-info> element in the <VAE-info> element,

the VAE-S:

- a) shall remove the received V2X service IDs from registration information corresponding to the V2X UE;
- b) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
 - 2) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <VAE-info> root element:
 - i) shall include a <de-registration-info> element with a <result> child element set to the value "success" or "failure" indicating success or failure of the de-registration; and
- c) shall send the HTTP 200 (OK) response towards the VAE-C.

6.4 Application level location tracking procedure

6.4.1 Client procedure

Upon entering a new geographical area if the V2X UE has been provisioned with geographical identifier groups (see clause 7) and the V2X UE has subscribed to a certain geographical area identifier group in order to receive V2X messages from the V2X AS for this area, the VAE-C shall send an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response message for V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and

- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <location-tracking-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE that subscribes to a geographical area;
 - 2) shall include a <geo-id> element set to the identity of the geographical area to be subscribed, i.e. the new geographical area where the UE entered; and
 - 3) shall include an <operation> element set to "subscribe".

Upon a successful subscription to a geographical area, the VAE-C shall send an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response message for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <location-tracking-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE that unsubscribes to a geographical area;
 - 2) shall include a <geo-id> element set to the identity of the geographical area to be unsubscribed, i.e. the old geographical area where the UE exited; and
 - 3) shall include an <operation> element set to "unsubscribe".

6.4.2 Server procedure

Upon reception of an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <VAE-info> root element with a <location-tracking-info> element with a <V2X-UE-id> element and an <operation> element set to "subscribe",

the VAE-S:

- a) shall store the received geographical area information and associate this area with the UE identity provided in the <V2X-UE-id> element;
- b) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
 - 2) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <location-tracking-info> element in the <VAE-info> root element:
 - i) shall include a <result> child element set to the value "success" or "failure" indicating success or failure of the subscription; and
 - ii) shall include an <operation> element set to "subscribe"; and
- c) shall send the HTTP 200 (OK) response towards the VAE-C.

Upon reception of an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.VAE-registration+xml MIME body with a <VAE-info> root element with a <location-tracking-info> element with an <V2X-UE-id> element and an <operation> element set to "unsubscribe",

the VAE-S:

- a) shall remove the received geographical area information associated with the UE identity provided in the <V2X-UE-id> element;
- b) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
 - 2) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <location-tracking-info> element in the <VAE-info> root element:
 - i) shall include a <result> child element set to the value "success" or "failure" indicating success or failure of the unsubscription; and
 - ii) shall include an <operation> element set to "unsubscribe"; and
- c) shall send the HTTP 200 (OK) response towards the VAE-C.

6.5 V2X message delivery procedure

6.5.1 Client procedure

6.5.1.1 Reception of a V2X message

Upon receiving an HTTP POST request containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <payload> element included in the <message-info> element in the <VAE-info> root element;

the VAE-C:

- a) shall provide the received information to the V2X application identified by the service indicated in the V2X message, if the identity or group of the V2X message matches the identity of the V2X UE or the group of the VAE client; and
- b) shall send a V2X message reception report as specified in clause 6.5.1.3 if the <message-reception-ind> element and <message-reception-uri> element are included in the received V2X message.

6.5.1.2 Reception of a V2X message reception report

Upon receiving an HTTP POST request containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <result> element included in the <message-info> root element;

the VAE-C:

- a) evaluates the content of the <result> element.

6.5.1.3 Sending of a V2X message reception report

In order to send a V2X message reception report, the VAE-C shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) message, the VAE-C:

- a) shall set the Request-URI to the URI included in the <message-reception-uri> element in the received HTTP POST request message for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and

- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <reception-report> element included in the <VAE-info> root element. In the <reception-report> element, the VAE-C:
 - 1) shall include a <result> element set to a value "success" or "fail" indicating success or failure of the V2X message reception.

6.5.1.4 Sending of a V2X message

In order to send a V2X message, the VAE-C shall send an HTTP POST request message according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request message, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response message for V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <message-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE which requests the sending of the V2X message;
 - 2) shall include a <V2X-service-id> element set to the identity of the V2X service which is interested in sending the V2X message;
 - 3) may include one or more <geo-id> element(s), each element set to the identity of the geographical area containing the location of the V2X UE;
 - 4) may include a <message-reception-ind> element to indicate to the VAE server that a reception report is required; and
 - 5) if a <message-reception-ind> element is included, shall include a <message-reception-uri> element set to the URI for a response to the VAE-C.

6.5.2 Server procedure

6.5.2.1 Reception of a V2X message

Upon receiving an HTTP POST request containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <payload> element included in the <message-info> element in the <VAE-info> root element;

the VAE-S:

- a) shall provide the received information to the V2X application server identified by the service indicated in the V2X message; and
- b) shall send a V2X message reception report as specified in clause 6.5.2.3 if the <message-reception-ind> element and <message-reception-uri> element are included in the received V2X message.

6.5.2.2 Reception of a V2X message reception report

Upon receiving an HTTP POST request containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <result> element included in the <message-info> element in the <VAE-info> root element;

the VAE-S:

- a) evaluates the content of the <result> element.

6.5.2.3 Sending of a V2X message reception report

In order to send a V2X message reception report, the VAE-S shall send a HTTP POST request message according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request message, the VAE-S:

- a) shall set the Request-URI to the URI included in the <message-reception-uri> element in the received HTTP POST request message for reception of a V2X message (see clause 6.5.2.1);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and a <result> element of the <message-info> element set to a value "success" or "fail".

6.5.2.4 Sending of a V2X message to target geographical areas

In order to send a V2X message received from a V2X application server to target geographical areas, the VAE-S shall send a HTTP POST request message to each VAE-C associated with the target geographical area according to procedures specified in IETF RFC 7231 [19]. In each HTTP POST request message, the VAE-S:

- a) shall set the Request-URI to the URI included in the received HTTP response message for V2X UE registration procedure (see clause 6.2) for the VAE-C identified by a <V2X-UE-id> element, determined by association from the target geographical area indicated by the V2X application server;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <message-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE to receive the V2X message, determined by association from the target geographical area indicated by the V2X application server;
 - 2) shall include a <V2X-service-id> element set to the identity of the V2X service which is interested in sending the V2X message;
 - 3) may include a <geo-id> element set to the identity of the geographical area containing the location of the V2X UE;
 - 4) may include a <message-reception-ind> element to indicate to the VAE server that a reception report is required; and
 - 5) if a <message-reception-ind> element is included, shall include a <message-reception-uri> element set to the URI for a response to the VAE-S.

6.5.2.5 Sending of a V2X message to a V2X group

In order to send a V2X message received from a V2X application server, the VAE-S shall send a HTTP POST request message according to procedures specified in IETF RFC 7231 [19] to each VAE-C which has registered for the V2X message delivery service. In the HTTP POST request message, the VAE-S:

- a) shall set the Request-URI to the URI of each VAE-C registered for V2X message delivery service (see clause 6.2);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <message-info> root element:
 - 1) shall include a <V2X-group-id> child element set to the V2X group identity of the VAE-C to receive the V2X message, determined by registration with the identity of the V2X group indicated by the V2X application server;
 - 2) shall include a <V2X-service-id> element set to the identity of the V2X service which is interested in sending the V2X message;

- 3) may include a <geo-id> element set to the identity of the geographical area applicable for the V2X message;
- 4) may include a <message-reception-ind> element to indicate to the VAE-C that a reception report is required; and
- 5) if a <message-reception-ind> element is included, shall include a <message-reception-uri> element set to the URI for a response to the VAE-C.

6.6 V2X service discovery procedure

6.6.1 Client procedure

In order to discover V2X service information from a VAE-S (e.g. available VAE services identified by V2X service identities), the VAE-C shall send an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI received in the VAE client UE configuration document via the SCM-S;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <service-discovery-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE which requests the service discovery.

6.6.2 Server procedure

Upon reception of an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <service-discovery-info> element in the <VAE-info> root element,

the VAE-S:

- a) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
 - 2) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <service-discovery-info> element in the <VAE-info> root element:
 - i) shall include a <result> child element set to the value "success" or "failure" indicating success or failure of getting the service discovery information; and
 - ii) if <result> element is set to "success", shall include a <service-discovery-data> element with one or more <V2X-service-map> element(s), each <V2X-service-map> element shall include:
 - A) one or more <V2X-service-id> element(s) set to the identities of the available V2X service IDs; and
 - B) a <V2X-AS-address> element set to the V2X AS address; and
- b) shall send the HTTP 200 (OK) response towards the VAE-C.

6.7 V2X service continuity procedure

6.7.1 Client procedure

In order to obtaining dynamic local V2X service information from a VAE-S, the VAE-C shall send an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response message for V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body and in the <local-service-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE which requests the local service information; and
 - 2) shall include a <geo-id> element set to the identity of the geographical area for which the local service information is requested.

6.7.2 Server procedure

Upon reception of an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with an <V2X-UE-id> element and a <geo-id> element in the <local-service-info> element in the <VAE-info> root element;

the VAE-S:

- a) shall determine the local service information (e.g. V2X server USD(s), V2X USD) corresponding to the geographical location information received in <geo-id>; and
- b) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
 - 2) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <local-service-info> element in the <VAE-info> root element:
 - i) shall include a <result> child element set to the value "success" or "failure" indicating success or failure of getting the local service information; and
 - ii) if the result is "success", the VAE-S shall include a <local-service-info-content> element which provides the local service information to the VAE-C; and
- c) shall send the HTTP 200 (OK) response towards the VAE-C.

6.8 Dynamic group management procedure

6.8.1 On-network dynamic group creation procedure

6.8.1.1 Server procedure

Upon receiving a Configure Dynamic Group request from a V2X application specific server (see 3GPP TS 29.486 [22]) the VAE-S shall assign a ProSe Layer-2 Group ID to the received dynamic group information from the available ProSe Layer-2 Group ID pool. Then the VAE-S shall generate an HTTP PUT request message according to procedures specified in IETF RFC 7231 [19]. In the HTTP PUT request message, the VAE-S:

- a) shall include a Request-URI set to the URI corresponding to the identity of the VAE-C of the group leader;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <layer2-group-id-mapping> element in the <VAE-info> root element which shall include:
 - 1) a <dynamic-group-info> element which shall include:

- i) a <dynamic-group-id> element set to the identity of the dynamic group;
 - ii) a <group-definition> element set to information about the V2X group; and
 - iii) a <group-leader-id> element set to the identity of the group leader; and
- 2) a <prose-layer2-group-id> element corresponding to the dynamic group information; and
- d) shall send the HTTP PUT request message towards the VAE-C according to IETF RFC 7231 [19].

6.8.1.2 Client procedure

Upon receiving an HTTP PUT request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <layer2-group-id-mapping> element in the <VAE-info> root element;

the VAE-C shall store the content of the <layer2-group-id-mapping> element and may further announce the dynamic group information including the corresponding ProSe Layer-2 Group ID to the other VAE clients within the PC5 communication proximity on a PC5 channel dedicated for V5-AE communications, enabling more V2X UEs to join the dynamic group.

6.8.2 On-network dynamic group notification procedure

6.8.2.1 Client procedure

Once the on-network dynamic group is created as defined in clause 6.8.1, if the group changes (i.e. UE joins or leaves the group), the VAE-C shall generate an HTTP POST request message according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall include a Request-URI set to the URI corresponding to the identity of the VAE-S;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with an <id-list-notification> element in the <VAE-info> root element which shall include:
 - 1) a <dynamic-group-id> element set to the identity of the dynamic group; and
 - 2) one or more <group-member-id> element(s), each of which contains a <V2X-UE-id> child element set to the identity of the joined or left V2X UE and a <group-scope> child element that has the value "joined" or "left"; and
- d) shall send the HTTP POST request message towards the VAE-S according to IETF RFC 7231 [19].

6.8.2.2 Server procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with an <id-list-notification> element in the <VAE-info> root element;

the VAE-S shall send Notify Dynamic Group request (see 3GPP TS 29.486 [22]) towards the V2X application specific server according to IETF RFC 7231 [19].

6.8.3 VAE client initiated on network dynamic group information update procedure

6.8.3.1 Client procedure

In order to update dynamic group information of an on-network V2X dynamic group, the VAE-C shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response message for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <dynamic-group-update-info> element included in the <VAE-info> root element which:
 - 1) shall include a <dynamic-group-info> element which shall include at least one of the followings:
 - i) a <dynamic-group-id> element set to the identity of the dynamic group;
 - ii) a <group-definition> element set to information about the V2X group; and
 - iii) a <group-leader-id> element set to the identity of the new group leader; and
 - 2) shall include an <endpoint-info> element set to the end point information to which response has to be sent;
- d) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19].

6.8.3.2 Server procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with an <dynamic-group-update-info> element in the <VAE-info> root element;

the VAE-S:

- a) shall check for the V2X user authorization to update the group information, and
 - 1) if the authorization fails or if the updated group information is not valid, respond with a HTTP 403 (Forbidden) response to the HTTP POST request and skip rest of the steps;
- b) if the update in group information requires consent from other group member(s), shall obtain the consent from the user as specified in clause 6.8.5;
- c) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
 - 2) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <dynamic-group-update-info> element in the <VAE-info> root element which:
 - i) shall include a <result> child element set to the value "success" or "failure" indicating success or failure of the Dynamic group information update request; and
 - ii) may include a <suggestion> child element including a <group-leader-id> element set to the identity of new potential group leader;
- d) shall send the HTTP 200 (OK) response towards the VAE-C; and
- e) shall update the group document as specified in clause 6.2.5.1 of TS 24.544 [9].

6.8.4 VAE server initiated on network dynamic group information update procedure

6.8.4.1 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with an <dynamic-group-info-update-indication> element in the <VAE-info> root element;

the VAE-C:

- a) shall notify the V2X application specific client about the possible update to group information.

6.8.4.2 Server procedure

In order to update dynamic group information of an on-network V2X dynamic group, if the update in group information requires consent from the group member(s), the VAE-S shall obtain the consent from the user as specified in clause 6.8.5 and shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall include a Request-URI set to the URI corresponding to the identity of the VAE-C;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <dynamic-group-info-update-indication> element in the <VAE-info> root element which shall include:
 - 1) a <dynamic-group-info> element which shall include:
 - i) a <dynamic-group-id> element set to the identity of the dynamic group;
 - ii) a <group-definition> element set to information about the V2X group; and
 - iii) a <group-leader-id> element set to the identity of the new group leader;
- d) shall send the HTTP POST request message towards the VAE-C according to IETF RFC 7231 [19]; and
- e) shall update the group document as specified in clause 6.2.5.1 of TS 24.544 [9].

6.8.5 VAE Server taking consent from user procedure

6.8.5.1 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with an <dynamic-group-update-consent-info> element in the <VAE-info> root element;

the VAE-C:

- a) shall notify the V2X application specific client about the dynamic group information update consent request.

Upon receiving the result of dynamic group information update consent request from the V2X application specific client, the VAE-C:

- b) shall send an HTTP 200(OK) response message including a <dynamic-group-update-consent-info> element with a <result> child element set to "accept" or "reject" in the <VAE-info> root element indicating acceptance or rejection of the request by the V2X user.

6.8.5.2 Server procedure

If the update in group information requires consent from other group member(s), the VAE-S shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall include a Request-URI set to the URI corresponding to the identity of the VAE-C;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <dynamic-group-update-consent-info> element in the <VAE-info> root element which shall include:
 - 1) a <dynamic-group-info> element which shall include:
 - i) a <dynamic-group-id> element set to the identity of the dynamic group;
 - ii) a <group-definition> element set to information about the V2X group; and
 - iii) a <group-leader-id> element set to the identity of the group leader; and
- d) shall send the HTTP POST request message towards the VAE-C according to IETF RFC 7231 [19].

6.9 Network monitoring by the V2X UE procedure

6.9.1 V2X UE subscription for network monitoring information

6.9.1.1 Client procedure

In order to subscribe for the network monitoring information from the VAE-S, the VAE-C shall send an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI corresponding to the identity of the VAE-S;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <network-monitoring-subscription-info> element in the <VAE-info> root element:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE which requests the registration;
 - 2) shall include a <subscription-events> element with one or more <event> child element set to the network monitoring events (e.g. uplink degradation, congestion, overload, coverage) to be subscribed; and
 - 3) shall include a <triggering-criteria> element set to the criteria to indicate when the VAE-S sends the monitoring reports to the VAE-C.

6.9.1.2 Server procedure

Upon reception of an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <network-monitoring-subscription-info> element in the <VAE-info> root element;

the VAE-S:

- a) shall store the received subscription information if the VAE-C is authorized and allowed to access the network monitoring information;
- b) shall generate an HTTP 200 (OK) response according to IETF RFC 7231 [19]. In the HTTP 200 (OK) response message, the VAE-S:
 - 1) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and

- 2) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <network-monitoring-subscription-info> element in the <VAE-info> root element:
 - i) shall include a <V2X-UE-id> element set to the identity of the V2X UE subscribing the network monitoring information; and
 - ii) shall include a <result> child element set to the value "success" or "failure" indicating success or failure of subscribing the network monitoring information; and
- c) shall send the HTTP 200 (OK) response towards the VAE-C.

6.9.2 Notifications for network monitoring information

6.9.2.1 Server procedure

Based on the UE subscription for network monitoring information, the VAE-S shall generate an HTTP POST request message according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall include a Request-URI set to the URI corresponding to the identity of the VAE-C;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <network-monitoring-info-notification> element in the <VAE-info> root element which shall include:
 - 1) a <V2X-UE-id> element set to the identity of the subscribed V2X UE;
 - 2) a <network-monitoring-info> element, which:
 - i) shall include one or more <trigger-id> elements set to the identity of the triggering criteria that resulted in the VAE-S sending the monitoring report to the VAE-C;
 - ii) may include an <uplink-quality-level> element set to the uplink quality level;
 - iii) may include a <congestion-info> element set to the congestion value;
 - iv) may include a <geographical-area> element which shall include at least one of the followings:
 - A) <cell-area>, an element specifying an NCGI which when entered triggers a request for a location report coded as specified in clause 19.6A in 3GPP TS 23.003 [2] for which the monitoring applies; and
 - B) <tracking-area>, an element specifying a tracking area identity coded as specified in clause 19.4.2.3 in 3GPP TS 23.003 [2] for which the monitoring applies;
 - v) may include a <time-validity> element set to the period for which the monitoring applies; and
 - vi) may include an <MBMS-level> element, which may include:
 - A) an <MBMS-coverage-level> element set to the coverage level for MBMS; and
 - B) an <MBMS-bearer-level-event> element set to the MBMS bearer level events; and
- d) shall send the HTTP POST request message towards the VAE-C according to IETF RFC 7231 [19].

6.10 PC5 Provisioning in multi-operator V2X scenarios procedure

6.10.1 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and

- b) an application/vnd.3gpp.vae-info+xml MIME body with a <PC5-provisioning-status-info> element;

the VAE-C shall generate an HTTP 200(OK) response message according to IETF RFC 7231 procedures specified in [19]. In the HTTP 200(OK) response, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <PC5-provisioning-status-info> element included in the <VAE-info> root element which:
 - 1) shall include a <result> element set to the value "success" or "failure" indicating success or failure of the PC5 provisioning status request; and
 - 2) shall include a <PC5-policy-status-report> corresponding to the PC5 policy status request; and
- d) shall send the HTTP 200(OK) response towards the VAE-S according to IETF RFC 7231 [19].

6.10.2 Server procedure

Upon receiving a V2X PC5 provisioning requirement from the V2X application specific server, the VAE-S:

- a) may generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:
 - 1) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
 - 2) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
 - 3) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <PC5-provisioning-status-info> element in the <VAE-info> root element which:
 - A) shall include a <VAE-server-id> element set to the identity of the VAE server which is requester of the PC5 parameters status;
 - B) shall include a <V2X-service-id> element set to the identity of the V2X service for which the VAE server's request corresponds to; and
 - C) may include a <PC5-provisioning-status-report-configuration> element set to the configuration of the VAE-client reporting related to the PC5 Policy status, and optionally PC5 events like PC5 unavailability, PQI load info; and
 - 4) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231[19];

NOTE: if step a) is performed, the VAE-S shall wait the response of step a) from the VAE-C and then perform step b).

6.11 Obtaining dynamic information of the UEs in proximity range procedure

6.11.1 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <subscribe-dynamic-info> element;

the VAE-C shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <subscribe-dynamic-info> element included in the <VAE-info> root element which:
 - 1) shall include a <result> element set to the value "success" or "failure" indicating success or failure of the subscribe dynamic information request; and
 - 2) shall include a <configuration-report> element corresponding to the <reporting-configuration> element; and
- d) shall send the HTTP 200(OK) response towards the VAE-S according to IETF RFC 7231 [19].

6.11.2 Server procedure

In order to manage the dynamic UE location group, the VAE-S shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <subscribe-dynamic-info> element in the <VAE-info> root element which:
 - 1) shall include a <V2X-UE-id> element set to the identity of the UE who are part of the dynamic UE location group; and
 - 2) shall include a <reporting-configuration> element indicating which configuration the UE should report (e.g. frequency of reporting, event based); and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

6.12 V2X groupcast/broadcast configuration by VAE layer procedure

6.12.1 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <V2X-groupcast/broadcast-configuration-info> element;

the VAE-C shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <V2X-groupcast/broadcast-configuration-info> element included in the <VAE-info> root element which:
 - 1) shall include a <result> element set to the value "success" or "failure" indicating success or failure of the V2X groupcast/broadcast configuration request; and
- d) shall send the HTTP 200(OK) response towards the VAE-S according to IETF RFC 7231 [19].

6.12.2 Server procedure

Upon receiving an V2V configuration requirement request from the V2X application specific server, the VAE-S shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <V2X-groupcast/broadcast-configuration-info> element in the <VAE-info> root element which:
 - 1) shall include a <V2X-server-id> element set to the identity of the VAE server which is requester of the V2X groupcast/broadcast configuration;
 - 2) shall include a <V2X-group-id> element set to the V2X group identity for which the V2X groupcast/broadcast configuration is requested;
 - 3) shall include a <V2X-service-id> element set to the V2X service ID for which the groupcast/broadcast configuration is requested;
 - 4) shall include a <PC5-provisioning-policies> element indicating the PC5 provisioning policies/parameters to be used by the V2X-UEs within the V2X service;
 - 5) may include a <relay-V2X-UE-id-list> element which shall include one or more <V2X-UE-id> child element(s), each of which set to the identity of the V2X UE to serve as application layer relays; and
 - 6) may include a <minimum-number-of-transmissions> element set to the minimum number of allowed re-transmissions for the V2X message delivery; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

6.13 Session-oriented services procedure

6.13.1 Client procedure

6.13.1.1 UE initiated session-oriented service establishment

In order to establish a session-oriented service with one or more V2X UEs (remote vehicle), the VAE-C (acting as remote controller) shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-service-trigger-info> element included in the <VAE-info> root element which:
 - 1) shall include a <V2X-UE-id> element set to the identity of the V2X UE which is the remote vehicle;
 - 2) shall include a <V2X-service-id> element set to the V2X service ID for which application requirement corresponds to;
 - 3) shall include a <V2X-application-specific-server-id-info> element set to the identity information of the V2X application specific server;
 - 4) may include a <session-id> element set to the session identifier to be used for the session-oriented service; and

- 5) may include a <V2X-application-QoS-requirements> element indicating the application QoS requirements (reliability, delay, jitter) for the session-oriented service; and
- d) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19].

6.13.1.2 UE initiated session-oriented service update

In order to update a session-oriented service with one or more V2X UEs (remote vehicle), the VAE-C (acting as remote controller) shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-change-trigger-info> element included in the <VAE-info> root element which shall include:
 - 1) a <session-id> element set to the session identifier of the session-oriented service; and
 - 2) a <V2X-application-QoS-requirements> element indicating the application QoS requirements (reliability, delay, jitter) for the session-oriented service that is to be updated; and
- d) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19].

6.13.1.3 UE initiated session-oriented service termination

In order to terminate a session-oriented service with one or more V2X UEs (remote vehicle), the VAE-C (acting as remote controller) shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-termination-trigger-info> element included in the <VAE-info> root element which shall include:
 - 1) a <session-id> element set to the session identifier of the session-oriented service that is to be terminated; and
- d) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19].

6.13.1.4 Session-oriented service establishment

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-service-info> element;

the VAE-C shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-C:

- a) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- b) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-service-info> element included in the <VAE-info> root element which shall include:
 - 1) an <acknowledgement> element indicating the acknowledgement for the request; and
- c) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19] and send a session-oriented service establish notification to the V2X application-specific client.

6.13.1.5 Session-oriented service update

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-change-info> element;

the VAE-C shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-C:

- a) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- b) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-change-info> element included in the <VAE-info> root element which shall include an <acknowledgement> child element indicating the acknowledgement for the change request; and
- c) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19] and send a session-oriented service change notification to the V2X application-specific client.

6.13.1.6 Session-oriented service termination

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-termination-info> element;

the VAE-C shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-C:

- a) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- b) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-termination-info> element included in the <VAE-info> root element which shall include an <acknowledgement> element indicating the acknowledgement for the termination request; and
- c) shall send the HTTP POST request towards the VAE-S according to IETF RFC 7231 [19] and send a session-oriented service termination notification to the V2X application-specific client.

6.13.2 Server procedure

6.13.2.1 UE initiated session-oriented service establishment

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-service-trigger-info> element,

the VAE-S shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-service-trigger-info> element in the <VAE-info> root element which shall include an <acknowledgement> element indicating the acknowledgement for the request; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

If the VAE-S acknowledges the request, the VAE-S shall perform the procedure to establish session oriented service with VAE client (e.g. remote vehicle) according to procedures specified in clause 6.13.2.4.

6.13.2.2 UE initiated session-oriented service update

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-change-trigger-info> element,

the VAE-S shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-change-trigger-info> element in the <VAE-info> root element which shall include an <acknowledgement> element indicating the acknowledgement for the request; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

If the VAE-S acknowledges the request, the VAE-S shall perform the procedure to change session oriented service with VAE client (e.g. remote vehicle) according to procedures specified in clause 6.13.2.5.

6.13.2.3 UE initiated session-oriented service termination

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-termination-trigger-info> element,

the VAE-S shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-termination-trigger-info> element in the <VAE-info> root element which shall include a <result> element indicating success or failure to terminate the session-oriented service; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

If the VAE-S terminates the requested session successfully, the VAE-S shall perform the procedure to terminate session oriented service with VAE client (e.g. remote vehicle) according to procedures specified in clause 6.13.2.6.

6.13.2.4 Session-oriented service establishment

Upon the request from the V2X application specific server or from the VAE client, in order to establish a session-oriented service with one or more VAE clients, the VAE-S shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-service-info> element in the <VAE-info> root element which:
 - 1) shall include a <VAE-client-id> element set to the identity of the VAE client;
 - 2) shall include a <V2X-service-id> element set to the V2X service ID for which application requirement corresponds to;

- 3) may include a <session-id> element set to the session identifier to be used for the session-oriented service; and
 - 4) shall include a <reporting-configuration> element indicating which configuration the UE should report (e.g. frequency of reporting, event based); and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

6.13.2.5 Session-oriented service update

Upon the request from the V2X application specific server or from the VAE client, in order to update a session-oriented service with one or more VAE clients, the VAE-S shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-change-info> element in the <VAE-info> root element which:
 - 1) shall include a <session-id> element set to the session identifier of the session-oriented service that is to be updated; and
 - 2) may include a <V2X-application-QoS-requirements> element indicating the application QoS requirements (reliability, delay, jitter) for the session-oriented service that is to be updated;
 - 3) may include a <network-info> element indicating the change of network; and
 - 4) may include a <server-info> element indicating the change of server; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

6.13.2.6 Session-oriented service termination

Upon the request from the V2X application specific server or from the VAE client, in order to terminate a session-oriented service with one or more VAE clients, the VAE-S shall generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <session-oriented-termination-info> element in the <VAE-info> root element which shall include a <session-id> element set to the session identifier of the session-oriented service that is to be terminated; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

6.14 Switching modes of operations for V2V communications procedure

6.14.1 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with an <communication-status-info> element;

the VAE-C shall generate an HTTP 200(OK) response message according to procedures specified in IETF RFC 7231 [19]. In the HTTP 200(OK) response, the VAE-C:

- a) shall set the Request-URI to the URI included in the received HTTP response for the V2X service discovery procedure (see clause 6.6);
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <communication-status-info> element included in the <VAE-info> root element which:
 - 1) shall include a <V2X-UE-id> element set to the identity of the V2X UE;
 - 2) shall include a <V2V-communication-mode> element indicating which V2V communication mode supported by the V2X UE;
 - 3) may include a <V2X-service-id> element corresponding to the communication status;
 - 4) may include a <cell-info> element indicating the cell information of which the V2X UE is located; and
 - 5) may include a <communication-link-status-info> element indicating the communication status of the V2X UE; and
- d) shall send the HTTP 200(OK) response towards the VAE-S according to IETF RFC 7231 [19].

6.14.2 Server procedure

In order to provide the assistance for V2V communication mode switching, the VAE-S may have acquired the application requirement from the V2X application specific server and may generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <communication-status-info> element in the <VAE-info> root element which:
 - 1) shall include a <V2X-UE-id> element set to the identity of the V2X UE; and
 - 2) may include a <V2X-service-id> element set to the identity of the V2X service being requested; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

Based on the reception of the network monitoring information from the 3GPP network or the communication status information from the <communication-link-status-info> element of an HTTP 200(OK) response, the VAE-S may generate an HTTP POST request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <V2V-communication-assistance-info> element in the <VAE-info> root element which:
 - 1) shall include a <V2X-UE-id> element set to the identity of the V2X UE;
 - 2) may include a <V2X-service-id> element set to the identity of the V2X service corresponding to the recommendation information; and
 - 3) shall include a <V2V-communication-assistance> element indicating the assistance information for V2V communication mode switching to the V2X UE; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

7 Provisioning of parameters by the VAE server

7.1 General

The VAE-S can provision network related information to a VAE-C over the V1-AE interface:

- a) V2X USD provisioning in order to provision V2X USDs for receiving MBMS based V2X traffic; and
- b) PC5 parameters provisioning in order to provide PC5 parameters configuration data.

7.2 V2X USD provisioning

7.2.1 General

The V2X USD information is provided to the VAE-C to allow the V2X service to send V2X messages using MBMS.

7.2.2 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with a <V2X-USD-announcement> element;

the VAE-C:

- a) shall store the received V2X USD information; and
- b) if the SEAL layer (see 3GPP TS 24.548 [13]) indicates that the V2X USD information was sent by unicast, the VAE-C shall send an acknowledgement of the V2X USD information to the VAE-S.

7.2.3 Server procedure

For each VAE-C that the VAE-S is sending a V2X USD announcement to, the VAE-S shall generate an HTTP POST request message request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an "application/vnd.3gpp.vae-info+xml" MIME body with a <V2X-USD-announcement> element associated with the MBMS bearer used to send V2X messages in the <VAE-info> root element which:
 - 1) shall include a <V2X-UE-id> element set to the identity of the V2X UE; and
 - 2) shall include a <V2X-USD-configuration-data> element set to the V2X USD configuration data as specified in 3GPP TS 23.285 [21] which:
 - i) shall include a <TMGI> element set to a TMGI value;
 - ii) shall include one or more MBMS service area IDs in <mbms-service-area-id> elements in the <mbms-service-areas> element;
 - iii) if multiple carriers are supported, shall include the frequency to be used in the <frequency> element; and
 - iv) shall include a <V2X-mbms-sdp> element set to the SDP configuration information applicable to MBMS bearer to use for sending V2X messages; and
- d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].

7.3 PC5 parameters provisioning

7.3.1 General

The PC5 parameters are provided to the VAE-C to allow the V2X service to send V2X messages using V2X communication over PC5.

7.3.2 Client procedure

Upon receiving an HTTP POST request message containing:

- a) a Content-Type header field set to "application/vnd.3gpp.vae-info+xml"; and
- b) an application/vnd.3gpp.vae-info+xml MIME body with an <set-PC5-parameters-info> element;

the VAE-C:

- a) shall store the received PC5 parameters; and
- b) shall send an HTTP 200(OK) response message including a <set-PC5-parameters-info> element with a <result> child element set to "success" or "failure" in the <VAE-info> root element as an acknowledgement of the PC5 parameters to the VAE-S.

7.3.3 Server procedure

For each VAE-C that the VAE-S is sending PC5 parameters to, the VAE-S shall generate an HTTP POST request message request according to procedures specified in IETF RFC 7231 [19]. In the HTTP POST request, the VAE-S:

- a) shall set the Request-URI to the URI corresponding to the identity of the V2X UE;
- b) shall include a Content-Type header field set to "application/vnd.3gpp.vae-info+xml";
- c) shall include an application/vnd.3gpp.vae-info+xml MIME body with a <set-PC5-parameters-info> element in the <VAE-info> root element which:
 - 1) shall include a <V2X-UE-id> element set to the identity of the V2X UE;
 - 2) may include a <PC5-parameters-configuration-data> element set to the PC5 parameters configuration data as specified in 3GPP TS 23.285 [21] which shall include:
 - i) an <expiration-time> set to the validity of the configuration parameters for V2X communication over PC5;
 - ii) one or more <plmn-id> elements in the <plmn-list> element which indicate the PLMNs in which the UE is authorized to use V2X communication over PC5 when the UE is served by E-UTRAN for V2X communication;
 - iii) an <authorized-when-not-served-by-E-UTRAN> element which indicates that the UE is authorized to use V2X communication over PC5 when the UE is not served by E-UTRAN; and
 - iv) a <radio-parameters> element which shall include the following elements:
 - A) one or more <radio-parameters-contents> elements set to the radio parameters for V2X communication over PC5 applicable when the UE is not served by E-UTRAN;
 - B) a <geographical-area> element set to the geographical location where the radio parameters are applicable; and
 - C) an <operator-managed> element which indicates that the radio parameters are "operator managed";
 - 3) may include one or more <V2X-service-id> elements and one or more <layer-2-id> elements in the <V2X-service-ids-list> element which indicate the V2X services authorized for V2X communication over PC5; and

- 4) may include a <result> element set to either "success" or "failure" used to indicate success or failure of the PC5 parameters provisioning; and
 - d) shall send the HTTP POST request towards the VAE-C according to IETF RFC 7231 [19].
-

8 Coding

8.1 General

This clause specifies the coding to enable a VAE-C and a VAE-S to communicate.

8.2 Application unique ID

The AUID shall be set to the VAE service ID as specified in specified in ETSI TS 102 965 [18] or ISO TS 17419 [20].

8.3 Structure

The VAE document shall conform to the XML schema described in clause 8.4.

The <VAE-info> element shall be the root element of the VAE document.

The <VAE-info> element shall include at least one of the followings:

- a) a <registration-info> element;
- b) a <de-registration-info> element;
- c) a <location-tracking-info> element;
- d) a <message-info> element;
- e) a <service-discovery-info> element;
- f) a <local-service-info> element;
- g) an <V2X-USD-announcement> element;
- h) a <set-PC5-parameters-info> element;
- i) a <layer2-group-id-mapping> element;
- j) an <id-list-notification> element;
- k) a <network-monitoring-subscription-info> element;
- l) a <network-monitoring-info-notification> element;
- m) a <communication-status-info> element;
- n) a <V2V-communication-assistance-info> element;
- o) a <dynamic-group-update-info> element;
- p) a <dynamic-group-info-update-indication> element;
- q) a <dynamic-group-update-consent-info> element;
- r) a <PC5-provisioning-status-info> element;
- s) a <subscribe-dynamic-info> element;
- t) a <session-oriented-termination-trigger-info> element;

- u) a <session-oriented-change-trigger-info> element;
- v) <V2X-groupcast/broadcast-configuration-info>;
- w) <session-oriented-service-trigger-info>;
- x) <session-oriented-service-info>;
- y) <session-oriented-change-info>; or
- z) <session-oriented-termination-info>.The <service-discovery-info> element shall include:
 - a) an <V2X-UE-id> element; or
 - b) a <result> element and may include a <service-discovery-data> element.

The <service-discovery-data> element shall include one or more <V2X-service-map> elements. Each <V2X-service-map> element shall include following elements:

- a) one or more <V2X-service-id> element(s); and
- b) a <V2X-AS-address> element.

The <registration-info> element shall include at least one of the followings:

- a) a <V2X-UE-id> element, a <reception-uri> element and one or more <V2X-service-ID> element(s);
- b) a <result> element; or
- c) a <UE-supported-RATs-list> element.

The <service> element shall include a <V2X-service-id> or a <V2X-MSG-type> child element.

The <de-registration-info> element shall include the followings:

- a) a <V2X-UE-id> element and one or more <V2X-service-id> element(s); or
- b) a <result> element.

The <location-tracking-info> element shall include either:

- a) the following elements:
 - a <V2X-UE-id> element;
 - a <geographical-identifier> element shall include a <geo-id> element; and
 - an <operation> element; or
- b) the following elements:
 - a <result> element; and
 - an <operation> element.

The <geographical-identifier> element shall include one or more <geo-id> elements.

The <message-info> element shall include at least one of the followings:

- a) a <V2X-UE-id> element;
- b) a <V2X-group-id> element;
- c) a <payload> element;
- d) a <V2X-service-id> element;
- e) a <geo-id> element;

- f) a <message-reception-ind> element;
- g) a <message-reception-uri> element; or
- h) a <result> element.

The <group> element shall include a <V2X-group-id> child element.

The <local-service-info> element shall include one of the following:

- a) a <V2X-UE-id> element and a <geo-id> element; or
- b) a <result> element and optionally a <local-service-info-content> element which shall include:
 - 1) a <V2X-server-USD> element which shall include:
 - i) a <TMGI> element;
 - ii) a <mbms-service-areas> element;
 - iii) a <frequency> element; and
 - iv) a <V2X-mbms-sdp> element;
 - 2) a <V2X-AS-address> element; and
 - 3) a <V2X-server-USD> element which shall include:
 - i) a <TMGI> element;
 - ii) a <mbms-service-areas> element;
 - iii) a <frequency> element; and
 - iv) a <V2X-mbms-sdp> element.

The <V2X-USD-announcement> element shall include the followings:

- a) a <V2X-UE-id> element; and
- b) a <V2X-USD-configuration-data> element which shall include the followings:
 - 1) a <TMGI> element;
 - 2) a <mbms-service-areas> element;
 - 3) a <frequency> element; and
 - 4) a <V2X-mbms-sdp> element.

The <set-PC5-parameters-info> element shall include the followings:

- a) a <V2X-UE-id> element;
- b) a <PC5-parameters-configure-data> element which shall include:
 - 1) an <expiration-time> element;
 - 2) a <plmn-list> element which shall include one or more <plmn-id> elements;
 - 3) an <authorized-when-not-served-by-E-UTRAN> element;
 - 4) a <radio-parameters> element which shall include:
 - i) one or more <radio-parameters-content> elements;
 - ii) a <geographical-area> element which shall include:
 - A) a <polygon-area> element; or

- B) an <ellipsoid-arc-area> element; and
- iii) an <operator-managed> element; and
- 5) a <V2X-service-ids-list> element which shall include the following elements:
 - i) one or more <V2X-service-id> elements; or
 - ii) one or more <layer-2-id> elements; and
- c) a <result> element.

The <layer2-group-id-mapping> element shall include the followings:

- a) a <dynamic-group-info> element which shall include the following elements:
 - 1) a <dynamic-group-id> element;
 - 2) a <group-definition> element; and
 - 3) a <group-leader-id> element; and
- b) a <prose-layer2-group-id> element.

The <id-list-notification> element shall include the followings:

- a) a <dynamic-group-id> element;
- b) one or more <group-member-id> element(s), each of which shall include the followings:
 - 1) a <V2X-UE-id> element; and
 - 2) a <group-scope> element.

The <network-monitoring-subscription-info> element shall include either:

- a) the following elements:
 - 1) an <V2X-UE-id> element;
 - 2) a <subscription-events> element which shall include one or more <event> elements; and
 - 3) a <triggering-criteria> element; or
- b) the following elements:
 - 1) an <identity> element; and
 - 2) a <result> element.

The <triggering-criteria> element shall include at least one of the following elements:

- 1) a <cell-change> element shall include one of the following sub-elements:
 - i) an <any-cell-change> element shall include a <trigger-id> element;
 - ii) an <enter-specific-cell> element shall include a <trigger-id> element; or
 - iii) an <exit-specific-cell> element include a <trigger-id> element;
- 2) a <tracking-area-change> element shall include one of the following sub-elements:
 - i) an <any-tracking-area-change> element shall include a <trigger-id> element;
 - ii) an <enter-specific-tracking-area> element shall include a <trigger-id> element; or
 - iii) an <exit-specific-tracking-area> element shall include a <trigger-id> element;
- 3) a <plmn-change> element shall include one of the following sub-elements:

- i) an <any-plmn-change> element shall include a <trigger-id> element;
 - ii) an <enter-specific-plmn> element shall include a <trigger-id> element; or
 - iii) an <exit-specific-plmn> element shall include a <trigger-id> element;
- 4) an <mbms-sa-change> element shall include one of the following sub-elements:
- i) an <any-mbms-sa-change> element shall include a <trigger-id> element;
 - ii) an <enter-specific-mbms-sa> element shall include a <trigger-id> element; or
 - iii) an <exit-specific-mbms-sa> element shall include a <trigger-id> element;
- 5) an <mbsfn-area-change> element shall include one of the following sub-elements:
- i) an <any-mbsfn-area-change> element shall include a <trigger-id> element;
 - ii) an <enter-specific-mbsfn-area> element shall include a <trigger-id> element; or
 - iii) an <exit-specific-mbsfn-area> element shall include a <trigger-id> element;
- 6) a <periodic-report> element shall include a <trigger-id> element;
- 7) a <travelled-distance> element shall include a <trigger-id> element;
- 8) a <vertical-application-event> element shall include one of the following sub-elements:
- i) an <initial-log-on> element shall include a <trigger-id> element;
 - ii) a <location-configuration-received> element shall include a <trigger-id> element; or
 - iii) an <any-other-event>, an optional element specifying that any other application signalling event than initial-log-on and location-configuration-received triggers a request for a location report. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- 9) a <geographical-area-change> element shall include one of the following sub-elements:
- i) an <any-area-change> element shall include a <trigger-id> element;
 - ii) an <enter-specific-area> element shall include the following sub-element:
 - A) a <geographical-area> element shall include:
 - I) a <polygon-area> element shall include a <trigger-id> element; or
 - II) an <ellipsoid-arc-area> element shall include a <trigger-id> element;
 - iii) an <exit-specific-area-type> element shall include a <trigger-id> element;

The <network-monitoring-info-notification> element shall include the followings:

- a) a <V2X-ue-id> element; and
- b) a <network-monitoring-info> element, which shall include one or more <trigger-id> elements and may include:
 - 1) an <uplink-quality-level> element;
 - 2) a <congestion-info> element;
 - 3) a <geographical-area> element which shall include at least one of the followings:
 - i) a <cell-area> element; or
 - ii) a <tracking-area> element;
 - 4) a <time-validity> element; or
 - 5) an <MBMS-level> element which may include:

- i) an <MBMS-coverage-level> element; or
- ii) an <MBMS-bearer-level-event> element.

The <communication-status-info> element shall include the followings:

- a) a <V2X-UE-id> element;
- b) a <V2V-communication-mode> element;
- c) a <V2X-service-id> element;
- d) a <cell-info> element; and
- e) a <communication-link-status-info> element.

The <V2V-communication-assistance-info> element shall include the followings:

- a) a <V2X-UE-id> element;
- b) a <V2X-service-id> element; and
- c) a <V2V-communication-assistance> element.

The <dynamic-group-update-info> element shall include the followings:

- a) a <result> element;
- b) an <endpoint-info> element; and
- c) a <dynamic-group-info> element.

The <dynamic-group-info-update-indication> element shall include the following:

- a) a <dynamic-group-info> element.

The <dynamic-group-update-consent-info> element shall include the followings:

- a) a <result> element; and
- b) a <dynamic-group-info> element.

The <PC5-provisioning-status-info> element shall include the followings:

- a) a <VAE-server-id> element;
- b) a <V2X-service-id> element;
- c) a <PC5-provisioning-status-report-configuration> element;
- d) a <result> element; and
- e) a <PC5-policy-status-report> element.

The <subscribe-dynamic-info> element shall include the followings:

- a) a <V2X-UE-id> element;
- b) a <reporting-configuration> element;
- c) a <result> element; and
- d) a <configuration-report> element.

The <V2X-groupcast/broadcast-configuration-info> element shall include the followings:

- a) a <V2X-server-id> element;
- b) a <V2X-group-id> element;

- c) a <V2X-service-id> element;
- d) a <PC5-provisioning-policies> element;
- e) a <relay-V2X-UE-id-list> element with one or more <V2X-UE-id> child element(s);
- f) a <minimum-number-of-transmissions> element; and
- g) a <result> element.

The <session-oriented-termination-trigger-info> element shall include the followings:

- a) a <session-id> element; and
- b) a <result> element.

The <session-oriented-change-trigger-info> element shall include the followings:

- a) a <session-id> element;
- b) a <V2X-application-QoS-requirements> element; and
- c) an <acknowledgement> element.

The <session-oriented-service-trigger-info> element shall include the followings:

- a) a <V2X-UE-id> element;
- b) a <V2X-service-id> element;
- c) a <V2X-application-specific-server-id-info> element;
- d) a <session-id> element;
- e) a <V2X-application-QoS-requirements> element; and
- f) an <acknowledgement> element.

The <session-oriented-service-info> element shall include the followings:

- a) a <VAE-client-id> element;
- b) a <V2X-service-id> element;
- c) a <session-id> element;
- d) a <reporting-configuration> element;
- e) an <acknowledgement> element.

The <session-oriented-change-info> element shall include the followings:

- a) a <session-id> element;
- b) a <V2X-application-QoS-requirements> element;
- c) a <network-info> element;
- d) a <server-info> element; and
- e) an <acknowledgement> element.

The <session-oriented-termination-info> element shall include the followings:

- a) a <session-id> element; and
- b) an <acknowledgement> element.

8.4 XML schema

8.4.1 General

This clause defines the XML schema for application/vnd.3gpp.vae-info+xml.

8.4.2 XML schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
targetNamespace="urn:3gpp:ns:vaeInfo:1.0"
xmlns:vaeinfo="urn:3gpp:ns:vaeInfo:1.0"
elementFormDefault="qualified"
attributeFormDefault="unqualified"
xmlns:xenc="http://www.w3.org/2001/04/xmlenc#">
  <!-- root XML element -->
  <xs:element name="vae-info" type="vaeinfo:vaeinfo-Type" id="vae"/>
  <xs:complexType name="vaeinfo-Type">
    <xs:sequence>
      <xs:element name="registration-info" type="vaeinfo:tRegistrationType" minOccurs="0"/>
      <xs:element name="de-registration-info" type="vaeinfo:tDeregistrationType" minOccurs="0"/>
      <xs:element name="location-tracking-info" type="vaeinfo:tLocationTrackingType"/>
      <xs:element name="message-info" type="vaeinfo:tMessageType" minOccurs="0"/>
      <xs:element name="service-discovery-info" type="vaeinfo:tServiceDiscoveryType" minOccurs="0"/>
      <xs:element name="local-service-info" type="vaeinfo:tLocalServiceType" minOccurs="0"/>
      <xs:element name="layer2-group-id-mapping" type="vaeinfo:tLayer2GroupIDMappingType"
minOccurs="0"/>
      <xs:element name="network-monitoring-subscription-info"
type="vaeinfo:tNetworkMonitoringSubscriptionType" minOccurs="0"/>
      <xs:element name="v2x-usd-announcement" type="vaeinfo:tUSDAnnouncementType"/>
      <xs:element name="set-pc5-parameters-info" type="vaeinfo:tSetPC5ParametersInfoType"/>
      <xs:element name="id-list-notification" type="vaeinfo:tIdListNotificationType" minOccurs="0"/>
      <xs:element name="network-monitoring-info-notification"
type="vaeinfo:tNetworkMonitoringInfoNotificationType" minOccurs="0"/>
      <xs:element name="communication-status-info" type="vaeinfo:tCommunicationStatusInfoType"
minOccurs="0"/>
      <xs:element name="v2v-communication-assistance-info"
type="vaeinfo:tV2vCommunicationAssistanceInfoType" minOccurs="0"/>
      <xs:element name="dynamic-group-info-update" type="vaeinfo:tDynamicGroupInfoUpdateType"
minOccurs="0"/>
      <xs:element name="dynamic-group-info-update-indication"
type="vaeinfo:tDynamicGroupInfoUpdateIndicationType" minOccurs="0"/>
      <xs:element name="dynamic-group-info-update-consent"
type="vaeinfo:tDynamicGroupInfoUpdateConsentType" minOccurs="0"/>
      <xs:element name="session-oriented-termination-trigger-info"
type="vaeinfo:tSessionOrientedServiceTerminationInfoType" minOccurs="0"/>
      <xs:element name="session-oriented-change-trigger-info"
type="vaeinfo:tSessionOrientedChangeTriggerInfoType" minOccurs="0"/>
      <xs:element name="session-oriented-service-trigger-info"
type="vaeinfo:tSessionOrientedServiceTriggerInfoType" minOccurs="0"/>
      <xs:element name="v2x-groupcast-broadcast-configuration-info"
type="vaeinfo:tGroupcastBroadcastConfigurationInfoType" minOccurs="0"/>
      <xs:element name="subscribe-dynamic-info" type="vaeinfo:tSubscribeDynamicInfoType"
minOccurs="0"/>
      <xs:element name="PC5-provisioning-status-info" type="vaeinfo:tPC5ProvisioningStatusInfoType"
minOccurs="0"/>
      <xs:element name="session-oriented-service-info"
type="vaeinfo:tSessionOrientedServiceInfoType" minOccurs="0"/>
      <xs:element name="session-oriented-change-info" type="vaeinfo:tSessionOrientedChangeInfoType"
minOccurs="0"/>
      <xs:element name="session-oriented-termination-info"
type="vaeinfo:tSessionOrientedTerminationInfoType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax"/> minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tRegistrationType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="v2x-service-id" type="xs:string" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="UE-supported-RATs-list" type="tRATType" minOccurs="1" maxOccurs="1"/>
      <xs:element name="result" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
  </xs:complexType>
</xs:schema>
```

```

    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tRATType">
    <xs:sequence>
      <xs:element name="RAT" type="vaeinfo:contentType" minOccurs="1" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tDeregistrationType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="reception-uri" type="xs:anyURI" minOccurs="0" maxOccurs="1"/>
      <xs:element name="v2x-service-id" type="xs:string" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="result" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tLocationTrackingType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="geo-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="result" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="operation" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tMessageType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="v2x-group-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="payload" type="xs:string" minOccurs="1" maxOccurs="unbounded"/>
      <xs:element name="v2x-service-id" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="geo-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="message-reception-ind" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="message-reception-uri" type="xs:anyURI" minOccurs="0" maxOccurs="1"/>
      <xs:element name="result" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tServiceDiscoveryType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="result" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="service-discovery-data" type="vaeinfo:tServiceDiscoveryDataType"
minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tLocalServiceType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="geo-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>
      <xs:element name="result" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="local-service-info-content" type="vaeinfo:tLocalServiceInfoContentType"
minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tLayer2GroupIDMappingType">
    <xs:sequence>
      <xs:element name="dynamic-group-info" type="vaeinfo:tDynamicGroupInfoType" minOccurs="1"
maxOccurs="1"/>
      <xs:element name="prose-layer2-group-id" type="vaeinfo:contentType" minOccurs="1"
maxOccurs="1"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tNetworkMonitoringSubscriptionType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="0" maxOccurs="1"/>

```

```

    <xs:element name="subscription-events" type="vaeinfo:tSubscriptionEventType" minOccurs="0"
maxOccurs="1"/>
    <xs:element name="triggering-criteria" type="vaeinfo:tTriggeringCriteriaType"/>
    <xs:any namespace="##other" processContents="lax"/>
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    <xs:element name="mbms-sa-change" type="vaeinfo:tMbmsSaChangeType" minOccurs="0"/>
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  <xs:sequence>
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    <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
  </xs:sequence>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>
<xs:complexType name="tRadioParametersType">
  <xs:sequence>
    <xs:element name="radio-parameters-content" type="xs:string" minOccurs="1"
maxOccurs="unbounded"/>
    <xs:element name="geographical-area" type="vaeinfo:tGeographicalAreaDef"/>
    <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
  </xs:sequence>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>
<xs:complexType name="tIDListType">
  <xs:sequence>
    <xs:element name="v2x-service-id" type="vaeinfo:contentType" minOccurs="1"
maxOccurs="unbounded"/>
    <xs:element name="layer2-id" type="vaeinfo:contentType" minOccurs="1" maxOccurs="unbounded"/>
    <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
  </xs:sequence>

```

```

    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tUeIDListType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="1" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tGeographicalAreaDef">
    <xs:sequence>
      <xs:element name="polygon-area" type="vaeinfo:tPolygonAreaType" minOccurs="0"/>
      <xs:element name="ellipsoid-arc-area" type="vaeinfo:tEllipsoidArcType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tPolygonAreaType">
    <xs:sequence>
      <xs:element name="corner" type="vaeinfo:tPointCoordinate" minOccurs="3" maxOccurs="15"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tEllipsoidArcType">
    <xs:sequence>
      <xs:element name="center" type="vaeinfo:tPointCoordinate"/>
      <xs:element name="radius" type="xs:nonNegativeInteger"/>
      <xs:element name="offset-angle" type="xs:unsignedByte"/>
      <xs:element name="included-angle" type="xs:unsignedByte"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tPointCoordinate">
    <xs:sequence>
      <xs:element name="longitude" type="vaeinfo:tCoordinateType"/>
      <xs:element name="latitude" type="vaeinfo:tCoordinateType"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tGroupMemberIdType">
    <xs:sequence>
      <xs:element name="v2x-ue-id" type="vaeinfo:contentType" minOccurs="1" maxOccurs="1"/>
      <xs:element name="group-scope" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tNetworkMonitoringInfoType">
    <xs:sequence>
      <xs:element name="triggering-criteria" type="vaeinfo:tTriggeringCriteriaType" minOccurs="1"
maxOccurs="1"/>
      <xs:element name="uplink-quality-level" type="vaeinfo:tIntegerAttributeType" minOccurs="0"/>
      <xs:element name="congestion-info" type="vaeinfo:tIntegerAttributeType" minOccurs="0"/>
      <xs:element name="geographical-area" type="vaeinfo:tGeographicalAreaDef" minOccurs="0"/>
      <xs:element name="time-validity" type="vaeinfo:tIntegerAttributeType" minOccurs="0"/>
      <xs:element name="MBMS-level" type="vaeinfo:tMbmsLevelType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="tMbmsLevelType">
    <xs:sequence>
      <xs:element name="MBMS-coverage-level" type="vaeinfo:tIntegerAttributeType" minOccurs="0"/>
      <xs:element name="MBMS-bearer-level-event" type="xs:string" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="vaeinfo:anyExtType" minOccurs="0"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
</xs:schema>

```

8.5 Data semantics

The <VAE-info> element is the root element of the XML document. The <VAE-info> element contains the <registration-info>, <de-registration-info>, <location-tracking-info>, <message-info>, <service-discovery-info>, <local-service-info>, <V2X-USD-announcement>, <set-PC5-parameters-info>, <layer2-group-id-mapping>, <id-list-notification>, <network-monitoring-subscription-info> and <network-monitoring-info-notification>, <communication-status-info>, <V2V-communication-assistance-info>, <dynamic-group-update-info>, <dynamic-group-info-update-indication>, <dynamic-group-update-consent-info>, <PC5-provisioning-status-info>, <subscribe-dynamic-info>, <V2X-groupcast/broadcast-configuration-info>, <session-oriented-termination-trigger-info>, <session-oriented-change-trigger-info>, <session-oriented-service-trigger-info>, <session-oriented-service-info>, <session-oriented-change-info> and <session-oriented-termination-info> sub-elements.

<registration-info> element contains the following elements:

- a) <V2X-UE-id>, an element contains the identity of the V2X UE;
- b) <reception-uri>, an element that contains the URI of the V2X UE;
- c) one or more <V2X-service-id> elements. Each <V2X-service-id> element contains the V2X service ID which the V2X UE is interested in receiving (e.g. PSID or ITS AID of ETSI ITS DENM, ETSI ITS CAM);
- d) <result>, an element which indicates a value either "success" or "fail"; and
- e) <UE-supported-RATs-list>, an optional element contains the following elements:
 - 1) one or more <RAT-type> elements. Each <RAT-type> element contains the RAT type which the V2X UE supports (e.g. NR, E-UTRA).

<V2X-UE-id> is a mandatory element used to include the identity of a VAL client. The <V2X-UE-id> element contains the identity of the VAL client. (e.g. StationID as specified in ETSI TS 102 894-2 [23] or GPSI as specified in clause 28.8

<reception-uri> element indicates the destination URI of messages sent to the V2X UE, and includes a URI as specified in IETF RFC 7231 [19].

<de-registration-info> element contains the following elements:

- a) <V2X-UE-id>, an element contains the identity of the V2X UE;
- b) one or more <V2X-service-id> elements. Each <V2X-service-id> element contains the V2X service ID which the V2X UE is no longer interested in receiving (e.g. PSID or ITS AID of ETSI ITS DENM, ETSI ITS CAM); and
- c) <result>, an element which indicates a value either "success" or "fail".

<location-tracking-info> element contains the following elements:

- a) a <V2X-UE-id> element set to the identity of the V2X UE that subscribes or unsubscribes to a geographical area;
- b) a <geo-id> element set to the identity of the geographical area to be subscribed or unsubscribed;
- c) an <operation> element which indicates a value either "subscribe" or "unsubscribe"; and
- d) a <result> element set to the value "success" or "failure" indicating success or failure of the subscription or unsubscription.

<message-info> element contains the following elements;

- a) <V2X-UE-id>, an optional element contains the identity of the V2X UE;
- b) <V2X-group-id>, an optional element contains the identity of the V2X group;
- c) <payload>, an optional element contains the payload of the V2X message (e.g. ETSI ITS DENM);
- d) <V2X-service-id>, an optional element contains the V2X service ID which the V2X message belongs to;

- e) <geo-id>, an optional element contains a geographical area identity representing a geographical area;
- f) <message-reception-ind>, an optional element used to indicate that a reception report is required to be sent;
- g) <message-reception-uri>, an optional element indicates the destination URI of a requested reception report, and includes a URI as specified in IETF RFC 7231 [19]; or
- h) <result>, an optional element contains a string set to either "success" or "failure" used to indicate success or failure of the V2X message reception.

<service-discovery-info> is a mandatory element used to include the V2X service discovery response information. The <service-discovery-info> element contains the following elements:

- a) an <V2X-UE-id> sub-element;
- b) a <result> sub-element; and
- c) <service-discovery-data> sub-element.

The <service-discovery-data> is an optional element which shall include one or more <V2X-service-map> elements.

The <V2X-service-map> element shall include following attributes:

- a) one or more <V2X-service-id> attributes that each contains a V2X service identifier as specified in ETSI TS 102 965 [18] and ISO TS 17419 [20]; and
- b) a <V2X-AS-address> attribute that contains a V2X application server address as specified in 3GPP TS 23.285 [21].

<local-service-info> element contains the following elements:

- a) a <V2X-UE-id> element and a <geo-id> element;
- b) a <result> element set to the value "success" or "failure" indicating success or failure of getting the local service information; and
- c) a <local-service-info-content> element which provides the local service information.

<geo-id> element contains a geographical area identity representing a geographical area.

<local-service-info-content> is an optional element and contains the following sub-elements:

- a) a <V2X-server-USD> element that specifying the information for V2X server USD and has the following sub-elements:
 - 1) a <TMGI> element;
 - 2) an <mbms-service-areas> element;
 - 3) a <frequency> element; and
 - 4) a <V2X-mbms-sdp> element;
- b) a <V2X-AS-address> element that contains a V2X application server address as specified in 3GPP TS 23.285 [21]; and
- c) a <V2X-USD> element that specifying the information for V2X USD and has the following sub-elements:
 - 1) a <TMGI> element;
 - 2) an <mbms-service-areas> element;
 - 3) a <frequency> element; and
 - 4) a <V2X-mbms-sdp> element.

<V2X-USD-announcement> is an element used to describe the V2X USD information that V2X UE received from the VAE server which contains the <V2X-UE-id> and <V2X-USD-configuration-data> sub-elements.

<V2X-USD-configuration-data> element is a mandatory element set to the V2X USD configuration data as specified in 3GPP TS 23.285 [21] which contains the <TMGI>, <mbms-service-areas>, <frequency> and <V2X-mbms-sdp> sub-elements.

<TMGI> is a mandatory element encoded as specified in 3GPP TS 24.008 [6] excluding the Temporary mobile group identity IEI and the length of Temporary mobile group identity IE contents.

<mbms-service-areas> is a mandatory element which contains one or more <mbms-service-area-id> elements. Each <mbms-service-area-id> contains a MBMS SAI, encoded as specified in 3GPP TS 23.003 [2].

<frequency> is an optional element encoded as specified in 3GPP TS 29.468 [15].

<V2X-mbms-sdp> is mandatory element which contains SDP configuration information encoded as specified in 3GPP TS 24.386 [8] clause 7.2.2.

<set-PC5-parameters-info> element contains the following elements:

- a) <V2X-UE-id>, an element contains the identity of the V2X UE;
- b) <PC5-parameters-configuration-data>, an optional element set to the PC5 parameters configuration data as specified in 3GPP TS 23.285 [21] contains the following elements:
 - 1) <expiration-time>, a mandatory element encoded as specified in 3GPP TS 24.385 [7] clause 5.5.2;
 - 2) <plmn-list>, a mandatory element which contains one or more <plmn-id> elements, each <plmn-id> element is encoded as specified in 3GPP TS 23.003 [2];
 - 3) <authorized-when-not-served-by-E-UTRAN>, a mandatory element encoded as specified in 3GPP TS 24.385 [7] clause 5.5.8;
 - 4) <radio-parameters>, a mandatory element contains the following elements:
 - i) one or more <radio-parameters-content> elements, each <radio-parameters-content> element is encoded as specified in 3GPP TS 36.331 [17] clause 9 for the SL-V2X-Preconfiguration;
 - ii) <geographical-area>, a mandatory element specifying a geographical area and has the following sub-elements:
 - A) <polygon-area>, an optional element specifying the area as a polygon specified in clause 5.2 of 3GPP TS 23.032 [3]; and
 - B) <ellipsoid-arc-area>, an optional element specifying the area as an ellipsoid arc specified in clause 5.7 of 3GPP TS 23.032 [3]; and
 - iii) <operator-managed>, a mandatory element encoded as specified in 3GPP TS 24.385 [7] clause 5.5.19; and
 - 5) <V2X-service-ids-list>, a mandatory element contains the following elements:
 - i) one or more <V2X-service-id> elements. Each <V2X-service-id> element contains the V2X service ID which the V2X UE is no longer interested in receiving (e.g. PSID or ITS AID of ETSI ITS DENM, ETSI ITS CAM); and
 - ii) one or more <layer2-id> elements. Each <layer2-id> element is encoded as the DestinationLayer2ID specified in 3GPP TS 36.300 [16]; and- c) <result>, an optional element which indicates a value either "success" or "failure".

<layer2-group-id-mapping> element contains the following elements:

- a) <dynamic-group-info> element; and
- b) <prose-layer2-group-id>, an element contains the identity of the ProSe Layer-2 Group.

<dynamic-group-info> element contains the following elements:

- a) <dynamic-group-id>, an element contains the identity of the dynamic group;

- b) <group-definition>, an element containing dynamic group definition information; and
- c) <group-leader-id>, an element contains the identity of the group leader.

<id-list-notification> element contains the following sub-elements:

- a) <dynamic-group-id>, an element set to the identity of the dynamic group; and
- b) one or more <group-member-id> element(s), each <group-member-id> element contains the following sub-elements:
 - 1) a <V2X-UE-id> element, an element set to the identity of the joined or left V2X UE; and
 - 2) <group-scope>, an element that has the value "joined" or "left". The value "joined" means that the V2X UE joined the group. The value "left" means that the V2X UE left the group.

<network-monitoring-subscription-info> is an optional element which contains the <V2X-UE-id>, <subscription-events> and <triggering-criteria> sub-elements.

<subscription-events> is a mandatory element which contains one or more <events> sub-elements.

<event> element contains a string set to either "uplink degradation" or "congestion" or "overload" or "coverage".

<triggering-criteria>, a mandatory element which contains at least one of the following sub-elements:

- a) <cell-change>, an optional element specifying what cell changes trigger the VAE-S to send monitoring reports to the VAE-C. This element consists of the following sub-elements:
 - 1) <any-cell-change>, an optional element. The presence of this element specifies that any cell change is a trigger. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
 - 2) <enter-specific-cell>, an optional element specifying an NCGI which when entered triggers a request for allocation report coded as specified in clause 19.6A in 3GPP TS 23.003 [2]. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string; and
 - 3) <exit-specific-cell>, an optional element specifying an NCGI which when exited triggers the VAE-S to send monitoring reports to the VAE-C coded as specified in clause 19.6A in 3GPP TS 23.003 [2]. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- b) <tracking-area-change>, an optional element specifying what tracking area changes trigger the VAE-S to send monitoring reports to the VAE-C. This element consists of the following sub-elements:
 - 1) <any-tracking-area-change>, an optional element. The presence of this element specifies that any tracking area change is a trigger. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
 - 2) <enter-specific-tracking-area>, an optional element specifying a tracking area identity coded as specified in clause 19.4.2.3 in 3GPP TS 23.003 [2] which when entered triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string; and
 - 3) <exit-specific-tracking-area>, an optional element specifying a tracking area identity coded as specified in clause 19.4.2.3 in 3GPP TS 23.003 [2] which when exited triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- c) <plmn-change>, an optional element specifying what PLMN changes trigger the VAE-S to send monitoring reports to the VAE-C. This element consists of the following sub-elements:
 - 1) <any-plmn-change>, an optional element. The presence of this element specifies that any PLMN change is a trigger. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
 - 2) <enter-specific-plmn>, an optional element specifying a PLMN id (MCC+MNC) coded as specified in 3GPP TS 23.003 [2] which when entered triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string; and

- 3) <exit-specific-plmn>, an optional element specifying a PLMN id (MCC+MNC) coded as specified in 3GPP TS 23.003 [2] which when exited triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- d) <mbms-sa-change>, an optional element specifying what MBMS changes trigger the VAE-S to send monitoring reports to the VAE-C. This element consists of the following sub-elements:
 - 1) <any-mbms-sa-change>, an optional element. The presence of this element specifies that any MBMS SA change is a trigger for the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
 - 2) <enter-specific-mbms-sa>, an optional element specifying an MBMS service area id which when entered triggers the VAE-S to send monitoring reports to the VAE-C. The MBMS service area id is coded as specified in clause 15.3 in 3GPP TS 23.003 [2] for service area identifier (SAI). This element contains a mandatory <trigger-id> attribute that shall be set to a unique string; and
 - 3) <exit-specific-mbms-sa>, an optional element specifying an MBMS service area id which when exited triggers the VAE-S to send monitoring reports to the VAE-C. The MBMS service area id is coded as specified in clause 15.3 in 3GPP TS 23.003 [2] for service area identifier (SAI). This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- e) <mbsfn-area-change>, an optional element specifying what MBSFN changes trigger a request for the VAE-S to send monitoring reports to the VAE-C. This element consists of the following sub-elements:
 - 1) <any-mbsfn-area-change>, an optional element. The presence of this element specifies that any MBSFN area change is a trigger for the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
 - 2) <enter-specific-mbsfn-area>, an optional element specifying an MBSFN area which when entered triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string; and
 - 3) <exit-specific-mbsfn-area>, an optional element specifying an MBSFN area which when exited triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- f) <periodic-report>, an optional element specifying that periodic request for the VAE-S to send monitoring reports to the VAE-C shall be sent. The value in seconds specifies the reporting interval. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- g) <travelled-distance>, an optional element specifying that the travelled distance shall trigger a request for the VAE-S to send monitoring reports to the VAE-C. The value in metres specified the travelled distance. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- h) <vertical-application-event>, an optional element specifying what application signalling events triggers the VAE-S to send monitoring reports to the VAE-C. The <vertical-application-event> element has the following sub-elements:
 - 1) <initial-log-on>, an optional element specifying that an initial log on triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
 - 2) <location-configuration-received>, an optional element specifying that a received location configuration triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string; and
 - 3) <any-other-event>, an optional element specifying that any other application signalling event than initial-log-on and location-configuration-received triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string; and
- i) <geographical-area-change>, an optional element specifying what geographical area changes trigger the VAE-S to send monitoring reports to the VAE-C. This element consists of the following sub-elements:

- 1) <any-area-change>, an optional element. The presence of this element specifies that any geographical area change is a trigger. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string;
- 2) <enter-specific-area>, an optional element specifying a geographical area which when entered triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string. The <enter-specific-area> element has the following sub-elements:
 - i) <geographical-area>, an optional element containing a <trigger-id> attribute and the following two sub-elements:
 - A) <polygon-area>, an optional element specifying the area as a polygon specified in clause 5.2 in 3GPP TS 23.032 [3]; and
 - B) <ellipsoid-arc-area>, an optional element specifying the area as an ellipsoid arc specified in clause 5.7 in 3GPP TS 23.032 [3]; and
- 3) <exit-specific-area-type>, an optional element specifying a geographical area which when exited triggers the VAE-S to send monitoring reports to the VAE-C. This element contains a mandatory <trigger-id> attribute that shall be set to a unique string.

The <network-monitoring-info-notification> element contains the following sub-elements:

- a) <VAL-UE-id>, an element contains the identity of the V2X UE who subscribes the network monitoring information; and
- b) <network-monitoring-info>, an element contains one or more <trigger-id> attributes that identifies the triggering criteria that resulted in the VAE-S sending the monitoring report to the VAE-C. In addition, the <network-monitoring-info> contains the following sub-elements:
 - 1) <uplink-quality-level>, an optional element contains an integer used to indicate the uplink quality level;
 - 2) <congestion-info>, an optional element contains an integer used to indicate the congestion level that may be exact value for congestion status reported by NWDAF to NEF or abstracted value e.g. (High, Medium, Low) which can be reported by the NEF to the AF;
 - 3) <geographical-area>, an optional element contains the following elements:
 - i) <cell-area>, an optional element specifying an NCGI which when entered triggers a request for a location report coded as specified in clause 19.6A in 3GPP TS 23.003 [2] for which the monitoring applies; and
 - ii) <tracking-area>, an optional element specifying a tracking area identity coded as specified in clause 19.4.2.3 in 3GPP TS 23.003 [2] for which the monitoring applies;
 - 4) <time-validity>, an optional element specifies the period for which the monitoring applies; and
 - 5) <MBMS-level>, an optional element contains the following elements:
 - i) <MBMS-coverage-level>, an optional element contains an integer used to indicate the MBMS coverage level; or
 - ii) <MBMS-bearer-level-event>, an optional element contains a string used to indicate the MBMS bearer level events.

The <communication-status-info> element contains the following sub-elements:

- a) <V2X-UE-id>, a mandatory element contains the identity of the V2X UE;
- b) <V2V-communication-mode>, a mandatory element contains a string "LTE-PC5" or "NR-PC5" indicating which V2V communication mode supported by the V2X UE;
- c) <V2X-service-id>, an optional element contains the V2X service ID corresponding to the communication status;
- d) <cell-info>, an optional element contains a string "NR cell" or "E-UTRA cell" indicating the cell information of which the V2X UE is located; and
- e) <communication-link-status-info>, an optional element contains the following sub-elements:

- 1) <uplink-data-rate>, an optional element contains a positive number set to the uplink data rate;
- 2) <downlink-data-rate>, an optional element contains a positive number set to the downlink data rate; and
- 3) <packet-loss-rate>, an optional element contains a percentage set to the packet loss rate.

The <V2V-communication-assistance-info> element contains the following sub-elements:

- a) <V2X-UE-id>, a mandatory element contains the identity of the V2X UE;
- b) <V2X-service-id>, an optional element contains the V2X service ID corresponding to the recommendation information; and
- c) <V2V-communication-assistance>, a mandatory element contains the following sub-elements:
 - 1) <V2V-communication-mode>, an optional element contains a string "LTE-PC5" or "NR-PC5" indicating which V2V communication mode recommended by the VAE-S;
 - 2) <geographical-area>, a mandatory element specifying a geographical area and has the following sub-elements:
 - i) <polygon-area>, an optional element specifying the area as a polygon specified in clause 5.2 of 3GPP TS 23.032 [3]; and
 - ii) <ellipsoid-arc-area>, an optional element specifying the area as an ellipsoid arc specified in clause 5.7 of 3GPP TS 23.032 [3];
 - 3) <V2X-service-id>, an optional element contains a string set to the V2X service ID corresponding to the switching mode;
 - 4) <time-validity>, an optional element specifying the period for which the switching applies;
 - 5) <V2X-service-status>, an optional element indicating the V2X service status corresponding to the V2X service ID; and
 - 6) <V2X-application-requirements>, an optional element contains a string indicating the application requirements for the V2V communication switching.

The <dynamic-group-update-info> element contains the following sub-elements:

- a) <dynamic-group-info>, a mandatory element indicates the dynamic group information to update which shall include at least one of the followings:
 - 1) <dynamic-group-id>, an element contains a string set to the identity of the dynamic group;
 - 2) <group-definition>, an element contains a string set to information about the V2X group; and
 - 3) <group-leader-id>, an element contains a string set to the identity of the new group leader;
- b) <endpoint-info>, an element contains a URI set to the end point information to which response has to be sent; and
- c) a <result> element set to the value "success" or "failure" indicating success or failure of indicating success or failure of the Dynamic group information update request.

The <dynamic-group-info-update-indication> contains the following element:

- a) <dynamic-group-info>, an element contains the dynamic group information for which update request has been received.

The <dynamic-group-update-consent-info> element contains the following sub-elements:

- a) <dynamic-group-info>, a mandatory element indicates the dynamic group information update consent; and
- b) a <result> element set to the value "accept" or "reject" indicating acceptance or rejection of the request by the V2X user.

The <PC5-provisioning-status-info> element contains the following sub-elements:

- a) <VAE-server-id>, an element contains a string set to the identity of the VAE server which is requester of the PC5 parameters status;
- b) <V2X-service-id>, an element contains the V2X service ID for which the VAE server's request corresponds to;
- c) <PC5-provisioning-status-report-configuration>, an element contains the following sub-elements:
 - 1) <configuration-reporting-PC5-policy-status>, an element contains a string used to indicate the configuration of the VAE-client reporting related to the PC5 Policy status; and
 - 2) <PC5-events>, an element contains one or more <PC5-event> element(s). Each of the <PC5-event> element contains a string set to either "PC5 unavailability" or "congestion".
- d) <result>, an element set to the value "success" or "failure" indicating success or failure of the PC5 provisioning status request; and
- e) <PC5-policy-status-report>, an element contains the following sub-elements:
 - 1) <selected-PQI-attributes>, an element contains a string set to the selected PQI attributes for the V2X service;
 - 2) <PQI-load-info>, an element contains a string indicating the PQI load information;
 - 3) <range>, an element contains a number in units of meters indicating the communication range for the V2X service;
 - 4) <RAT-type>, an element contains a string "LTE-PC5" or "NR-PC5" indicating which RAT type is preferred;
 - 5) <RAT-availability>, an element contains a string "YES" or "NOT" indicating the expected RAT availability / unavailability; and
 - 6) <out-of-coverage>, presence of this element indicating the expected V2X-UE moving out of coverage.

The <subscribe-dynamic-info> element contains the following sub-elements:

- a) <V2X-UE-id>, an element contains a string set to the identity of the UE who are part of the dynamic UE location group;
- b) <reporting-configuration>, an element contains a string used to indicate which configuration the UE should report, e.g., frequency of reporting, event based;
- c) <result>, an element set to the value "success" or "failure" indicating success or failure of the subscribe dynamic information request; and
- d) <configuration-report>, an element contains a string corresponding to the reporting configuration request.

The <V2X-groupcast/broadcast-configuration-info> element contains the following sub-elements:

- a) <V2X-server-id>, an element contains a string set to the identity of the VAE server which is requester of the V2X groupcast/broadcast configuration;
- b) <V2X-group-id>, an element contains a string set to the V2X group identity for which the V2X groupcast/broadcast configuration is requested;
- c) <V2X-service-id>, an element contains a string set to the V2X service ID for which the groupcast/broadcast configuration is requested;
- d) <PC5-provisioning-policies>, an element contains a string used to indicate the PC5 provisioning policies/parameters to be used by the V2X-UEs within the V2X service;
- e) <relay-V2X-UE-id-list>, an element contains one or more <V2X-UE-id> child element(s), each of which set to the identity of the V2X UE to serve as application layer relays;
- f) <minimum-number-of-transmissions>, an element contains an integer used to indicate the minimum number of allowed re-transmissions for the V2X message delivery; and

- g) <result>, an element set to the value "success" or "failure" indicating success or failure of the V2X groupcast/broadcast configuration request.

The <session-oriented-termination-trigger-info> element contain the following sub-elements:

- a) <session-id>, an element contains a string set to the session identifier of the session-oriented service that is to be terminated; and
- b) <result>, an element contains a string set to the value "success" or "failure" indicating success or failure to terminate the session-oriented service.

The <session-oriented-change-trigger-info> element contain the following sub-elements:

- a) <session-id>, an element contains a string set to the session identifier of the session-oriented service;
- b) <V2X-application-QoS-requirements>, an element contains the following sub-elements for the session-oriented service that is to be updated:
 - 1) <reliability>, an element contains a percentage used to indicate the reliability requirement of the V2X application;
 - 2) <delay>, an element contains an integer expressed in units of 1 μ s used to indicate the delay requirement of the V2X application; and
 - 3) <jitter>, an element contains an integer expressed in units of 1 μ s used to indicate the jitter requirement of the V2X application; and
- c) <acknowledgement>, an element contains a string set to the value "yes" or "not" indicating the acknowledgement for the change request.

The <session-oriented-service-trigger-info> element contain the following sub-elements:

- a) <V2X-UE-id>, an element contains a string set to the identity of the V2X UE which is the remote vehicle;
- b) <V2X-service-id>, an element contains a string set to the V2X service ID for which application requirement corresponds to;
- c) <V2X-application-specific-server-id-info>, an element contains a string set to the identity information of the V2X application specific server;
- d) <session-id>, an element contains a string set to the session identifier to be used for the session-oriented service;
- e) <V2X-application-QoS-requirements>, an element contains the following sub-elements for the session-oriented service:
 - 1) <reliability>, an element contains a percentage used to indicate the reliability requirement of the V2X application;
 - 2) <delay>, an element contains an integer expressed in units of 1 μ s used to indicate the delay requirement of the V2X application; and
 - 3) <jitter>, an element contains an integer expressed in units of 1 μ s used to indicate the jitter requirement of the V2X application; and
- f) <acknowledgement>, an element contains a string set to the value "yes" or "not" indicating the acknowledgement for the request.

The <session-oriented-service-info> element contain the following sub-elements:

- a) <VAE-client-id>, an element contains a string set to the identity of the VAE client;
- b) <V2X-service-id>, an element contains a string set to the V2X service ID for which application requirement corresponds to;
- c) <session-id>, an element contains a string set to the session identifier to be used for the session-oriented service;

- d) <reporting-configuration>, an element contains a string used to indicate which configuration the UE should report, e.g., frequency of reporting, event based; and
- e) <acknowledgement>, an element contains a string set to the value "yes" or "not" indicating the acknowledgement for the request. The <session-oriented-change-info> element contains the following sub-elements:
- a) <session-id>, an element contains a string set to the session identifier of the session-oriented service that is to be updated;
 - b) <V2X-application-QoS-requirements>, an element contains the following sub-elements for the session-oriented service that is to be updated:
 - 1) <reliability>, an element contains a percentage used to indicate the reliability requirement of the V2X application;
 - 2) <delay>, an element contains an integer expressed in units of 1 μ s used to indicate the delay requirement of the V2X application; and
 - 3) <jitter>, an element contains an integer expressed in units of 1 μ s used to indicate the jitter requirement of the V2X application;
 - c) <network-info>, an element contains a string set to the identifier of the changed network;
 - d) <server-info>, an element contains a string set to the identifier of the changed server;
 - e) <acknowledgement>, an element contains a string set to the value "yes" or "not" indicating the acknowledgement for the change request.

The <session-oriented-termination-info> element contains the following sub-elements:

- a) <session-id>, an element contains a string set to the session identifier of the session-oriented service that is to be terminated; and
- b) <acknowledgement>, an element contains a string set to the value "yes" or "not" indicating the acknowledgement for the termination request.

8.6 MIME types

The MIME type for the VAE document shall be "application/vnd.3gpp.vae-info+xml MIME body".

8.7 IANA registration template

Editor's note: The registration should be made after approval of the specification.

<MCC name>

Your Email Address:

<MCC email address>

Media Type Name:

Application

Subtype name:

application/vnd.3gpp.vae-info+xml

Required parameters:

None

Optional parameters:

"charset" the parameter has identical semantics to the charset parameter of the "application/xml" media type as specified in section 9.1 of IETF RFC 7303.

Encoding considerations:

binary.

Security considerations:

Same as general security considerations for application/xml media type as specified in section 9.1 of IETF RFC 7303. In addition, this media type provides a format for exchanging information in SIP or in HTTP, so the security considerations from IETF RFC 3261 apply while exchanging information in SIP and the security considerations from IETF RFC 7231 apply while exchanging information in HTTP.

The information transported in this media type does not include active or executable content.

Mechanisms for privacy and integrity protection of protocol parameters exist. Those mechanisms as well as authentication and further security mechanisms are described in 3GPP TS 24.229.

This media type does not include provisions for directives that institute actions on a recipient's files or other resources.

This media type does not include provisions for directives that institute actions that, while not directly harmful to the recipient, may result in disclosure of information that either facilitates a subsequent attack or else violates a recipient's privacy in any way.

This media type does not employ compression.

Interoperability considerations:

Same as general interoperability considerations for application/xml media type as specified in section 9.1 of IETF RFC 7303. Any unknown XML elements and any unknown XML attributes are to be ignored by recipient of the MIME body.

Published specification:

3GPP TS 24.486 "Vehicle-to-Everything (V2X) Application Enabler (VAE) layer; Protocol aspects; Stage 3" version 16.0.0, available via <http://www.3gpp.org/specs/numbering.htm>.

Applications which use this media type:

Applications supporting the Vehicle-to-Everything (V2X) Application Enabler (VAE) layer as described in the published specification.

Fragment identifier considerations:

The handling in section 5 of IETF RFC 7303 applies.

Restrictions on usage:

None

Provisional registration? (standards tree only):

N/A

Additional information:

1. Deprecated alias names for this type: none
2. Magic number(s): none
3. File extension(s): none
4. Macintosh File Type Code(s): none
5. Object Identifier(s) or OID(s): none

Intended usage:

Common

Person to contact for further information:

- Name: <MCC name>
- Email: <MCC email address>
- Author/Change controller:
 - i) Author: 3GPP CT1 Working Group/3GPP_TSG_CT_WG1@LIST.ETSI.ORG
 - ii) Change controller: <MCC name>/<MCC email address>

9 VAE related configuration

9.1 General

This clause specifies VAE specific configurations to be used along with common configurations defined in 3GPP TS 24.546 [11].

9.2 VAE client UE configuration coding

9.2.1 General

This clause specified the extension of the SEAL UE configuration document as defined in 3GPP TS 24.546 [11]. The procedure to retrieve configuration document is also specified in 3GPP TS 24.546 [11].

9.2.2 Application unique ID

The AUID shall be set to the VAE service ID as specified in specified in ETSI TS 102 965 [18] or ISO TS 17419 [20].

9.2.3 Structure

The VAE client UE configuration document structure is described in clause 7.2 of 3GPP TS 24.546 [11] with the VAE specific clarifications specified in this clause.

The <on-network> element of the <seal-UE-configuration> element specified in clause 7.2 of 3GPP TS 24.546 [11]:

- a) shall include a <VAE-server-ip> element;
- b) shall include a <VAE-server-transport-port> element;
- c) may include an <V2X-USD-announcement> element as specified in clause 8; and
- d) may include a <geo-id> element as specified in clause 8.

9.2.4 XML schema

9.2.4.1 General

The V2X UE configuration document is composed according the XML schema described in the clause 7.2 of 3GPP TS 24.546 [11], and extended with extensions from the XML schema defined in clause 9.2.4.2.

9.2.4.2 XML schema for V2X specific extensions

```
<?xml version="1.0" encoding="UTF-8"?>  
<xs:schema
```

```
xmlns="urn:3gpp:ns:seal:V2XUEConfig:1.0"
targetNamespace="urn:3gpp:ns:seal:V2XUEConfig:1.0"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:v2xuec="urn:3gpp:ns:seal:v2xUEConfig:1.0"
elementFormDefault="qualified"
attributeFormDefault="unqualified">

<!--V2X specific "on-network" child elements -->
<xs:element name="VAE-server-ip" type="xs:string"/>
<xs:element name="VAE-server-transport-port" type="xs:unsignedInt"/>

</xs:schema>
```

9.2.5 Data semantics

The <VAL-UE-id> element in <seal-UE-configuration> element is V2X UE ID.

The <VAL-Service-id> element in <seal-UE-configuration> element is V2X service ID.

The <VAE-server-ip> element in <on-network> element of <seal-UE-configuration> element is IP address information of the initial VAE server serving the VAE client.

The <VAE-server-transport-port> element in <on-network> element of <seal-UE-configuration> element is port information of the initial VAE server serving the VAE client.

The <V2X-USD-announcement> element contains V2X server USD as specified in clause 8.

The <geo-id> element contains GEO ID identity information as specified in clause 8.

9.2.6 MIME types

The MIME type for the VAE client UE configuration document shall use the MIME type as specified in the clause 7.2.6 of 3GPP TS 24.546 [11].

Annex A (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2019-08	CT1#119	C1-194367				Draft skeleton provided by the rapporteur.	0.0.0
2019-09	CT1#119					Implementing the following p-CR agreed by CT1: C1-194368	0.1.0
2019-09	CT1 e-mail review					Correction done by the rapporteur to the title of clause 3	0.1.1
2019-10	CT1#120					Implementing the following p-CRs agreed by CT1: C1-196373, C1-196376, C1-196618, C1-196859	0.2.0
2019-11	CT1#121					Implementing the following p-CRs agreed by CT1: C1-198550, C1-198624 Corrections done by the rapporteur.	0.3.0
2020-03	CT1#122-e					Implementing the following p-CRs agreed by CT1: C1-200530, C1-200532, C1-200533, C1-200622, C1-200623, C1-200624, C1-200903, C1-200905, C1-200906, C1-200944 Corrections done by the rapporteur.	0.4.0
2020-03	CT-87e	CP-200165				Presentation to TSG CT for information	1.0.0
2020-04	CT1#123-e					Implementing the following p-CRs agreed by CT1: C1-202212, C1-202458, C1-202546, C1-202728, C1-202729, C1-202762, C1-202763, C1-202764, C1-202765, C1-202766, C1-202788, C1-202789, C1-202790, C1-202791 Corrections done by the rapporteur.	1.1.0
2020-06	CT1#124-e					Implementing the following p-CRs agreed by CT1: C1-203448, C1-203452, C1-203568, C1-203570, C1-203573, C1-203574, C1-203575, C1-203623, C1-203953, C1-203954, C1-204072, C1-204073, C1-204074, C1-204076, C1-204102, C1-204105, C1-204106 Corrections done by the rapporteur.	1.2.0
2020-06	CT-88e					Presentation to TSG CT for approval	2.0.0
2020-06	CT-88e					Version 16.0.0 created after approval	16.0.0
2020-09	CT-89e	CP-202169	0001		F	Addition of used abbreviations	16.1.0
2020-09	CT-89e	CP-202169	0002		F	Correction of root element term use	16.1.0
2020-09	CT-89e	CP-202169	0004	1	F	Application level location tracking procedure correction	16.1.0
2020-09	CT-89e	CP-202169	0005	1	F	V2X message delivery procedure corrections	16.1.0
2020-09	CT-89e	CP-202169	0006	1	F	V2X service discovery procedure corrections	16.1.0
2020-09	CT-89e	CP-202169	0007	1	F	Geo-id correction	16.1.0
2020-09	CT-89e	CP-202169	0008	1	F	V2X service continuity procedure corrections	16.1.0
2020-09	CT-89e	CP-202169	0009	1	F	Network monitoring procedure corrections	16.1.0
2020-09	CT-89e	CP-202169	0010	1	F	V2X application resource management procedure	16.1.0
2020-09	CT-89e	CP-202169	0011	1	F	File distribution procedure	16.1.0
2020-09	CT-89e	CP-202169	0012	2	F	Dynamic group management procedure	16.1.0
2020-09	CT-89e	CP-202169	0013		F	Reference update for V2X service ID	16.1.0
2020-09	CT-89e	CP-202169	0014	1	F	Correction to client procedure of V2X UE registration procedure	16.1.0
2020-09	CT-89e	CP-202169	0015	1	F	Update to server procedure of V2X UE registration procedure	16.1.0
2020-09	CT-89e	CP-202169	0016		F	XML schema for UE registration procedure	16.1.0
2020-09	CT-89e	CP-202169	0017		F	Correction to client procedure of V2X UE de-registration procedure	16.1.0
2020-09	CT-89e	CP-202169	0018	1	F	Update to server procedure of V2X UE de-registration procedure	16.1.0
2020-09	CT-89e	CP-202169	0019		F	Update to server procedure of application level location tracking procedure	16.1.0
2020-09	CT-89e	CP-202169	0020	1	F	Corrections to request URI and clause reference	16.1.0
2020-09	CT-89e	CP-202169	0023		F	Correction to V2X message reception report	16.1.0
2020-12	CT-90e	CP-203216	0024	1	F	XML schema for UE de-registration procedure	16.2.0
2020-12	CT-90e	CP-203216	0025	1	F	Update to application level location tracking procedure	16.2.0
2020-12	CT-90e	CP-203216	0026	1	F	XML schema for application level location tracking procedure	16.2.0
2020-12	CT-90e	CP-203216	0027	2	F	XML schema for V2X message delivery procedure	16.2.0
2020-12	CT-90e	CP-203216	0029	1	F	Update to server procedure of V2X service discovery procedure	16.2.0
2020-12	CT-90e	CP-203216	0030	1	F	XML schema for V2X service discovery procedure	16.2.0
2020-12	CT-90e	CP-203216	0031	1	F	Update to V2X service continuity procedure	16.2.0
2020-12	CT-90e	CP-203216	0032	1	F	Update to server procedure of V2X service continuity procedure	16.2.0
2020-12	CT-90e	CP-203216	0033	1	F	XML schema for V2X service continuity procedure	16.2.0
2020-12	CT-90e	CP-203216	0034	1	F	XML schema for dynamic group management procedure	16.2.0
2020-12	CT-90e	CP-203216	0035	3	F	Update to network monitoring by the V2X UE procedure	16.2.0
2020-12	CT-90e	CP-203216	0036	3	F	Update to server procedure of V2X UE subscription for network monitoring information procedure	16.2.0
2020-12	CT-90e	CP-203216	0037	3	F	XML schema for network monitoring by the V2X UE procedure	16.2.0
2020-12	CT-90e	CP-203216	0038	4	F	XML schema for V2X USD provisioning procedure	16.2.0
2020-12	CT-90e	CP-203216	0039	1	F	XML schema for PC5 parameters provisioning procedure	16.2.0
2020-12	CT-90e	CP-203217	0040		F	Update to service discovery data elements	16.2.0
2020-12	CT-90e	CP-203217	0042		F	Correction of <identity> element	16.2.0
2020-12	CT-90e	CP-203217	0043	1	F	Direct use of <V2X-UE-id> element	16.2.0
2020-12	CT-90e	CP-203217	0044		F	Correction of destination at geographical area message target	16.2.0

2020-12	CT-90e	CP-203217	0045	1	F	Addition of reception URI in registration procedure	16.2.0
2020-12	CT-90e	CP-203217	0046		F	Correction of URI used in V2X group message procedure	16.2.0
2020-12	CT-90e	CP-203217	0047		F	Add the semantics for message info element	16.2.0
2020-12	CT-90e	CP-203217	0048	1	F	Update to PC5 parameters provisioning procedure	16.2.0
2020-12	CT-90e	CP-203217	0049	1	F	Update to V2X USD provisioning procedure	16.2.0
2020-12	CT-90e	CP-203217	0050		F	XML schema for on-network dynamic group notification procedure	16.2.0
2020-12	CT-90e	CP-203217	0051		F	Addition of <any> element in XML schema	16.2.0
2020-12	CT-90e	CP-203217	0052	1	F	Correction of client USD provisioning elements	16.2.0
2020-12	CT-90e	CP-203217	0055	1	F	Correction of client PC5 provisioning procedure elements	16.2.0
2020-12	CT-90e	CP-203217	0057	1	F	Update to V2X message delivery procedure	16.2.0
2020-12	CT-90e	CP-203217	0058		F	Corrections to the V2X UE registration procedure and de-registration procedure	16.2.0
2021-03	CT-91e	CP-210113	0060	1	F	V2X UE de-registration procedure response correction	16.3.0
2021-03	CT-91e	CP-210113	0061	1	F	V2XAPP drafting rules corrections	16.3.0
2021-03	CT-91e	CP-210113	0062		F	Correction of <geographical-area> element	16.3.0
2021-03	CT-91e	CP-210113	0063		F	Registration type XML schema correction	16.3.0
2021-03	CT-91e	CP-210113	0064		F	V2X service discovery procedure element correction	16.3.0
2021-03	CT-91e	CP-210113	0065		F	Updates to the notifications for network monitoring information procedure	16.3.0
2021-03	CT-91e	CP-210113	0066	1	F	Removal of redundant elements	16.3.0
2021-03	CT-91e	CP-210113	0067		F	XML schema for notifications for network monitoring information procedure	16.3.0
2021-03	CT-91e	CP-210113	0068		F	Removal of editor's note on XML schema	16.3.0
2021-03	CT-91e	CP-210113	0069		F	Corrections to misaligned list style	16.3.0
2021-06	CT-92e	CP-211127	0084	1	F	Correction of reference	16.4.0
2021-06	CT-92e	CP-211127	0085	-	F	Alignment of semantics	16.4.0
2021-06	CT-92e	CP-211127	0086	-	F	Correction of V2X-USD-announcement-info element	16.4.0
2021-06	CT-92e	CP-211143	0070	1	C	Update to the V2X UE identity	17.0.0
2021-06	CT-92e	CP-211143	0071	3	C	Update to the V2X UE registration procedure	17.0.0
2021-06	CT-92e	CP-211143	0073	1	F	Structure for switching modes of operations for V2V communications procedure	17.0.0
2021-06	CT-92e	CP-211143	0074	1	F	Data semantics for switching modes of operations for V2V communications procedure	17.0.0
2021-06	CT-92e	CP-211143	0075	1	F	VAE client initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0076	1	F	Structure for VAE client initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0077	1	F	Data semantics for VAE client initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0078	1	F	VAE server initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0079	1	F	Structure for VAE server initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0080	1	F	Data semantics for VAE server initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0081	1	F	VAE server taking consent from user procedure	17.0.0
2021-06	CT-92e	CP-211143	0082	1	F	Structure for VAE server taking consent from user procedure	17.0.0
2021-06	CT-92e	CP-211143	0083	1	F	Data semantics for VAE server taking consent from user procedure	17.0.0
2021-06	CT-92e	CP-211143	0087	-	F	XML schema for switching modes of operations for V2V communications procedure	17.0.0
2021-06	CT-92e	CP-211143	0088	1	F	XML schema for VAE client initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0089	1	F	XML schema for VAE server initiated on network dynamic group information update procedure	17.0.0
2021-06	CT-92e	CP-211143	0090	1	F	XML schema for VAE server taking consent from user procedure	17.0.0
2021-06	CT-92e	CP-211143	0091	1	F	PC5 Provisioning in multi-operator V2X scenarios procedure	17.0.0
2021-06	CT-92e	CP-211143	0092	-	F	Structure for PC5 Provisioning in multi-operator V2X scenarios procedure	17.0.0
2021-06	CT-92e	CP-211143	0093	2	F	Data Semantics for PC5 Provisioning in multi-operator V2X scenarios procedure	17.0.0
2021-06	CT-92e	CP-211143	0094	1	F	Obtaining dynamic information of the UEs in proximity range procedure	17.0.0
2021-06	CT-92e	CP-211143	0095	1	F	Structure for obtaining dynamic information of the UEs in proximity range procedure	17.0.0
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