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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Contents

Foreword

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

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

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shall not indicates an interdiction (prohibition) to do something

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

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

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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 stage 3 Protocol and data model for the UAS Application Enabler (UAE) Server services, for enabling the support of Uncrewed Aerial System (UAS) applications over 3GPP networks. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the UAE Server.

The stage 2 application layer architecture for Uncrewed Aerial System (UAS), functional requirements, procedures and information flows necessary for enabling Uncrewed Aerial System (UAS) applications over 3GPP networks are specified in 3GPP TS 23.255 [6].

The common protocol and interface aspects for API definition are specified in clause 5.2 of 3GPP TS 29.122 [2].

2 References

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

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

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

[2] 3GPP TS 29.122: "T8 reference point for Northbound Application Programming Interfaces (APIs)".

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

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

[5] 3GPP TR 21.900: "Technical Specification Group working methods".

[6] 3GPP TS 23.255: "Application layer support for Uncrewed Aerial System (UAS); Functional architecture and information flows".

[7] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[8] 3GPP TS 29.572: "5G System; Location Management Services; Stage 3".

[9] 3GPP TS 23.222: "Common API Framework for 3GPP Northbound APIs; Stage 2".

[10] 3GPP TS 29.222: "Common API Framework for 3GPP Northbound APIs; Stage 3".

[11] 3GPP TS 33.122: "Security aspects of Common API Framework (CAPIF) for 3GPP northbound APIs".

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

3 Definitions, symbols and abbreviations

3.1 Definitions

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

For the purpose of the present document, the terms and definitions given in clause 3 of 3GPP TS 23.255 [6] also apply, including the ones referencing other specifications.

3.2 Symbols

Void.

3.3 Abbreviations

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

BVLOS	Beyond Visual Line Of Sight
C2	Command and Control
CAA	Civil Aviation Authorities
RSRP	Reference Signal Received Power
UAE	UAS Application Enabler
UAS	Uncrewed Arial System
UASS	UAS Application Specific Server
UAV	Uncrewed Aerial Vehicle
UAV-C	Uncrewed Aerial Vehicle – Controller
USS	UAS Service Supplier
UTM	UAS Traffic Management

4 Overview

The UAS Application Enabler (UAE) Server forms part of the UAS application enabler layer that aims to ensure the efficient use and deployment of UAS over 3GPP systems. The UAE Server supports for this purpose, among other functionalities defined in 3GPP TS 23.255 [6], the following functionalities:

- UAS application layer support functions to a UASS (e.g. USS/UTM) over the Us reference point, i.e.:
  - C2 operation mode configuration management for a UAS (i.e. pair of UAV and UAV-C);
  - C2 communication modes switching control and management for a UAS (i.e. pair of UAV and UAV-C);
  - Real-Time UAV Connection Status Monitoring and Location reporting; and
  - interaction with other UAE Servers over the UAE-E reference point, in order to support distributed UAE Server deployments.

Figure 4-1 shows the reference model of the UAS Application Layer, with a focus on the UAE Server:

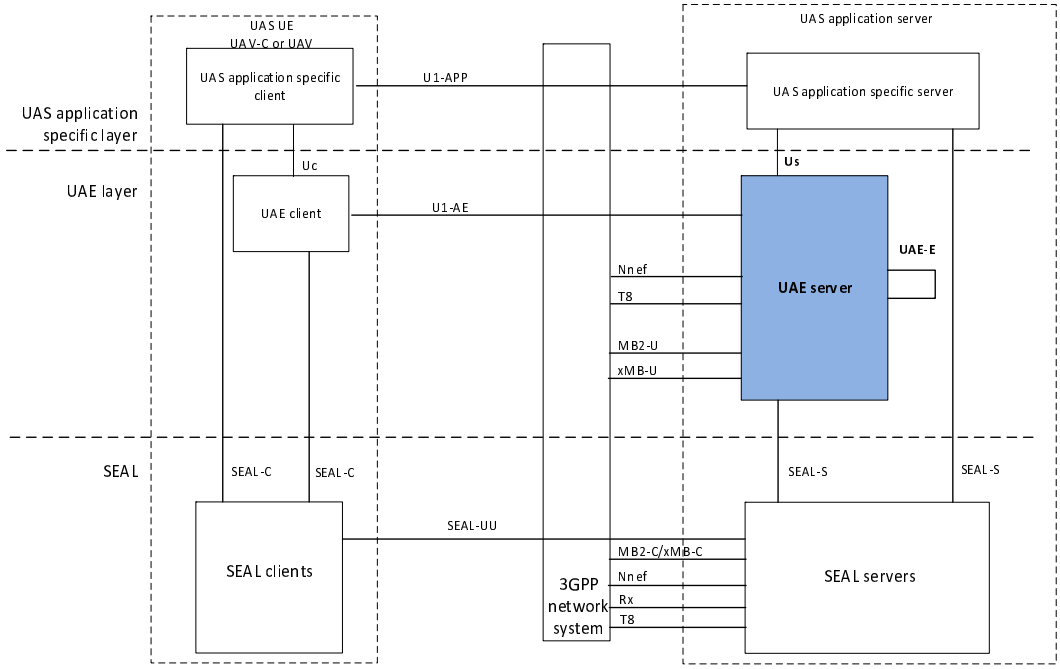

Figure 4-1: UAS Application Layer functional model

5 Services offered by the UAE Server

5.1 Introduction

The UAE Server provides the following services:

- UAE_C2OperationModeManagement
- UAE_RealtimeUAVStatus

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

Table 5.1-1: API Descriptions

Service Name	Clause	Description	OpenAPI Specification File	API Name	Annex
UAE_C2OperationModeManagement	5.2	UAE Server C2 Operation Mode Management Service	TS29257_UAE_C2OperationModeManagement.yaml	uae-c2opmode-mngt	A.2
UAE_RealtimeUAVStatus	5.3	UAE Server Real-time UAV Status Service	TS29257_UAE_RealtimeUAVStatus.yaml	uae-uav-status	A.3

NOTE: When 3GPP TS 29.122 [2] is referenced for the common protocol and interface aspects for API definition in the clauses under clause 5, the UAE Server takes the role of the SCEF and the UASS takes the role of the SCS/AS.

5.2 UAE_C2OperationModeManagement Service

5.2.1 Service Description

The UAE_C2OperationModeManagement service exposed by the UAE Server enables a UASS (e.g. USS/UTM) to:

- communicate C2 operation mode configuration information to the UAE Server for a UAS (i.e. pair of UAV and UAV-C);
- receive notifications from the UAE Server on the C2 operation mode management completion;
- receive notifications from the UAE Server on the C2 communication mode selected by a UAS (i.e. pair of UAV and UAV-C); and
- receive notifications from the UAE Server when C2 communication mode switching is carried out and decide whether to authorize it or not.

5.2.2 Service Operations

5.2.2.1 Introduction

The service operations defined for the UAE_C2OperationModeManagement service are shown in table 5.2.2.1-1.

Table 5.2.2.1-1: UAE_C2OperationModeManagement Service Operations

Service Operation Name	Description	Initiated by
UAE_C2OperationModeManagement_Initiate	This service operation enables a UASS to initiate the configuration of C2 operation modes for a UAS (i.e. pair of UAV and UAV-C) by communicating the associated C2 operation mode configuration information to the UAE Server.	e.g. UASS
UAE_C2OperationModeManagement_Notify	This service operation enables a UAE Server to notify a previously subscribed UASS either: - on C2 operation mode management completion; - on the C2 communication mode selected by a UAS (i.e. pair of UAV and UAV-C); or - when C2 communication mode switching is carried out. The UASS may then confirm the targeted C2 communication mode switching or not.	UAE Server

5.2.2.2 UAE_C2OperationModeManagement_Initiate

5.2.2.2.1 General

This service operation is used by a UASS to request the provisioning of C2 operation mode configuration information for a UAS (i.e. pair of UAV and UAV-C) to the UAE Server.

The following procedures are supported by the "UAE_C2OperationModeManagement_Initiate" service operation:

- C2 Operation Mode Initiation procedure.

5.2.2.2.2 C2 Operation Mode Initiation

Figure 5.2.2.2.2-1 depicts a scenario where a UASS sends a request to the UAE Server to request the provisioning of C2 operation mode configuration information for a UAS (i.e. pair of UAV and UAV-C) (see also clause 7.4 of 3GPP°TS°23.255°[6]).

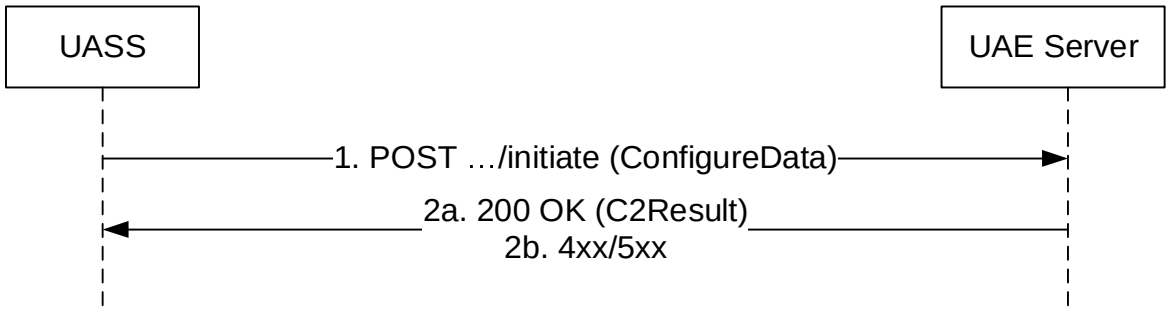

Figure 5.2.2.2.2-1: C2 Operation Mode Initiation procedure

1. The UASS shall send for this purpose an HTTP POST request (custom operation: "Initiate") to the UAE Server, with the request URI set to "{apiRoot}/uae-c2opmode-mngt/<apiVersion>/initiate" and the request body including the ConfigureData data structure that shall contain:

   - the identifier of the UASS that is sending the request, within the "uassId" attribute;
   - the identifier of the target UAS (i.e. pair of UAV and UAV-C) to which the C2 Operation Mode configuration information is destined, within the "uasId" attribute;
   - the allowed C2 communication modes for the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute, within the "allowedC2CommModes" attribute;
   - the C2 Operation Mode switching types to be supported by the UAE Server, within the "c2CommModeSwitchTypes" attribute;
   - the notification URI via which the UASS desires to receive notifications from the UAE Server, within the "notificationUri" attribute;
   - the primary C2 communication mode (i.e. either Direct C2 Communication mode or Network-Assisted C2 Communication mode) to be used by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute, within the "primaryC2CommMode" attribute; and
   - the C2 operation mode switching policies, within the "c2SwitchPolicies" attribute;

   and may also contain:

   - the secondary C2 communication mode (i.e. either Direct C2 Communication mode or Network-Assisted C2 Communication mode) to be used by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute, within the "secondaryC2CommMode" attribute;
   - the service area within which the C2 operation mode management request applies (i.e. a geographical area or a topological area), within the "c2ServiceArea" attribute; and
   - the list of features supported by the UASS among the ones defined in clause 6.1.8, within the "suppFeat" attribute.

2a. Upon success, the UAE Server shall respond with an HTTP "200 OK" status code with the response body including the C2Result data structure which shall contain a feedback from the UAE Server on whether the request for C2 Operation Mode configuration information provisioning is confirmed (i.e. can be undertaken by the UAE Server) or not. The C2Result data structure may also contain the list of negotiated supported features.

2b. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP POST response body.

5.2.2.3 UAE_C2OperationModeManagement_Notify

5.2.2.3.1 General

This service operation is used by a UAE Server to notify a previously subscribed UASS either on C2 operation mode management completion, on the C2 communication mode selected by a UAS (i.e. pair of UAV and UAV-C) or when

C2 communication mode switching is carried out. For the latter, the UASS may then confirm the targeted C2 communication mode switching or not. See also clause 7.4 of 3GPP°TS°23.255 [6].

The following procedures are supported by the "UAE_C2OperationModeManagement_Notify" service operation:

- C2 Operation Mode Management Completion Notification.
- Selected C2 Communication Mode Notification.
- C2 Communication Mode Switching Notification.

5.2.2.3.2 C2 Operation Mode Management Completion Notification

Figure 5.2.2.3.2-1 depicts a scenario where the UAE Server sends a request to notify a previously subscribed UASS on the C2 operation mode management completion status for a UAS (i.e. pair of UAV and UAV-C). See also clause 7.4 of 3GPP°TS°23.255°[6].

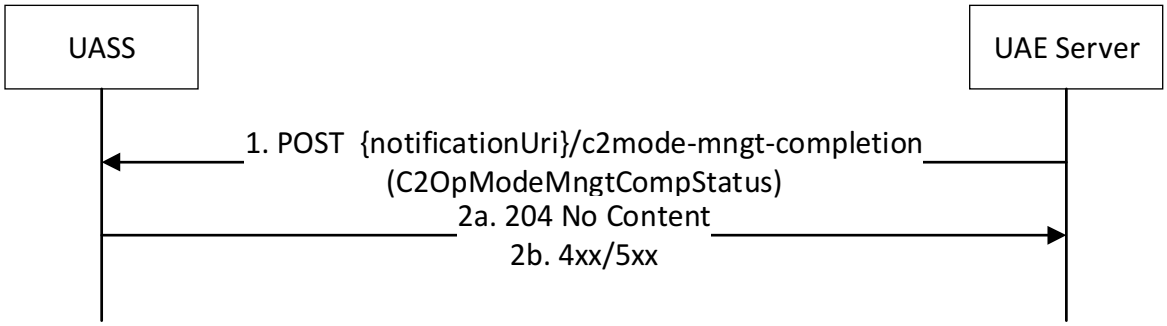

Figure 5.2.2.3.2-1: C2 Operation Mode Management Completion Notification procedure

1. The UAE Server shall send for this purpose an HTTP POST request to the UASS with the request URI set to "{notificationUri}/c2mode-mngt-completion", where the "notificationUri" is set to the value received from the UASS during the C2 Operation Mode Initiation procedure defined in clause 5.2.2.2, and the request body including the C2OpModeMngtCompStatus data structure that shall contain:

   - the identifier of the UAS (i.e. pair of UAV and UAV-C) to which the notification is related, within the "uasId" attribute; and
   - the C2 operation mode management completion status (i.e. either successful or not successful) for the concerned UAS (i.e. pair of UAV and UAV-C), within the "status" attribute.

2a. Upon success, the UASS shall respond to the UAE Server with an HTTP "204 No Content" status code to acknowledge the reception of the notification.

   If the UASS is not able to handle the notification request, it may respond with an HTTP "307 Temporary Redirect" status code or an HTTP "308 Permanent Redirect" status code including an HTTP "Location" header containing an alternative URI representing the end point of an alternative UASS where the notification should be sent, as defined in clause 5.2.10 of 3GPP TS 29.122 [2].

2b. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP POST response body.

5.2.2.3.3 Selected C2 Communication Mode Notification

Figure 5.2.2.3.3-1 depicts a scenario where the UAE Server sends a request to notify a previously subscribed UASS on the C2 communication mode selected by a UAS (i.e. pair of UAV and UAV-C). See also clause 7.4 of 3GPP°TS°23.255°[6].

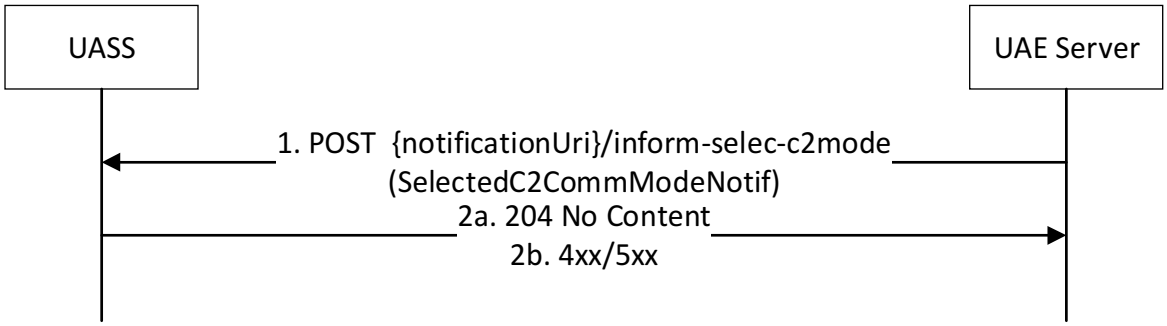

Figure 5.2.2.3.3-1: Selected C2 Communication Mode Notification procedure

1. The UAE Server shall send for this purpose an HTTP POST request to the UASS with the request URI set to "{notificationUri}/inform-selec-c2mode", where the "notificationUri" is set to the value received from the UASS during the C2 Operation Mode Initiation procedure defined in clause 5.2.2.2, and the request body including the SelectedC2CommModeNotif data structure that shall contain:

   - the identifier of the UAS (i.e. pair of UAV and UAV-C) to which the notification is related, within the "uasId" attribute; and

   - the primary C2 communication mode selected by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute, within the "selPrimaryC2CommMode" attribute;

   and may also contain:

   - the secondary C2 communication mode selected by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute, within the "selSecondaryC2CommMode" attribute.

2a. Upon success, the UASS shall respond to the UAE Server with an HTTP "204 No Content" status code to acknowledge the reception of the notification.

   If the UASS is not able to handle the notification request, it may respond with an HTTP "307 Temporary Redirect" status code or an HTTP "308 Permanent Redirect" status code including an HTTP "Location" header containing an alternative URI representing the end point of an alternative UASS where the notification should be sent, as defined in clause 5.2.10 of 3GPP TS 29.122 [2].

2b. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP POST response body.

5.2.2.3.4 C2 Communication Mode Switching Notification

Figure 5.2.2.3.4-1 depicts a scenario where the UAE Server sends a request to notify a previously subscribed UASS on the targeted C2 communication mode switching for a UAS (i.e. pair of UAV and UAV-C) and may request confirmation from the UASS. See also clause 7.4 of 3GPP°TS°23.255°[6].

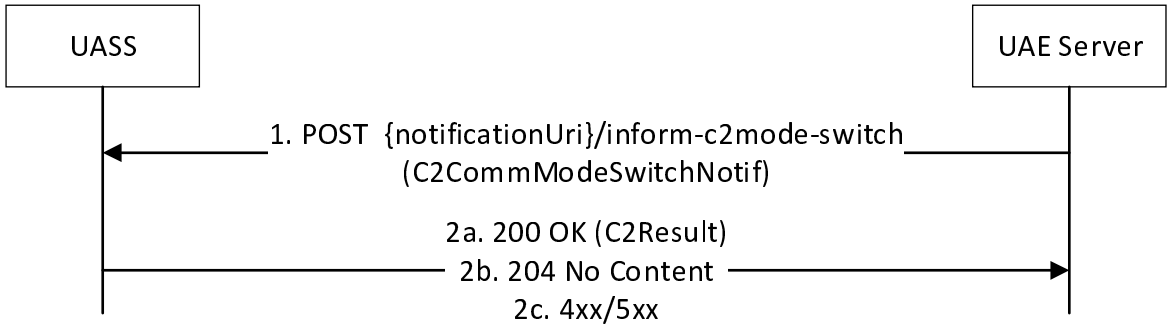

Figure 5.2.2.3.4-1: C2 Communication Mode Switching Notification procedure

1. The UAE Server shall send for this purpose an HTTP POST request to the UASS with the request URI set to "{notificationUri}/inform-c2mode-switch", where the "notificationUri" is set to the value received from the UASS during the C2 Operation Mode Initiation procedure defined in clause 5.2.2.2, and the request body including the C2CommModeSwitchNotif data structure that shall contain:

   - the identifier of the UAE Server that is sending the notification and possibly requesting C2 Communication Mode switching confirmation for a UAS (i.e. pair of UAV and UAV-C) from the UASS, within the "uaeServerId" attribute;

   - the identifier of the UAS (i.e. pair of UAV and UAV-C) to which the provided C2 Communication Mode switching information is related, within the "uasId" attribute; and

   - the targeted C2 Communication Mode switching for the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute, within the "c2CommModeSwitchType" attribute;

   And may contain:

   - the C2 Communication Mode switching cause, within the "switchingCause" attribute.

2a. Upon success, if the UASS has to confirm (i.e. approve) the C2 Communication Mode switching operation to the UAE Server, the UASS shall respond with an HTTP "200 OK" status code with the response body including the C2Result data structure which shall contain a feedback from the UASS on whether this C2 Communication Mode switching is confirmed (i.e. approved) or not.

2b. Otherwise, upon success, if the UASS does not have to confirm (i.e. approve) the C2 Communication Mode switching operation to the UAE Server, the UASS shall respond to the UAE Server with an HTTP "204 No Content" status code to acknowledge the reception of the notification.

   If the UASS is not able to handle the notification request, it may respond with an HTTP "307 Temporary Redirect" status code or an HTTP "308 Permanent Redirect" status code including an HTTP "Location" header containing an alternative URI representing the end point of an alternative UASS where the notification should be sent, as defined in clause 5.2.10 of 3GPP TS 29.122 [2].

2c. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP POST response body.

5.3 UAE_RealtimeUAVStatus Service

5.3.1 Service Description

The UAE_RealtimeUAVStatus service exposed by the UAE Server enables a UASS (e.g. USS/UTM) to:

- subscribe to real-time UAV status information reporting;

- update an existing real-time UAV status information reporting subscription;

- receive real-time UAV status notifications; and

- unsubscribe from real-time UAV status information reporting.

The UAV status information includes the UAV network connection status information and the UAV location information.

5.3.2 Service Operations

5.3.2.1 Introduction

The service operations defined for the UAE_RealtimeUAVStatus service are shown in table 5.3.2.1-1.

Table 5.3.2.1-1: UAE_RealtimeUAVStatus Service Operations

Service Operation Name	Description	Initiated by
UAE_RealtimeUAVStatus_Subscribe	This service operation enables a UASS to subscribe to real-time UAV status information reporting or update an existing real-time UAV status information reporting subscription.	e.g. UASS
UAE_RealtimeUAVStatus_Unsubscribe	This service operation enables a UASS to unsubscribe from real-time UAV status information reporting.	e.g. UASS
UAE_RealtimeUAVStatus_Notify	This service operation enables a UAE Server to notify a previously subscribed UASS on real-time UAV status information.	UAE Server

5.3.2.2 UAE_RealtimeUAVStatus_Subscribe

5.3.2.2.1 General

This service operation is used by a UASS to subscribe to real-time UAV status information reporting or update an existing real-time UAV status information reporting subscription.

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

- Subscribe to real-time UAV status information reporting.
- Update an existing real-time UAV status information reporting subscription.

5.3.2.2.2 Subscribe to real-time UAV status information reporting

Figure 5.3.2.2.2-1 depicts a scenario where a UASS sends a request to the UAE Server to request the creation of a subscription to real-time UAV status information reporting (see also clause 7.5 of 3GPP°TS°23.255°[6]).

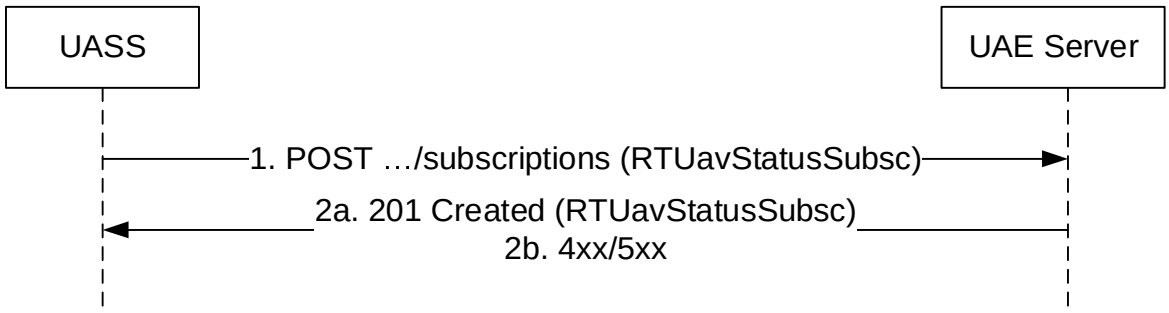

Figure 5.3.2.2.2-1: Procedure for subscribing to real-time UAV status information reporting

1. In order to subscribe to real-time UAV status reporting, the UASS shall send an HTTP POST request to the UAE Server, with the request URI set to "{apiRoot}/uae-uav-status/<apiVersion>/subscriptions" and the request body including the RTUavStatusSubsc data structure that shall contain:
   - the identifier of the UASS that is sending the request, within the "uassId" attribute;
   - the identifier(s) of the target UAV(s) to which the subscription is related, within the "uavIds" attribute;
   - the notification URI via which the UASS desires to receive real-time UAV status notifications from the UAE Server, within the "notificationUri" attribute; and
   - the list of features supported by the UASS among the ones defined in clause 6.2.8, within the "suppFeat" attribute.

2a. Upon success, the UAE Server shall respond with an HTTP "201 Created" status code with the response body containing a representation of the created Individual Real-time UAV Status Subscription resource within the RTUavStatusSubsc data structure.

2b. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP POST response body.

5.3.2.2.3 Update an existing real-time UAV status information reporting subscription

Figure 5.3.2.2.3-1 depicts a scenario where a UASS sends a request to the UAE Server to request the update of an existing subscription to real-time UAV status information reporting.

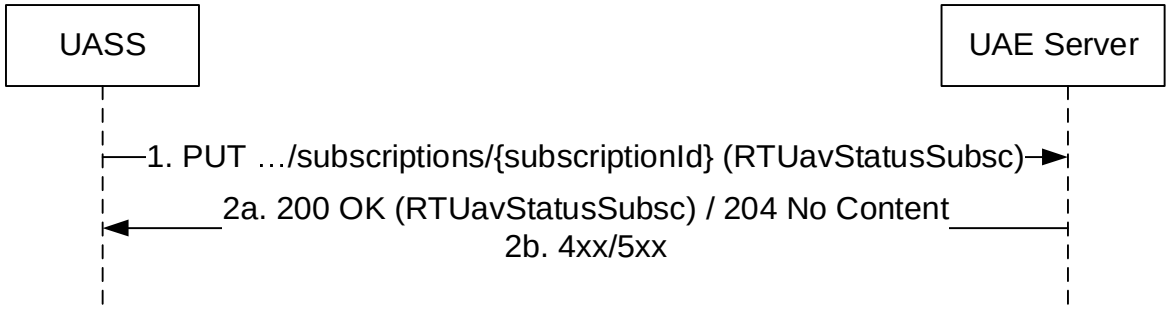

Figure 5.3.2.2.3-1: Procedure for updating a real-time UAV status information reporting subscription

1. In order to update an existing real-time UAV status reporting subscription, the UASS shall send an HTTP PUT request to the UAE Server, with the request URI set to "{apiRoot}/uae-uav-status/<apiVersion>/subscriptions/{subscriptionId}", requesting to update the Individual Real-time UAV Status Subscription resource identified by the provided "subscriptionId" path segment. The request body shall include an updated representation of the resource within the RTUavStatusSubsc data structure that shall contain:

   - the identifier of the UASS that is sending the request, within the "uassId" attribute;

NOTE: An alternative UASS than the one that requested the creation of the subscription resource can send this subscription update request.

   - the same or an updated list of identifier(s) of the target UAV(s) to which the subscription is related, within the "uavIds" attribute; and

   - the same or an updated notification URI via which the UASS desires to receive real-time UAV status notifications from the UAE Server, within the "notificationUri" attribute.

2a. Upon success, the UAE Server shall update the concerned Individual Real-time UAV Status Subscription resource accordingly and respond with either:

   - an HTTP "200 OK" status code with the response body containing a representation of the updated Individual Real-time UAV Status Subscription resource within the RTUavStatusSubsc data structure; or

   - an HTTP "204 No Content" status code.

   If the UAE Server is not able to handle the request, it may respond with an HTTP "307 Temporary Redirect" status code or an HTTP "308 Permanent Redirect" status code including an HTTP "Location" header containing an alternative URI of the resource located in an alternative UAE Server, as defined in clause 5.2.10 of 3GPP TS 29.122 [2].

2b. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP PUT response body.

5.3.2.3 UAE_RealtimeUAVStatus_Unsubscribe

5.3.2.3.1 General

This service operation is used by a UASS to unsubscribe from real-time UAV status information reporting.

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

- Unsubscribe from real-time UAV status information reporting.

5.3.2.3.2 Unsubscribe from real-time UAV status information reporting

Figure 5.3.2.3.2-1 depicts a scenario where a UASS sends a request to the UAE Server to request the deletion of an existing Individual Real-time UAV Status Subscription resource (see also clause 7.5 of 3GPP°TS°23.255°[6]).

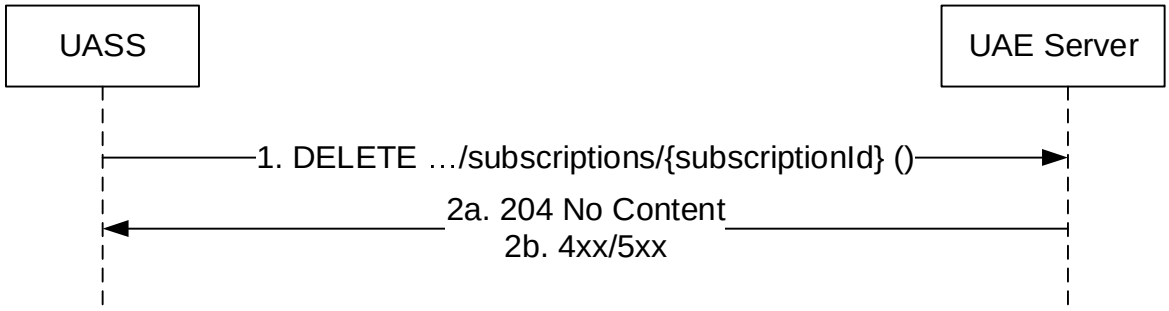

Figure 5.3.2.3.2-1: Procedure for unsubscribing from real-time UAV status information reporting

1. In order to unsubscribe from real-time UAV status reporting, the UASS shall send an HTTP DELETE request to the UAE Server, with the request URI set to "{apiRoot}/uae-uav-status/<apiVersion>/subscriptions/{subscriptionId}", requesting to delete the Individual Real-time UAV Status Subscription resource identified by the provided "subscriptionId" path segment.

2a. Upon success, the UAE Server shall respond with an HTTP "204 No Content" status code.

   If the UAE Server is not able to handle the request, it may respond with an HTTP "307 Temporary Redirect" status code or an HTTP "308 Permanent Redirect" status code including an HTTP "Location" header containing an alternative URI of the resource located in an alternative UAE Server, as defined in clause 5.2.10 of 3GPP TS 29.122 [2].

2b. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP DELETE response body.

5.3.2.4 UAE_RealtimeUAVStatus_Notify

5.3.2.4.1 General

This service operation is used by a UAE Server to notify a previously subscribed UASS on real-time UAV status information. See also clause 7.5 of 3GPP°TS°23.255 [6].

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

- Real-time UAV Status Notification.

5.3.2.4.2 Real-time UAV Status Notification

Figure 5.3.2.4.2-1 depicts a scenario where the UAE Server sends a request to notify a previously subscribed UASS on real-time UAV status information. See also clause 7.5 of 3GPP°TS°23.255°[6].

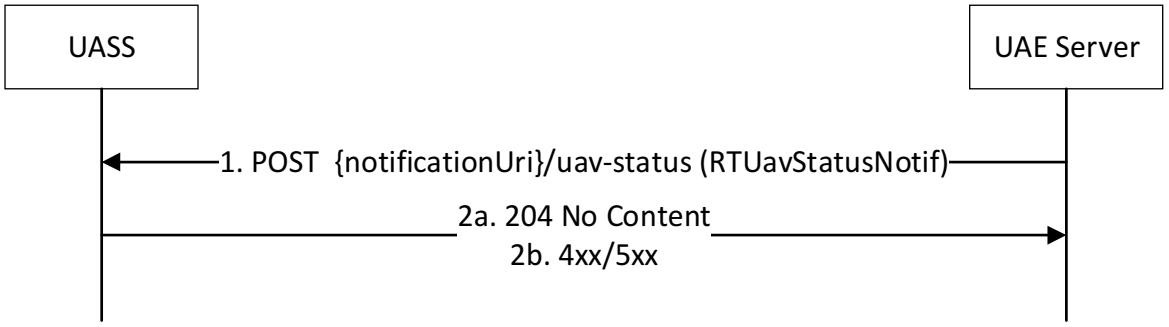

Figure 5.3.2.4.2-1: Real-time UAV Status Notification procedure

1. The UAE Server shall send for this purpose an HTTP POST request to the UASS with the request URI set to "{notificationUri}/uav-status", where the "notificationUri" is set to the value received from the UASS during the real-time UAV status reporting subscription creation/update procedures defined in clause 5.3.2.2, and the request body including the RTUavStatusNotif data structure that shall contain:

   - The identifier of the Individual Real-time UAV Status Subscription to which the notification is related, within the "subscriptionId" attribute; and

   - The real-time UAV status information for the concerned UAV(s), within the "rTUavStatus" attribute.

2a. Upon success, the UASS shall respond with an HTTP "204 No Content" status code to acknowledge the reception of the notification to the UAE Server.

   If the UASS is not able to handle the notification request, it may respond with an HTTP "307 Temporary Redirect" status code or an HTTP "308 Permanent Redirect" status code including an HTTP "Location" header containing an alternative URI representing the end point of an alternative UASS where the notification should be sent, as defined in clause 5.2.10 of 3GPP TS 29.122 [2].

2b. On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the HTTP POST response body.

6 API Definitions

6.1 UAE_C2OperationModeManagement Service API

6.1.1 Introduction

The UAE_C2OperationModeManagement service shall use the UAE_C2OperationModeManagement API.

The API URI of the UAE_C2OperationModeManagement API shall be:

{apiRoot}/<apiName>/<apiVersion>

The request URIs used in HTTP requests shall have the Resource URI structure defined in clause 5.2.4 of 3GPP TS 29.122 [2], i.e.:

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

with the following components:

- The {apiRoot} shall be set as described in clause 5.2.4 of 3GPP TS 29.122 [2].
- The <apiName> shall be "uae-c2opmode-mngt".
- The <apiVersion> shall be "v1".
- The <apiSpecificSuffixes> shall be set as described in clause 5.2.4 of 3GPP TS 29.122 [2].

NOTE: When 3GPP TS 29.122 [2] is referenced for the common protocol and interface aspects for API definition in the clauses under clause 6.1, the UAE Server takes the role of the SCEF and the UASS takes the role of the SCS/AS.

6.1.2 Usage of HTTP

The provisions of clause 5.2.2 of 3GPP TS 29.122 [2] shall apply for the UAE_C2OperationModeManagement API.

6.1.3 Resources

There are no resources defined for this API in this release of the specification.

6.1.4 Custom Operations without associated resources

6.1.4.1 Overview

The structure of the custom operation URIs of the UAE_C2OperationModeManagement API is shown in Figure 6.1.4.1-1.

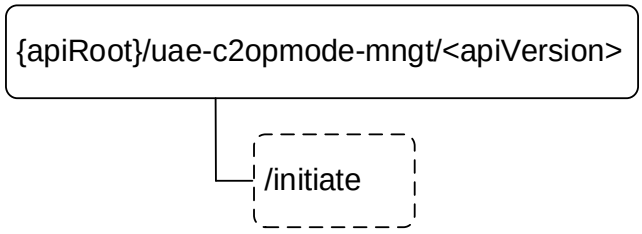

Figure 6.1.4.1-1: Custom operation URI structure of the UAE_C2OperationModeManagement API

Table 6.1.4.1-1 provides an overview of the custom operations and applicable HTTP methods defined for the UAE_C2OperationModeManagement API.

Table 6.1.4.1-1: Custom operations without associated resources

Operation name	Custom operation URI	Mapped HTTP method	Description
Initiate	/initiate	POST	Enables a UASS to request to provision C2 Operation Mode configuration information for a UAS (i.e. pair of UAV and UAV-C) to the UAE Server.

6.1.4.2 Operation: Initiate

6.1.4.2.1 Description

The custom operation enables a UASS to initiate the configuration of C2 operation modes for a UAS (i.e. pair of UAV and UAV-C) by communicating the associated C2 Operation Mode configuration information to the UAE Server.

6.1.4.2.2 Operation Definition

This operation shall support the request data structures and the response data structures and response codes specified in tables 6.1.4.2.2-1 and 6.1.4.2.2-2.

Table 6.1.4.2.2-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
ConfigureData	M	1	Contains the parameters to request to provision C2 Operation Mode configuration information for a UAS (i.e. pair of UAV and UAV-C).

Table 6.1.4.2.2-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
C2Result	M	1	200 OK	The communicated C2 Operation Mode configuration information was successfully received. The response body shall contain the feedback of the UAE Server on whether this C2 Operation Mode configuration request is confirmed (i.e. can be undertaken by the UAE Server) or not.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative target URI located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative target URI located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2]
NOTE: The manadatory HTTP error status code for the HTTP POST method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.1.4.2.2-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative target URI located in an alternative UAE Server.

Table 6.1.4.2.2-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative target URI located in an alternative UAE Server.

6.1.5 Notifications

6.1.5.1 General

Notifications shall comply to clause 5.2.5 of 3GPP TS 29.122 [2].

Table 6.1.5.1-1: Notifications overview

Notification	Callback URI	HTTP method or custom operation	Description (service operation)
C2 Operation Mode Management Completion Notification	{notificationUri}/c2mode-mngt-completion	c2mode-mngt-completion (POST)	This service operation enables a UAE Server to notify a previously subscribed UASS on the C2 operation mode management completion status for the concerned UAS (i.e. pair of UAV and UAV-C).
Selected C2 Communication Mode Notification	{notificationUri}/inform-selec-c2mode	inform-selec-c2mode (POST)	This service operation enables a UAE Server to notify a previously subscribed UASS on the C2 communication mode selected by the concerned UAS (i.e. pair of UAV and UAV-C).
C2 Communication Mode Switching Notification	{notificationUri}/inform-c2mode-switch	inform-c2mode-switch (POST)	This service operation enables a UAE Server to notify a previously subscribed UASS when C2 communication mode switching is carried out for the concerned UAS (i.e. pair of UAV and UAV-C) and possibly request confirmation from the UASS.

6.1.5.2 C2 Operation Mode Management Completion Notification

6.1.5.2.1 Description

The C2 Operation Mode Management Completion Notification is used by a UAE Server to notify a previously subscribed UASS on the C2 operation mode management completion status for a UAS (i.e. pair of UAV and UAV-C).

6.1.5.2.2 Target URI

The Callback URI **"{notificationUri}/c2mode-mngt-completion"** shall be used with the callback URI variables defined in table 6.1.5.2.2-1.

Table 6.1.5.2.2-1: Callback URI variables

Name	Data type	Definition
notificationUri	Uri	String formatted as a URI containing the Callback URI.

6.1.5.2.3 Standard Methods

6.1.5.2.3.1 POST

This method shall support the request data structures specified in table 6.1.5.2.3.1-1 and the response data structures and response codes specified in table 6.1.5.2.3.1-2.

Table 6.1.5.2.3.1-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
C2OpModeMngtCompStatus	M	1	Contains the C2 operation mode management completion status for the concerned UAS (i.e. pair of UAV and UAV-C).

Table 6.1.5.2.3.1-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	The C2 operation mode management completion status for the concerned UAS (i.e. pair of UAV and UAV-C) is successfully received and acknowledged.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The mandatory HTTP error status codes for the HTTP POST method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.1.5.2.3.1-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

Table 6.1.5.2.3.1-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

6.1.5.3 Selected C2 Communication Mode Notification

6.1.5.3.1 Description

The Selected C2 Communication Mode Notification is used by a UAE Server to notify a previously subscribed UASS on the C2 communication mode selected by a UAS (i.e. pair of UAV and UAV-C).

6.1.5.3.2 Target URI

The Callback URI **"{notificationUri}/inform-selec-c2mode"** shall be used with the callback URI variables defined in table 6.1.5.3.2-1.

Table 6.1.5.3.2-1: Callback URI variables

Name	Data type	Definition
notificationUri	Uri	String formatted as a URI containing the Callback URI.

6.1.5.3.3 Standard Methods

6.1.5.3.3.1 POST

This method shall support the request data structures specified in table 6.1.5.3.3.1-1 and the response data structures and response codes specified in table 6.1.5.3.3.1-2.

Table 6.1.5.3.3.1-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
SelectedC2CommModeNotif	M	1	Contains information on the C2 Communication Mode selected by the concerned UAS (i.e. pair of UAV and UAV-C).

Table 6.1.5.3.3.1-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	The C2 Communication Mode selected by the concerned UAS (i.e. pair of UAV and UAV-C) is successfully received and acknowledged.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The mandatory HTTP error status codes for the HTTP POST method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.1.5.3.3.1-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

Table 6.1.5.3.3.1-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

6.1.5.4 C2 Communication Mode Switching Notification

6.1.5.4.1 Description

The C2 Communication Mode Switching Notification is used by a UAE Server to notify a previously subscribed UASS on the targeted C2 Communication Mode switching for a UAS (i.e. pair of UAV and UAV-C).

6.1.5.4.2 Target URI

The Callback URI **"{notificationUri}/inform-c2mode-switch"** shall be used with the callback URI variables defined in table 6.1.5.4.2-1.

Table 6.1.5.4.2-1: Callback URI variables

Name	Data type	Definition
notificationUri	Uri	String formatted as a URI containing the Callback URI.

6.1.5.4.3 Standard Methods

6.1.5.4.3.1 POST

This method shall support the request data structures specified in table 6.1.5.4.3.1-1 and the response data structures and response codes specified in table 6.1.5.4.3.1-2.

Table 6.1.5.4.3.1-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
C2CommModeSwitchNotif	M	1	Contains information on the targeted C2 Communication Mode switching for the concerned UAS (i.e. pair of UAV and UAV-C).

Table 6.1.5.4.3.1-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
C2Result	M	1	200 OK	The targeted C2 Communication Mode switching for the concerned UAS (i.e. pair of UAV and UAV-C) is successfully received. The response body shall contain the feedback of the UASS on whether this C2 Communication Mode switching is confirmed (i.e. validated) or not.
n/a			204 No Content	The targeted C2 Communication Mode switching for the concerned UAS (i.e. pair of UAV and UAV-C) is successfully received and acknowledged, and the UASS does not need to confirm (i.e. validate) it.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The mandatory HTTP error status codes for the HTTP POST method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.1.5.4.3.1-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

Table 6.1.5.4.3.1-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

6.1.6 Data Model

6.1.6.1 General

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

Table 6.1.6.1-1 specifies the data types defined for the UAE_C2OperationModeManagement API.

Table 6.1.6.1-1: UAE_C2OperationModeManagement API specific Data Types

Data type	Clause defined	Description	Applicability
ConfigureData	6.1.6.2.2	Represents the parameters to request to provision C2 Operation Mode configuration information for a UAS (i.e. pair of UAV and UAV-C).	
SelectedC2CommModeNotif	6.1.6.2.3	Represents information on the C2 Communication Mode slected by a UAS (i.e. pair of UAV and UAV-C).	
C2CommModeSwitchNotif	6.1.6.2.4	Represents information on the targeted C2 Communication Mode switching for a UAS (i.e. pair of UAV and UAV-C).	
C2LinkQualityThrlds	6.1.6.2.11	Represents the C2 link quality thresholds.	
C2OpModeMngtCompStatus	6.1.6.2.9	Represents the C2 operation mode management completion status for a UAS (i.e. pair of UAV and UAV-C).	
C2OpModeStatus	6.1.6.3.6	Represents the C2 operation mode management completion status.	
C2Result	6.1.6.2.5	Represents the result of an action related to C2 of a UAS.	
C2ServiceArea	6.1.6.2.8	Represents a C2 service area.	
C2SwitchPolicies	6.1.6.2.10	Represents the C2 operation mode switching policies.	
UasId	6.1.6.2.6	Represents the identifier of a UAS (i.e. pair of UAV and UAV-C).	
UavId	6.1.6.2.7	Represents the identifier of a UAV (e.g. UAV, UAV-C).	
C2CommMode	6.1.6.3.3	Represents the C2 Communication Modes.	
C2CommModeSwitching	6.1.6.3.4	Represents the C2 Communication Mode Switching types.	
C2SwitchingCause	6.1.6.3.5	Represents the C2 Communication Mode switching cause.	

Table 6.1.6.1-2 specifies data types re-used by the UAE_C2OperationModeManagement API from other specifications, including a reference to their respective specifications, and when needed, a short description of their use within the UAE_C2OperationModeManagement API.

Table 6.1.6.1-2: UAE_C2OperationModeManagement API re-used Data Types

Data type	Reference	Comments	Applicability
ExternalGroupId	3GPP TS 29.122 [2]	Represents an external group identifier.	
GeographicArea	3GPP TS 29.572 [8]	Represents a geographical area.	
Gpsi	3GPP TS 29.571 [7]	Represents a GPSI.	
Ncgi	3GPP TS 29.571 [7]	Represents an NCGI.	
PacketLossRate	3GPP TS 29.571 [7]	Represents the packet loss rate.	
SupportedFeatures	3GPP TS 29.571 [7]	Used to negotiate the applicability of the optional features.	
Tai	3GPP TS 29.571 [7]	Represents a tracking area identifier.	
Uri	3GPP TS 29.122 [2]	Represents a URI.	

6.1.6.2 Structured data types

6.1.6.2.1 Introduction

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

6.1.6.2.2 Type: ConfigureData

Table 6.1.6.2.2-1: Definition of type ConfigureData

Attribute name	Data type	P	Cardinality	Description	Applicability
uassId	Uri	M	1	Contains the identity of the UASS communicating the C2 Operation Mode configuration information for a UAS (i.e. pair of UAV and UAV-C). It takes the form of a URI.	
uasId	UasId	M	1	Contains the identity of the UAS (i.e. pair of UAV and UAV-C) to which the provided C2 Operation Mode configuration information is destined. This shall be either in the form of a UAS identifier (e.g. group ID) or a collection of individual identifiers (e.g. CAA level UAV ID, GPSI) of the UAV and UAV-C composing the UAS.	
allowedC2CommModes	array(C2CommMode)	M	1..N	Contains the allowed C2 communication modes for the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute.	
c2CommModeSwitchTypes	array(C2CommModeSwitching)	M	1..N	Contains the C2 Communication Mode switching types to be supported by the UAE Server for the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute. The possible switching types are: - from "Direct C2 Communication" to "Network-Assisted C2 Communication"; - from "Network-Assisted C2 Communication" to "Direct C2 Communication"; - from "Direct C2 Communication" to "UTM-Navigated C2 Communication"; and/or - from "Network-Assisted C2 Communication" to "UTM-Navigated C2 Communication".	
notificationUri	Uri	M	1	Contains the notification URI via which the UASS desires to receive notifications from the UAE Server.	
primaryC2CommMode	C2CommMode	M	1	Contains the primary C2 communication mode to be used by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute. It shall be set to either "DIRECT_C2_COMMUNICATION" or "NETWORK_ASSISTED_C2_COMMUNICATION".	
secondaryC2CommMode	C2CommMode	O	0..1	Contains the secondary C2 communication mode to be used by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute. When provided, it shall be set to either "DIRECT_C2_COMMUNICATION" or "NETWORK_ASSISTED_C2_COMMUNICATION".	
c2SwitchPolicies	C2SwitchPolicies	M	1	Contains the C2 operation mode switching policies.	
c2ServiceArea	C2ServiceArea	O	0..1	Contains the service area within which the C2 operation mode management request applies. This shall be either a geographical area or a topological area.	
suppFeat	SupportedFeatures	C	0..1	Contains the list of supported features among the ones defined in clause 6.1.8. This attribute shall be provided if at least one feature is supported by the UASS.	

6.1.6.2.3 Type: SelectedC2CommModeNotif

Table 6.1.6.2.3-1: Definition of type SelectedC2CommModeNotif

Attribute name	Data type	P	Cardinality	Description	Applicability
uasId	UasId	M	1	Contains the identity of the UAS (i.e. pair of UAV and UAV-C) to which the notification is related. This shall be either in form of a UAS identifier (e.g. group ID) or a collection of individual identifiers (e.g. CAA level UAV ID, GPSI) of the UAV and UAV-C composing the UAS.	
selPrimaryC2CommMode	C2CommMode	M	1	Contains the primary C2 communication mode selected by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute. It shall be set to either "DIRECT_C2_COMMUNICATION" or "NETWORK_ASSISTED_C2_COMMUNICATION".	
selSecondaryC2CommMode	C2CommMode	O	0..1	Contains the secondary C2 communication mode to be used by the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute. When provided, it shall be set to either "DIRECT_C2_COMMUNICATION" or "NETWORK_ASSISTED_C2_COMMUNICATION".	

6.1.6.2.4 Type: C2CommModeSwitchNotif

Table 6.1.6.2.4-1: Definition of type C2CommModeSwitchNotif

Attribute name	Data type	P	Cardinality	Description	Applicability
uaeServerId	Uri	M	1	Contains the identifier of the UAE Server that is sending the notification and requesting C2 Communication Mode switching confirmation for a UAS (i.e. pair of UAV and UAV-C) from the UASS.	
uasId	UasId	M	1	Contains the identifier of the UAS (i.e. pair of UAV and UAV-C) to which the provided C2 Communication Mode switching information is related. This shall be either in form of a UAS identifier (e.g. group ID) or a collection of individual identifiers (e.g. CAA level UAV ID, GPSI) of the UAV and UAV-C composing the UAS.	
c2CommModeSwitchType	C2CommModeSwitching	M	1	Contains the targeted C2 Communication Mode switching for the UAS (i.e. pair of UAV and UAV-C) identified by the "uasId" attribute.	
switchingCause	C2SwitchingCause	O	0..1	Contains the cause that triggers the C2 Communication Mode switching.	

6.1.6.2.5 Type: C2Result

Table 6.1.6.2.5-1: Definition of type C2Result

Attribute name	Data type	P	Cardinality	Description	Applicability
c2OpConfirmed	Boolean	M	1	This attribute indicates whether the requested action (e.g. targeted C2 Communication Mode switching, C2 Operation Mode configuration information provisioning) is confirmed or not. - "true" means that the requested action is confirmed or approved. - "false" means that the requested action is not confirmed or not approved.	
suppFeat	SupportedFeatures	C	0..1	Indicates the list of negotiated supported features. This attribute shall be provided by the UAE Server in the response to a request in which the UASS provided the list of features that it supports.	

6.1.6.2.6 Type: UasId

Table 6.1.6.2.6-1: Definition of type UasId

Attribute name	Data type	P	Cardinality	Description	Applicability
groupId	ExternalGroupId	C	0..1	Contains the identity of a UAS (i.e. a pair of UAV and UAV-C) in the form of a group identifier. (NOTE)	
individualUasId	array(UavId)	C	0..N	Contains the identity of a UAS (i.e. a pair of UAV and UAV-C) in the form of a collection of individual identifiers of the UAV and UAV-C composing the UAS. (NOTE)	
NOTE: The "groupId" attribute and the "individualUasId" attribute are mutually exclusive.					

6.1.6.2.7 Type: UavId

Table 6.1.6.2.7-1: Definition of type UavId

Attribute name	Data type	P	Cardinality	Description	Applicability
gpsi	Gpsi	C	0..1	Contains the identity of a UAV or UAV-C in the form of a GPSI. (NOTE)	
caaId	string	C	0..1	Contains the identity of a UAV or UAV-C in the form of a CAA level UAV ID. (NOTE)	
NOTE: At least one of the "groupId" attribute or the "caaId" attribute shall be provided within the UavId data type.					

6.1.6.2.8 Type: C2ServiceArea

Table 6.1.6.2.8-1: Definition of type C2ServiceArea

Attribute name	Data type	P	Cardinality	Description	Applicability
ncgiList	array(Ncgi)	C	0..N	Contains a list of NR cell identifier(s) that constitutes the C2 service area.	
taiList	array(Tai)	C	0..N	Contains a list of tracking area identifier(s) that constitutes the C2 service area.	
geographicAreaList	array(GeographicArea)	C	0..N	Contains a list of geographic area(s) that constitutes the C2 service area.	
NOTE: Either the "geographicAreaList" attribute or the "ncgiList" attribute and/or the "taiList" attribute shall be provided.					

6.1.6.2.9 Type: C2OpModeMngtCompStatus

Table 6.1.6.2.9-1: Definition of type C2OpModeMngtCompStatus

Attribute name	Data type	P	Cardinality	Description	Applicability
uasId	UasId	M	1	Contains the identifier of the UAS (i.e. pair of UAV and UAV-C) to which the provided C2 operation mode management completion status information is related.	
status	C2OpModeStatus	M	1	Contains the C2 operation mode management completion status.	

6.1.6.2.10 Type: C2SwitchPolicies

Table 6.1.6.2.10-1: Definition of type C2SwitchPolicies

Attribute name	Data type	P	Cardinality	Description	Applicability
directC2LinkQualityThrlds	C2LinkQualityThrlds	O	0..1	Contains the threshold(s) used to evaluate the quality of the direct C2 link.	
uuC2LinkQualityThrlds	C2LinkQualityThrlds	O	0..1	Contains the threshold(s) used to evaluate the quality of the Network-Assisted (i.e. Uu based) C2 link.	
NOTE: Either the "directC2LinkQualityThrlds" attribute, the "uuC2LinkQualityThrlds" attribute or both shall be provided.					

6.1.6.2.11 Type: C2LinkQualityThrlds

Table 6.1.6.2.11-1: Definition of type C2LinkQualityThrlds

Attribute name	Data type	P	Cardinality	Description	Applicability
nrRsrpThrldLow	integer	O	0..1	Represents the lower RSRP value threshold for the direct C2 link. Value range: 0-127. (NOTE 1)	
nrRsrpThrldHigh	integer	O	0..1	Represents the upper RSRP value threshold for the direct C2 link. Value range: 0-127. (NOTE 2)	
nrRsrqThrldLow	integer	O	0..1	Represents the lower RSRQ value threshold for the direct C2 link. Value range: 0-127. (NOTE 1)	
nrRsrqThrldHigh	integer	O	0..1	Represents the upper RSRQ value threshold for the direct C2 link. Value range: 0-127. (NOTE 2)	
packetLossThrldLow	PacketLossRate	O	0..1	Represents the lower packet loss rate value threshold for the direct C2 link. (NOTE 1)	
packetLossThrldHigh	PacketLossRate	O	0..1	Represents the upper packet loss rate value threshold for the direct C2 link. (NOTE 2)	
NOTE 1: At least one of the "nrRsrpThrldLow", "nrRsrqThrldLow" or "packetLossThrldLow" attributes shall be provided. NOTE 2: At least one of the "nrRsrpThrldHigh", "nrRsrqThrldHigh" or "packetLossThrldHigh" attributes shall be provided.					

6.1.6.3 Simple data types and enumerations

6.1.6.3.1 Introduction

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

6.1.6.3.2 Simple data types

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

Table 6.1.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

6.1.6.3.3 Enumeration: C2CommMode

The enumeration C2CommMode represents C2 Communication Modes. It shall comply with the provisions of table 6.1.6.3.3-1.

Table 6.1.6.3.3-1: Enumeration C2CommMode

Enumeration value	Description	Applicability
DIRECT_C2_COMMUNICATION	Represents Direct C2 Communication mode.	
NETWORK_ASSISTED_C2_COMMUNICATION	Represents Network-Assisted C2 Communication mode.	
UTM_NAVIGATED_C2_COMMUNICATION	Represents UTM-Navigated C2 communication mode.	

6.1.6.3.4 Enumeration: C2CommModeSwitching

The enumeration C2CommModeSwitching represents C2 Communication Mode Switching types. It shall comply with the provisions of table 6.1.6.3.4-1.

Table 6.1.6.3.4-1: Enumeration C2CommModeSwitching

Enumeration value	Description	Applicability
DIRECT_TO_NETWORK_ASSISTED_C2	Represents the C2 Communication Mode switching from Direct C2 Communication mode to Network-Assisted C2 Communication mode.	
NETWORK_ASSISTED_TO_DIRECT_C2	Represents the C2 Communication Mode switching from Network-Assisted C2 Communication mode to Direct C2 Communication mode.	
DIRECT_TO_UTM_NAVIGATED_C2	Represents the C2 Communication Mode switching from Direct C2 Communication mode to UTM-Navigated C2 communication mode.	
NETWORK_ASSISTED_TO_UTM_NAVIGATED_C2	Represents the C2 Communication Mode switching from Network-Assisted C2 Communication mode to UTM-Navigated C2 communication mode.	

6.1.6.3.5 Enumeration: C2SwitchingCause

The enumeration C2SwitchingCause represents the C2 Communication Mode switching cause. It shall comply with the provisions of table 6.1.6.3.5-1.

Table 6.1.6.3.5-1: Enumeration C2SwitchingCause

Enumeration value	Description	Applicability
DIRECT_LINK_QUALITY_DEGRADATION	Indicates that the C2 Communication Mode switching was triggered due to a degradation in the direct radio link quality.	
DIRECT_LINK_AVAILABLE	Indicates that the C2 Communication Mode switching was triggered due to the availability of a direct link, i.e. direct radio link quality enables its usage.	
MOVING_BVLOS	Indicates that the C2 Communication Mode switching was triggered due to the UAV moving BVLOS.	
LOCATION_CHANGE	Indicates that the C2 Communication Mode switching was triggered due to an actual or expected location/mobility of the UAV (e.g. which impacts the UAV-to-UAV-C location).	
TRAFFIC_CONTROL_NEEDED	Indicates that the C2 Communication Mode switching was triggered due to the necessity to have air traffic control.	
SECURITY_REASONS	Indicates that the C2 Communication Mode switching was triggered due to security reasons.	
OTHER_REASONS	Indicates that the C2 Communication Mode switching was triggered due to other reasons (e.g. unpredictable event, unknown reason, weather conditions, topography, etc.).	

6.1.6.3.6 Enumeration: C2OpModeStatus

The enumeration C2OpModeStatus represents C2 Operation Mode Management Completion status. It shall comply with the provisions of table 6.1.6.3.6-1.

Table 6.1.6.3.6-1: Enumeration C2CommMode

Enumeration value	Description	Applicability
SUCCESSFUL	Indicates that the C2 operation mode configuration was successful.	
NOT_SUCCESSFUL	Indicates that the C2 operation mode configuration was not successful.	

6.1.6.4 Data types describing alternative data types or combinations of data types

There are no data types describing alternative data types or combinations of data types defined for this API in this release of the specification.

6.1.6.5 Binary data

6.1.6.5.1 Binary Data Types

Table 6.1.6.5.1-1: Binary Data Types

Name	Clause defined	Content type

6.1.7 Error Handling

6.1.7.1 General

For the UAE_C2OperationModeManagement API, HTTP error responses shall be supported as specified in clause 5.2.6 of 3GPP TS 29.122 [2]. Protocol errors and application errors specified in clause 5.2.6 of 3GPP TS 29.122 [2] shall be supported for the HTTP status codes specified in table 5.2.6-1 of 3GPP TS 29.122 [2].

In addition, the requirements in the following clauses are applicable for the UAE_C2OperationModeManagement API.

6.1.7.2 Protocol Errors

No specific protocol errors for the UAE_C2OperationModeManagement API are specified.

6.1.7.3 Application Errors

The application errors defined for the UAE_C2OperationModeManagement API are listed in Table 6.1.7.3-1.

Table 6.1.7.3-1: Application errors

Application Error	HTTP status code	Description

6.1.8 Feature negotiation

The optional features listed in table 6.1.8-1 are defined for the UAE_C2OperationModeManagement API. They shall be negotiated using the extensibility mechanism defined in clause 5.2.7 of 3GPP TS 29.122 [2].

Table 6.1.8-1: Supported Features

Feature number	Feature Name	Description

6.1.9 Security

The provisions of clause 6 of 3GPP TS 29.122 [2] shall apply for the UAE_C2OperationModeManagement API.

6.2 UAE_RealtimeUAVStatus Service API

6.2.1 Introduction

The UAE_RealtimeUAVStatus service shall use the UAE_RealtimeUAVStatus API.

The API URI of the UAE_RealtimeUAVStatus API shall be:

{apiRoot}/<apiName>/<apiVersion>

The request URIs used in HTTP requests shall have the Resource URI structure defined in clause 5.2.4 of 3GPP TS 29.122 [2], i.e.:

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

with the following components:

- The {apiRoot} shall be set as described in clause 5.2.4 of 3GPP TS 29.122 [2].
- The <apiName> shall be "uae-uav-status".

- The <apiVersion> shall be "v1".
- The <apiSpecificSuffixes> shall be set as described in clause 5.2.4 of 3GPP TS 29.122 [2].

NOTE: When 3GPP TS 29.122 [2] is referenced for the common protocol and interface aspects for API definition in the clauses under clause 6.2, the UAE Server takes the role of the SCEF and the UASS takes the role of the SCS/AS.

6.2.2 Usage of HTTP

The provisions of clause 5.2.2 of 3GPP TS 29.122 [2] shall apply for the UAE_RealtimeUAVStatus API.

6.2.3 Resources

6.2.3.1 Overview

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

Figure 6.2.3.1-1 depicts the resource URIs structure for the UAE_RealtimeUAVStatus API.

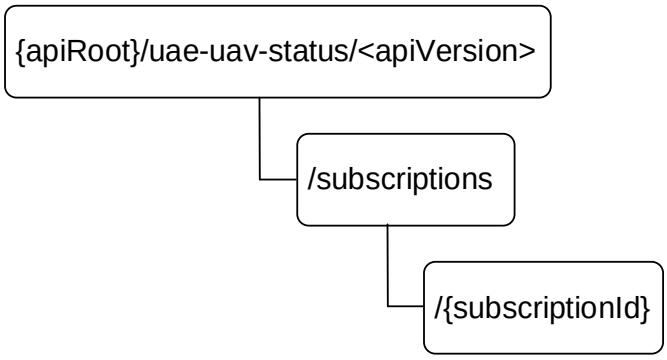

Figure 6.2.3.1-1: Resource URIs structure of the UAE_RealtimeUAVStatus API

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

Table 6.2.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
Real-time UAV Status Subscriptions	/subscriptions	GET	Retrieve all the active real-time UAV status subscriptions managed by the UAE Server.
		POST	Request the creation of a subscription to real-time UAV status reporting.
Individual Real-time UAV Status Subscription	/subscriptions/{subscriptionId}	GET	Retrieve a real-time UAV status subscription resource identified by the provided subscription identifier.
		PUT	Update an existing real-time UAV status subscription resource identified by the provided subscription identifier.
		DELETE	Request the deletion of a real-time UAV status subscription resource identified by the provided subscription identifier.

6.2.3.2 Resource: Real-time UAV Status Subscriptions

6.2.3.2.1 Description

This resource represents the collection of real-time UAV status subscriptions managed by the UAE Server.

6.2.3.2.2 Resource Definition

Resource URI: **{apiRoot}/uae-uav-status/<apiVersion>/subscriptions**

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

Table 6.2.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 5.2.4 of 3GPP TS 29.122 [2].

6.2.3.2.3 Resource Standard Methods

6.2.3.2.3.1 GET

The GET method allows a UASS to retrieve all the active real-time UAV status subscriptions managed by the UAE Server.This method shall support the URI query parameters specified in table 6.2.3.2.3.1-1.

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

Name	Data type	P	Cardinality	Description	Applicability
n/a					

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

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

Data type	P	Cardinality	Description
n/a			

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

Data type	P	Cardinality	Response codes	Description
array(RTUavStatusSubsc)	M	1..N	200 OK	Successful case. All the active real-time UAV status subscriptions managed by the UAE Server shall be returned.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The manadatory HTTP error status code for the HTTP GET method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.2.3.2.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

Table 6.2.3.2.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

6.2.3.2.3.2 POST

The POST method allows a UASS to request the creation of a subscription to real-time UAV status reporting at the UAE Server. This method shall support the URI query parameters specified in table 6.2.3.2.3.2-1.

Table 6.2.3.2.3.2-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.2.3.2.3.2-2 and the response data structures and response codes specified in table 6.2.3.2.3.2-3.

Table 6.2.3.2.3.2-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
RTUavStatusSubsc	M	1	Represents the parameters to request the creation of a subscription to real-time UAV status reporting.

Table 6.2.3.2.3.2-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
RTUavStatusSubsc	M	1	201 Created	Successful case. The subscription is successfully created and a representation of the created Individual Real-time UAV Status Subscription resource shall be returned. An HTTP "Location" header that contains the resource URI of the created Individual Real-time UAV Status Subscription resource shall also be included.
NOTE: The manadatory HTTP error status code for the HTTP POST method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.2.3.2.3.2-4: Headers supported by the 201 Response Code on this resource

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

6.2.3.2.4 Resource Custom Operations

There are no resource custom operations defined for this resource in this release of the specification.

6.2.3.3 Resource: Individual Real-time UAV Status Subscription

6.2.3.3.1 Description

This resource represents an individual real-time UAV status subscription managed by the UAE Server.

6.2.3.3.2 Resource Definition

Resource URI: **{apiRoot}/uae-uav-status/<apiVersion>/subscriptions/{subscriptionId}**

This resource shall support the resource URI variables defined in table 6.2.3.3.2-1.

Table 6.2.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 5.2.4 of 3GPP TS 29.122 [2].
subscriptionId	string	Represents the subscription identifier.

6.2.3.3.3 Resource Standard Methods

6.2.3.3.3.1 GET

The GET method allows a UASS to retrieve a real-time UAV status subscription identified by the subscription identifier included in the request URI (i.e. within the "/{subscriptionId}" path segment).This method shall support the URI query parameters specified in table 6.2.3.3.3.1-1.

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

Name	Data type	P	Cardinality	Description	Applicability
n/a					

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

Table 6.2.3.3.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

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

Data type	P	Cardinality	Response codes	Description
RTUavStatusSubsc	M	1	200 OK	Successful case. The requested Individual Real-time UAV Status Subscription resource shall be returned.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The manadatory HTTP error status code for the HTTP GET method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.2.3.3.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

Table 6.2.3.3.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

6.2.3.3.3.2 PUT

The PUT method allows a UASS to request the update of an existing real-time UAV status subscription identified by the subscription identifier included in the request URI (i.e. within the "/{subscriptionId}" path segment). This method shall support the URI query parameters specified in table 6.2.3.3.3.2-1.

Table 6.2.3.3.3.2-1: URI query parameters supported by the PUT method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.2.3.3.3.2-2 and the response data structures and response codes specified in table 6.2.3.3.3.2-3.

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

Data type	P	Cardinality	Description
RTUavStatusSubsc	M	1	Represents the parameters to request the update of an existing subscription to real-time UAV status reporting.

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

Data type	P	Cardinality	Response codes	Description
RTUavStatusSubsc	M	1	200 OK	Successful case. The real-time UAV status subscription is successfully updated and a representation of the updated Individual Real-time UAV Status Subscription resource shall be returned.
n/a			204 No Content	Successful case. The real-time UAV status subscription is successfully updated.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The manadatory HTTP error status code for the HTTP PUT method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.2.3.3.3.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

Table 6.2.3.3.3.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

6.2.3.3.3 DELETE

The DELETE method allows a UASS to request the deletion of an existing real-time UAV status subscription identified by the subscription identifier included in the request URI (i.e. within the "/{subscriptionId}" path segment). This method shall support the URI query parameters specified in table 6.2.3.3.3.3-1.

Table 6.2.3.3.3.3-1: URI query parameters supported by the DELETE method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.2.3.3.3.3-2 and the response data structures and response codes specified in table 6.2.3.3.3.3-3.

Table 6.2.3.3.3.3-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.2.3.3.3.3-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful case. The real-time UAV status subscription is successfully deleted.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI of the resource located in an alternative UAE Server. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The manadatory HTTP error status code for the HTTP DELETE method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.2.3.3.3.3-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

Table 6.2.3.3.3.3-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative UAE Server.

6.2.3.3.4 Resource Custom Operations

There are no resource custom operations defined for this resource in this release of the specification.

6.2.4 Custom Operations without associated resources

There are no custom operations without associated resources defined for this API in this release of the specification.

6.2.5 Notifications

6.2.5.1 General

Notifications shall comply to clause 5.2.5 of 3GPP TS 29.122 [2].

Table 6.2.5.1-1: Notifications overview

Notification	Callback URI	HTTP method or custom operation	Description (service operation)
Real-time UAV Status Notification	{notificationUri}/uav-status	uav-status (POST)	This service operation enables a UAE Server to notify a previously subscribed UASS on the real-time UAV status information.

6.2.5.2 Real-time UAV Status Notification

6.2.5.2.1 Description

The Real-time UAV Status Notification is used by a UAE Server to notify a previously subscribed UASS on the real-time UAV status information.

6.2.5.2.2 Target URI

The Callback URI **"{notificationUri}/uav-status"** shall be used with the callback URI variables defined in table 6.2.5.2.2-1.

Table 6.2.5.2.2-1: Callback URI variables

Name	Data type	Definition
notificationUri	Uri	String formatted as a URI containing the Callback URI.

6.2.5.2.3 Standard Methods

6.2.5.2.3.1 POST

This method shall support the request data structures specified in table 6.2.5.2.3.1-1 and the response data structures and response codes specified in table 6.2.5.2.3.1-2.

Table 6.2.5.2.3.1-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
RTUavStatusNotif	M	1	Represents a real-time UAV status notification.

Table 6.2.5.2.3.1-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful case. The real-time UAV status notification is successfully received and acknowledged.
n/a			307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
n/a			308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing an alternative URI representing the end point of an alternative UASS where the notification should be sent. Redirection handling is described in clause 5.2.10 of 3GPP TS 29.122 [2].
NOTE: The mandatory HTTP error status codes for the HTTP POST method listed in table 5.2.6-1 of 3GPP TS 29.122 [2] also apply.				

Table 6.2.5.2.3.1-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

Table 6.2.5.2.3.1-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative UASS towards which the notification should be redirected.

6.2.6 Data Model

6.2.6.1 General

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

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

Table 6.2.6.1-1: UAE_RealtimeUAVStatus API specific Data Types

Data type	Clause defined	Description	Applicability
RTUavStatusSubsc	6.2.6.2.2	Represents the parameters to request the creation of a subscription to real-time UAV status reporting.	
RTUavStatusNotif	6.2.6.2.3	Represents a real-time UAV status notification.	
RTUavStatus	6.2.6.2.4	Represents real-time UAV status information.	
UavNetConnStatus	6.2.6.2.5	Represents the UAV network connection status information.	

Table 6.2.6.1-2 specifies data types re-used by the UAE_RealtimeUAVStatus API from other specifications, including a reference to their respective specifications, and when needed, a short description of their use within the UAE_RealtimeUAVStatus API.

Table 6.2.6.1-2: UAE_RealtimeUAVStatus API re-used Data Types

Data type	Reference	Comments	Applicability
DateTime	3GPP TS 29.122 [2]	Represents a date and a time.	
MonitoringType	3GPP TS 29.122 [2]	Represents a monitoring event type.	
LocationInfo	3GPP TS 29.122 [2]	Represents user location information.	
SupportedFeatures	3GPP TS 29.571 [7]	Used to negotiate the applicability of the optional features.	
UavId	Clause 6.1.6.2.7	Represents a UAV identifier.	
Uri	3GPP TS 29.122 [2]	Represents a URI.	

6.2.6.2 Structured data types

6.2.6.2.1 Introduction

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

6.2.6.2.2 Type: RTUavStatusSubsc

Table 6.2.6.2.2-1: Definition of type RTUavStatusSubsc

Attribute name	Data type	P	Cardinality	Description	Applicability
uassId	Uri	M	1	Contains the identity of the UASS that is sending the request. It takes the form of a URI.	
uavIds	array(UavId)	M	1..N	Contains the identity of the UAV(s) to which the real-time UAV status subscription is related.	
notificationUri	Uri	M	1	Contains the notification URI via which the UASS desires to receive real-time UAV status notifications from the UAE Server.	
suppFeat	SupportedFeatures	C	0..1	Contains the list of supported features among the ones defined in clause 6.2.8. This attribute shall be provided in the HTTP POST request for subscription resource creation and in the associated successful response.	

6.2.6.2.3 Type: RTUavStatusNotif

Table 6.2.6.2.3-1: Definition of type RTUavStatusNotif

Attribute name	Data type	P	Cardinality	Description	Applicability
subscriptionId	string	M	1	Contains the identifier of the Individual Real-time UAV Status Subscription to which the notification is related.	
rTUavStatus	array(RTUavStatus)	M	1..N	Contains the real-time UAV status information for a UAV.	

6.2.6.2.4 Type: RTUavStatus

Table 6.2.6.2.4-1: Definition of type RTUavStatus

Attribute name	Data type	P	Cardinality	Description	Applicability
uavId	UavId	M	1	Contains the identity of the UAV to which the real-time UAV status information is related.	
uavNetConnStatus	UavNetConnStatus	C	0..1	Contains the network connection status information for the UAV. (NOTE)	
uavLocInfo	LocationInfo	M	1	Contains the location information for the UAV. (NOTE)	
NOTE: Either only the "uavLocInfo" attribute or both the "uavNetConnStatus" attribute and the "uavLocInfo" attribute shall be present.					

6.2.6.2.5 Type: UavNetConnStatus

Table 6.2.6.2.5-1: Definition of type UavNetConnStatus

Attribute name	Data type	P	Cardinality	Description	Applicability
statusInfo	MonitoringType	M	1	Contains the network connection status monitoring event that occurred. Only the "LOSS_OF_CONNECTIVITY", "UE_REACHABILITY", "COMMUNICATION_FAILURE" and "PDN_CONNECTIVITY_STATUS" values are applicable.	
timestamp	DateTime	M	1	Contains the timestamp of the provided network connection status information.	

6.2.6.3 Simple data types and enumerations

6.2.6.3.1 Introduction

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

6.2.6.3.2 Simple data types

The simple data types defined in table 6.2.6.3.2-1 shall be supported.

Table 6.2.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

6.2.6.4 Data types describing alternative data types or combinations of data types

There are no data types describing alternative data types or combinations of data types defined for this API in this release of the specification.

6.2.6.5 Binary data

6.2.6.5.1 Binary Data Types

Table 6.2.6.5.1-1: Binary Data Types

Name	Clause defined	Content type

6.2.7 Error Handling

6.2.7.1 General

For the UAE_RealtimeUAVStatus API, HTTP error responses shall be supported as specified in clause 5.2.6 of 3GPP TS 29.122 [2]. Protocol errors and application errors specified in clause 5.2.6 of 3GPP TS 29.122 [2] shall be supported for the HTTP status codes specified in table 5.2.6-1 of 3GPP TS 29.122 [2].

In addition, the requirements in the following clauses are applicable for the UAE_RealtimeUAVStatus API.

6.2.7.2 Protocol Errors

No specific protocol errors for the UAE_RealtimeUAVStatus API are specified.

6.2.7.3 Application Errors

The application errors defined for the UAE_RealtimeUAVStatus API are listed in Table 6.2.7.3-1.

Table 6.2.7.3-1: Application errors

Application Error	HTTP status code	Description

6.2.8 Feature negotiation

The optional features listed in table 6.2.8-1 are defined for the UAE_RealtimeUAVStatus API. They shall be negotiated using the extensibility mechanism defined in clause 5.2.7 of 3GPP TS 29.122 [2].

Table 6.2.8-1: Supported Features

Feature number	Feature Name	Description

6.2.9 Security

The provisions of clause 6 of 3GPP TS 29.122 [2] shall apply for the UAE_RealtimeUAVStatus API.

7 Using Common API Framework

7.1 General

When CAPIF is used with a UAE Server service, the UAE Server shall support the following functionalities as defined in 3GPP TS 29.222 [10]:

- the API exposing function and the related APIs over CAPIF-2/2e and CAPIF-3/3e reference points;
- the API publishing function and the related APIs over CAPIF-4/4e reference point;
- the API management function and the related APIs over CAPIF-5/5e reference point; and
- at least one of the security methods for authentication and authorization, and the related security mechanisms.

In a centralized deployment as defined in 3GPP TS 23.222 [9], where the CAPIF core function and the API provider domain functions are co-located, the interactions between the CAPIF core function and the API provider domain functions may be independent of the CAPIF-3/3e, CAPIF-4/4e and CAPIF-5/5e reference points.

When CAPIF is used with a UAE Server service, the UAE Server shall register all the northbound APIs features in the CAPIF Core Function.

7.2 Security

When CAPIF is used for external exposure, before invoking an API exposed by the UAE Server, the service API consumer (e.g. UASS) acting as an API invoker shall negotiate the security method (PKI, TLS-PSK or OAuth 2.0) with the CAPIF core function and ensure that the UAE Server has enough credentials to authenticate the service API consumer (e.g. UASS), as defined in clauses 5.6.2.2 and 6.2.2.2 of 3GPP TS 29.222 [10].

If PKI or TLS-PSK is selected as the security method to be used between the service API consumer (e.g. UASS) and the UAE Server, upon API invocation, the UAE Server shall retrieve the authorization information from the CAPIF core function as described in clause 5.6.2.4 of 3GPP TS 29.222 [10].

As indicated in 3GPP TS 33.122 [11], the access to the UAE Server APIs may be authorized by means of the OAuth 2.0 protocol (see IETF RFC 6749 [12]), using the "Client Credentials" authorization grant, where the CAPIF core function (see 3GPP TS 29.222 [10]) plays the role of the authorization server.

NOTE 1: In this release, only "Client Credentials" authorization grant is supported.

If OAuth 2.0 is selected as the security method to be used between the service API consumer (e.g. UASS) and the UAE Server, the service API consumer (e.g. UASS) shall, prior to consuming the services offered by the UAE Server APIs, obtain a "token" from the authorization server, by invoking the Obtain_Authorization service operation as described in clause 5.6.2.3.2 of 3GPP TS 29.222 [10].

The UAE Server APIs do not define any scopes for OAuth 2.0 authorization. It is the UAE Server responsibility to check whether the service API consumer (e.g. UASS) is authorized to use an API based on the provided "token". Once the UAE Server verifies the "token", it shall check whether the UAE Server identifier in the "token" matches its own published identifier, and whether the API name in the "token" matches its own published API name. If those checks are passed, the service API consumer (e.g. UASS) has full authority to access any resource or operation provided by the invoked API.

NOTE 2: For the aforementioned security methods, the UAE Server needs to apply admission control according to access control policies after performing the authorization checks.

Annex A (normative): OpenAPI specification

A.1 General

This Annex specifies the formal definition of the API(s) defined in the present specification. It consists of OpenAPI specifications in YAML format.

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

NOTE 1: The semantics and procedures, as well as conditions, e.g. for the applicability and allowed combinations of attributes or values, not expressed in the OpenAPI definitions but defined in other parts of the specification also apply.

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

A.2 UAE_C2OperationModeManagement API

```
openapi: 3.0.0
info:
  title: UAE Server C2 Operation Mode Management Service
  version: 1.0.0
  description: |
    UAE Server C2 Operation Mode Management Service.
    © 2022, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: >
    3GPP TS 29.257 V17.1.0; Application layer support for Uncrewed Aerial System (UAS);
    UAS Application Enabler (UAE) Server Services; Stage 3.
  url: https://www.3gpp.org/ftp/Specs/archive/29_series/29.257/

servers:
  - url: '{apiRoot}/uae-c2opmode-mngt/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 5.2.4 of 3GPP TS 29.122

security:
  - {}
  - oAuth2ClientCredentials: []

paths:
  /initiate:
    post:
      summary: Request the provisioning of C2 Operation Mode configuration information for a UAS
(i.e. pair of UAV and UAV-C).
      operationId: InitiateC2OpModeConfig
      tags:
        - Initiate C2 Operation Mode configuration
      requestBody:
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/ConfigureData'
      responses:
        '200':
          description: >
            The communicated C2 Operation Mode configuration information was successfully
            received. The response body contains the feedback of the UAE Server on whether
            this C2 Operation Mode configuration request is confirmed (i.e. can be undertaken
```

```
        by the UAE Server) or not.
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/C2Result'
    '307':
      $ref: 'TS29122_CommonData.yaml#/components/responses/307'
    '308':
      $ref: 'TS29122_CommonData.yaml#/components/responses/308'
    '400':
      $ref: 'TS29122_CommonData.yaml#/components/responses/400'
    '401':
      $ref: 'TS29122_CommonData.yaml#/components/responses/401'
    '403':
      $ref: 'TS29122_CommonData.yaml#/components/responses/403'
    '404':
      $ref: 'TS29122_CommonData.yaml#/components/responses/404'
    '411':
      $ref: 'TS29122_CommonData.yaml#/components/responses/411'
    '413':
      $ref: 'TS29122_CommonData.yaml#/components/responses/413'
    '415':
      $ref: 'TS29122_CommonData.yaml#/components/responses/415'
    '429':
      $ref: 'TS29122_CommonData.yaml#/components/responses/429'
    '500':
      $ref: 'TS29122_CommonData.yaml#/components/responses/500'
    '503':
      $ref: 'TS29122_CommonData.yaml#/components/responses/503'
    default:
      $ref: 'TS29122_CommonData.yaml#/components/responses/default'
callbacks:
  C2OpModeMngtCompletionNotification:
    '{$request.body#/notificationUri}/c2mode-mngt-completion':
      post:
        requestBody:
          required: true
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/C2OpModeMngtCompStatus'
        responses:
          '204':
            description: >
              No Content. The notification was succesfull and the C2 Operation Mode
              Management Completion status for the concerned UAS (i.e. pair of UAV
              and UAV-C) was successfully received and acknowledged by the UASS.
          '307':
            $ref: 'TS29122_CommonData.yaml#/components/responses/307'
          '308':
            $ref: 'TS29122_CommonData.yaml#/components/responses/308'
          '400':
            $ref: 'TS29122_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29122_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29122_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29122_CommonData.yaml#/components/responses/404'
          '411':
            $ref: 'TS29122_CommonData.yaml#/components/responses/411'
          '413':
            $ref: 'TS29122_CommonData.yaml#/components/responses/413'
          '415':
            $ref: 'TS29122_CommonData.yaml#/components/responses/415'
          '429':
            $ref: 'TS29122_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29122_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29122_CommonData.yaml#/components/responses/503'
          default:
            $ref: 'TS29122_CommonData.yaml#/components/responses/default'
  SelectedC2CommunicationModeNotification:
    '{$request.body#/notificationUri}/inform-selec-c2mode':
      post:
        requestBody:
          required: true
```

```
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/SelectedC2CommModeNotif'
        responses:
          '204':
            description: >
              No Content. The notification was succesfull and the C2 Communication Mode
              selected by the concerned UAS (i.e. pair of UAV and UAV-C) was successfully
              received and acknowledged by the UASS.
          '307':
            $ref: 'TS29122_CommonData.yaml#/components/responses/307'
          '308':
            $ref: 'TS29122_CommonData.yaml#/components/responses/308'
          '400':
            $ref: 'TS29122_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29122_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29122_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29122_CommonData.yaml#/components/responses/404'
          '411':
            $ref: 'TS29122_CommonData.yaml#/components/responses/411'
          '413':
            $ref: 'TS29122_CommonData.yaml#/components/responses/413'
          '415':
            $ref: 'TS29122_CommonData.yaml#/components/responses/415'
          '429':
            $ref: 'TS29122_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29122_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29122_CommonData.yaml#/components/responses/503'
          default:
            $ref: 'TS29122_CommonData.yaml#/components/responses/default'
  C2CommunicationModeSwitchingNotification:
    '{$request.body#/notificationUri}/inform-c2mode-switch':
      post:
        requestBody:
          required: true
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/C2CommModeSwitchNotif'
        responses:
          '200':
            description: >
              OK. The targeted C2 Communication Mode switching for the concerned UAS
              (i.e. pair of UAV and UAV-C) is successfully received. The response body
              contains the feedback of the UASS on whether this C2 Communication Mode
              switching is confirmed (i.e. validated) or not.
            content:
              application/json:
                schema:
                  $ref: '#/components/schemas/C2Result'
          '204':
            description: >
              No Content. The targeted C2 Communication Mode switching for the concerned
              UAS (i.e. pair of UAV and UAV-C) is successfully received and acknowledged,
              and the UASS does not need to confirm (i.e. validate) it.
          '307':
            $ref: 'TS29122_CommonData.yaml#/components/responses/307'
          '308':
            $ref: 'TS29122_CommonData.yaml#/components/responses/308'
          '400':
            $ref: 'TS29122_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29122_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29122_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29122_CommonData.yaml#/components/responses/404'
          '411':
            $ref: 'TS29122_CommonData.yaml#/components/responses/411'
          '413':
            $ref: 'TS29122_CommonData.yaml#/components/responses/413'
          '415':
```

```
                $ref: 'TS29122_CommonData.yaml#/components/responses/415'
              '429':
                $ref: 'TS29122_CommonData.yaml#/components/responses/429'
              '500':
                $ref: 'TS29122_CommonData.yaml#/components/responses/500'
              '503':
                $ref: 'TS29122_CommonData.yaml#/components/responses/503'
              default:
                $ref: 'TS29122_CommonData.yaml#/components/responses/default'

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{tokenUrl}'
          scopes: {}

  schemas:
    ConfigureData:
      description: >
        Represents the parameters to request to provision C2 Operation Mode configuration
        information for a UAS (i.e. pair of UAV and UAV-C).
      type: object
      properties:
        uassId:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/Uri'
        uasId:
          $ref: '#/components/schemas/UasId'
        allowedC2CommModes:
          type: array
          items:
            $ref: '#/components/schemas/C2CommMode'
          minItems: 1
        c2CommModeSwitchTypes:
          type: array
          items:
            $ref: '#/components/schemas/C2CommModeSwitching'
          minItems: 1
        notificationUri:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/Uri'
        primaryC2CommMode:
          $ref: '#/components/schemas/C2CommMode'
        secondaryC2CommMode:
          $ref: '#/components/schemas/C2CommMode'
        c2SwitchPolicies:
          $ref: '#/components/schemas/C2SwitchPolicies'
        c2ServiceArea:
          $ref: '#/components/schemas/C2ServiceArea'
        suppFeat:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      required:
        - uassId
        - uasId
        - allowedC2CommModes
        - c2CommModeSwitchTypes
        - notificationUri
        - primaryC2CommMode
        - c2SwitchPolicies

    SelectedC2CommModeNotif:
      description: >
        Represents information on the C2 Communication Mode selected by a UAS (i.e. pair of
        UAV and UAV-C).
      type: object
      properties:
        uasId:
          $ref: '#/components/schemas/UasId'
        selPrimaryC2CommMode:
          $ref: '#/components/schemas/C2CommMode'
        selSecondaryC2CommMode:
          $ref: '#/components/schemas/C2CommMode'
      required:
        - uasId
        - selPrimaryC2CommMode

    C2CommModeSwitchNotif:
```

```
    description: >
      Represents information on the targeted C2 Communication Mode switching for a UAS
      (i.e. pair of UAV and UAV-C).
    type: object
    properties:
      uaeServerId:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/Uri'
      uasId:
        $ref: '#/components/schemas/UasId'
      c2CommModeSwitchType:
        $ref: '#/components/schemas/C2CommModeSwitching'
      switchingCause:
        $ref: '#/components/schemas/C2SwitchingCause'
    required:
      - uaeServerId
      - uasId
      - c2CommModeSwitchType

  C2Result:
    description: Represents the result of an action related to C2 of a UAS.
    type: object
    properties:
      c2OpConfirmed:
        type: boolean
      suppFeat:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
    required:
      - c2OpConfirmed

  UasId:
    description: Represents the identifier of a UAS (i.e. pair of UAV and UAV-C).
    type: object
    properties:
      groupId:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/ExternalGroupId'
      individualUasId:
        type: array
        items:
          $ref: '#/components/schemas/UavId'
        minItems: 2
    oneOf:
      - required: [groupId]
      - required: [individualUasId]

  UavId:
    description: Represents the identifier of a UAV (e.g. UAV, UAV-C).
    type: object
    properties:
      gpsi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
      caaId:
        type: string
    anyOf:
      - required: [gpsi]
      - required: [caaId]

  C2ServiceArea:
    description: Represents a C2 service area.
    type: object
    properties:
      ncgiList:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Ncgi'
      taiList:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Tai'
      geographicAreaList:
        type: array
        items:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GeographicArea'
    oneOf:
      - required: [geographicAreaList]
      - anyOf:
        - required: [ncgiList]
        - required: [taiList]
```

```
    C2OpModeMngtCompStatus:
      description: >
        Represents the C2 Operation Mode Management Completion status for a UAV
        (e.g. UAV, UAV-C).
      type: object
      properties:
        uasId:
          $ref: '#/components/schemas/UasId'
        status:
          $ref: '#/components/schemas/C2OpModeStatus'
      required:
        - uasId
        - status

    C2SwitchPolicies:
      description: Represents the C2 operation mode switching policies.
      type: object
      properties:
        directC2LinkQualityThrlds:
          $ref: '#/components/schemas/C2LinkQualityThrlds'
        uuC2LinkQualityThrlds:
          $ref: '#/components/schemas/C2LinkQualityThrlds'

    C2LinkQualityThrlds:
      description: Represents the C2 link quality thresholds.
      type: object
      properties:
        nrRsrpThrldLow:
          type: integer
          minimum: 0
          maximum: 127
        nrRsrpThrldHigh:
          type: integer
          minimum: 0
          maximum: 127
        nrRsrqThrldLow:
          type: integer
          minimum: 0
          maximum: 127
        nrRsrqThrldHigh:
          type: integer
          minimum: 0
          maximum: 127
        packetLossThrldLow:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/PacketLossRate'
        packetLossThrldHigh:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/PacketLossRate'

# ENUMS:

    C2CommMode:
      anyOf:
        - type: string
          enum:
          - DIRECT_C2_COMMUNICATION
          - NETWORK_ASSISTED_C2_COMMUNICATION
          - UTM_NAVIGATED_C2_COMMUNICATION
        - type: string
          description: >
            This string represents the C2 Communication Mode.
      description: |
        Possible values are:
        - DIRECT_C2_COMMUNICATION: Indicates Direct C2 Communication mode.
        - NETWORK_ASSISTED_C2_COMMUNICATION: Indicates Network-Assisted C2 Communication mode.
        - UTM_NAVIGATED_C2_COMMUNICATION: Indicates UTM-Navigated C2 communication mode.

    C2CommModeSwitching:
      anyOf:
        - type: string
          enum:
          - DIRECT_TO_NETWORK_ASSISTED_C2
          - NETWORK_ASSISTED_TO_DIRECT_C2
          - DIRECT_TO_UTM_NAVIGATED_C2
          - NETWORK_ASSISTED_TO_UTM_NAVIGATED_C2
        - type: string
          description: >
            This string represents the C2 Communication Mode Switching type.
      description: |
```

```
        Possible values are:
        - DIRECT_TO_NETWORK_ASSISTED_C2: Indicates the C2 Communication Mode switching from Direct
C2 Communication mode to Network-Assisted C2 Communication mode.
        - NETWORK_ASSISTED_TO_DIRECT_C2: Indicates the C2 Communication Mode switching from Network-
Assisted C2 Communication mode to Direct C2 Communication mode.
        - DIRECT_TO_UTM_NAVIGATED_C2: Indicates the C2 Communication Mode switching from Direct C2
Communication mode to UTM-Navigated C2 communication mode.
        - NETWORK_ASSISTED_TO_UTM_NAVIGATED_C2: Indicates the C2 Communication Mode switching from
Network-Assisted C2 Communication mode to UTM-Navigated C2 communication mode.

    C2SwitchingCause:
      anyOf:
        - type: string
          enum:
          - DIRECT_LINK_QUALITY_DEGRADATION
          - DIRECT_LINK_AVAILABLE
          - MOVING_BVLOS
          - LOCATION_CHANGE
          - TRAFFIC_CONTROL_NEEDED
          - SECURITY_REASONS
          - OTHER_REASONS
        - type: string
          description: >
            This string represents the C2 Communication Mode Switching cause.
      description: |
        Possible values are:
        - DIRECT_LINK_QUALITY_DEGRADATION: Indicates that the C2 Communication Mode switching was
triggered due to a degradation in the direct radio link quality.
        - DIRECT_LINK_AVAILABLE: Indicates that the C2 Communication Mode switching was triggered
due to the availability of a direct link, i.e. direct radio link quality enables its usage.
        - MOVING_BVLOS: Indicates that the C2 Communication Mode switching was triggered due to the
UAV moving BVLOS.
        - LOCATION_CHANGE: Indicates that the C2 Communication Mode switching was triggered due to
an actual or expected location/mobility of the UAV (e.g. which impacts the UAV-to-UAV-C location).
        - TRAFFIC_CONTROL_NEEDED: Indicates that the C2 Communication Mode switching was triggered
due to the necessity to have air traffic control.
        - SECURITY_REASONS: Indicates that the C2 Communication Mode switching was triggered due to
security reasons.
        - OTHER_REASONS: Indicates that the C2 Communication Mode switching was triggered due to
other reasons (e.g. unpredictable event, unknown reason, weather conditions, topography, etc.).

    C2OpModeStatus:
      anyOf:
        - type: string
          enum:
          - SUCCESSFUL
          - NOT_SUCCESSFUL
        - type: string
          description: >
            This string represents the C2 Operation Mode Management Completion status.
      description: |
        Possible values are:
        - SUCCESSFUL: Indicates that the C2 operation mode configuration was successful.
        - NOT_SUCCESSFUL: Indicates that the C2 operation mode configuration was not successful.
```

A.3 UAE_RealtimeUAVStatus API

```
openapi: 3.0.0
info:
  title: UAE Server Real-time UAV Status Service
  version: 1.0.1
  description: |
    UAE Server Real-time UAV Status Service.
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    All rights reserved.

externalDocs:
  description: >
    3GPP TS 29.257 V17.2.0; Application layer support for Uncrewed Aerial System (UAS);
    UAS Application Enabler (UAE) Server Services; Stage 3.
  url: https://www.3gpp.org/ftp/Specs/archive/29_series/29.257/

servers:
  - url: '{apiRoot}/uae-uav-status/v1'
    variables:
```

```
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 5.2.4 of 3GPP TS 29.122

security:
  - {}
  - oAuth2ClientCredentials: []

paths:
  /subscriptions:
    get:
      summary: Retrieve all the active real-time UAV status subscriptions managed by the UAE Server.
      operationId: GetRTUavStatusSubscriptions
      tags:
        - Real-time UAV Status Subscriptions (Collection)
      responses:
        '200':
          description: >
            OK. All the active real-time UAV status subscriptions managed by the UAE Server
            shall be returned.
          content:
            application/json:
              schema:
                type: array
                items:
                  $ref: '#/components/schemas/RTUavStatusSubsc'
        '307':
          $ref: 'TS29122_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29122_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29122_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29122_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29122_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29122_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29122_CommonData.yaml#/components/responses/406'
        '429':
          $ref: 'TS29122_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29122_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29122_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29122_CommonData.yaml#/components/responses/default'

    post:
      summary: Request the creation of a subscription to real-time UAV status reporting.
      operationId: CreateRTUavStatusSubsc
      tags:
        - Real-time UAV Status Subscriptions (Collection)
      requestBody:
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/RTUavStatusSubsc'
      responses:
        '200':
          description: >
            OK. The subscription is successfully created and a representation of the created
            Individual Real-time UAV Status Subscription resource shall be returned.
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/RTUavStatusSubsc'
          headers:
            Location:
              description: >
                Contains the URI of the created Individual Real-time UAV Status Subscription
                resource.
              required: true
              schema:
                type: string
        '400':
```

```
        $ref: 'TS29122_CommonData.yaml#/components/responses/400'
      '401':
        $ref: 'TS29122_CommonData.yaml#/components/responses/401'
      '403':
        $ref: 'TS29122_CommonData.yaml#/components/responses/403'
      '404':
        $ref: 'TS29122_CommonData.yaml#/components/responses/404'
      '411':
        $ref: 'TS29122_CommonData.yaml#/components/responses/411'
      '413':
        $ref: 'TS29122_CommonData.yaml#/components/responses/413'
      '415':
        $ref: 'TS29122_CommonData.yaml#/components/responses/415'
      '429':
        $ref: 'TS29122_CommonData.yaml#/components/responses/429'
      '500':
        $ref: 'TS29122_CommonData.yaml#/components/responses/500'
      '503':
        $ref: 'TS29122_CommonData.yaml#/components/responses/503'
      default:
        $ref: 'TS29122_CommonData.yaml#/components/responses/default'
    callbacks:
      RTUavStatusNotification:
        '{$request.body#/notificationUri}/uav-status':
          post:
            requestBody:
              required: true
              content:
                application/json:
                  schema:
                    $ref: '#/components/schemas/RTUavStatusNotif'
            responses:
              '204':
                description: >
                  No Content. The real-time UAV status notification is successfully
                  received and acknowledged.
              '307':
                $ref: 'TS29122_CommonData.yaml#/components/responses/307'
              '308':
                $ref: 'TS29122_CommonData.yaml#/components/responses/308'
              '400':
                $ref: 'TS29122_CommonData.yaml#/components/responses/400'
              '401':
                $ref: 'TS29122_CommonData.yaml#/components/responses/401'
              '403':
                $ref: 'TS29122_CommonData.yaml#/components/responses/403'
              '404':
                $ref: 'TS29122_CommonData.yaml#/components/responses/404'
              '411':
                $ref: 'TS29122_CommonData.yaml#/components/responses/411'
              '413':
                $ref: 'TS29122_CommonData.yaml#/components/responses/413'
              '415':
                $ref: 'TS29122_CommonData.yaml#/components/responses/415'
              '429':
                $ref: 'TS29122_CommonData.yaml#/components/responses/429'
              '500':
                $ref: 'TS29122_CommonData.yaml#/components/responses/500'
              '503':
                $ref: 'TS29122_CommonData.yaml#/components/responses/503'
              default:
                $ref: 'TS29122_CommonData.yaml#/components/responses/default'


  /subscriptions/{subscriptionId}:
    get:
      summary: Retrieve a real-time UAV status subscription resource.
      operationId: GetRTUavStatusSubscription
      tags:
        - Individual Real-time UAV Status Subscription (Document)
      parameters:
        - name: subscriptionId
          in: path
          description: Individual Real-time UAV Status Subscription identifier.
          required: true
          schema:
            type: string
      responses:
```

```
        '200':
          description: OK. The requested real-time UAV status subscription resource shall be
returned.
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/RTUavStatusSubsc'
        '307':
          $ref: 'TS29122_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29122_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29122_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29122_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29122_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29122_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29122_CommonData.yaml#/components/responses/406'
        '429':
          $ref: 'TS29122_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29122_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29122_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29122_CommonData.yaml#/components/responses/default'

    put:
      summary: Request the update of an existing real-time UAV status subscription.
      operationId: UpdateRTUavStatusSubscription
      tags:
        - Individual Real-time UAV Status Subscription (Document)
      parameters:
        - name: subscriptionId
          in: path
          description: Individual Real-time UAV Status Subscription identifier.
          required: true
          schema:
            type: string
      requestBody:
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/RTUavStatusSubsc'
      responses:
        '200':
          description: >
            OK. The real-time UAV status subscription is successfully updated and a
            representation of the updated Individual Real-time UAV Status Subscription
            resource shall be returned.
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/RTUavStatusSubsc'
        '204':
          description: No Content. The real-time UAV status subscription is successfully updated.
        '307':
          $ref: 'TS29122_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29122_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29122_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29122_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29122_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29122_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29122_CommonData.yaml#/components/responses/406'
        '429':
          $ref: 'TS29122_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29122_CommonData.yaml#/components/responses/500'
```

```
        '503':
          $ref: 'TS29122_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29122_CommonData.yaml#/components/responses/default'

    delete:
      summary: Request the deletion of an existing real-time UAV status subscription.
      operationId: DeleteRTUavStatusSubscription
      tags:
        - Individual Real-time UAV Status Subscription (Document)
      parameters:
        - name: subscriptionId
          in: path
          description: Individual Real-time UAV Status Subscription identifier.
          required: true
          schema:
            type: string
      responses:
        '204':
          description: >
            No Content. The Individual Real-time UAV Status Subscription resource
            is successfully deleted.
        '307':
          $ref: 'TS29122_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29122_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29122_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29122_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29122_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29122_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29122_CommonData.yaml#/components/responses/406'
        '429':
          $ref: 'TS29122_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29122_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29122_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29122_CommonData.yaml#/components/responses/default'


components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{tokenUrl}'
          scopes: {}

  schemas:
    RTUavStatusSubsc:
      description: >
        Represents the parameters to request the creation or update of a subscription
        to real-time UAV status reporting.
      type: object
      properties:
        uassId:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/Uri'
        uavIds:
          type: array
          items:
            $ref: 'TS29257_UAE_C2OperationModeManagement.yaml#/components/schemas/UavId'
          minItems: 1
        notificationUri:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/Uri'
        suppFeat:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      required:
        - uassId
        - uavIds
        - notificationUri
```

```
    RTUavStatusNotif:
      description: Represents a real-time UAV status notification.
      type: object
      properties:
        subscriptionId:
          type: string
        rTUavStatus:
          type: array
          items:
            $ref: '#/components/schemas/RTUavStatus'
          minItems: 1
      required:
        - subscriptionId
        - rTUavStatus

    RTUavStatus:
      description: Represents real-time UAV status information.
      type: object
      properties:
        uavId:
          $ref: 'TS29257_UAE_C2OperationModeManagement.yaml#/components/schemas/UavId'
        uavNetConnStatus:
          $ref: '#/components/schemas/UavNetConnStatus'
        uavLocInfo:
          $ref: 'TS29122_MonitoringEvent.yaml#/components/schemas/LocationInfo'
      allOf:
        - required: [uavId]
        - anyOf:
          - required: [uavLocInfo]
          - required: [uavLocInfo, uavNetConnStatus]

    UavNetConnStatus:
      description: Represents UAV network connection status information.
      type: object
      properties:
        statusInfo:
          $ref: 'TS29122_MonitoringEvent.yaml#/components/schemas/MonitoringType'
        timestamp:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/DateTime'
      required:
        - statusInfo
        - timestamp
```

Annex B (informative): Withdrawn API versions

B.1 General

This Annex lists withdrawn API versions of the APIs defined in the present specification. Clause 4.3.1.6 of 3GPP TS 29.501 [5] describes the withdrawal of API versions.

B.2 UAE_C2OperationModeManagement API

The API versions listed in table B.2-1 are withdrawn for the UAE_C2OperationModeManagement API.

Table B.2-1: Withdrawn API versions of the UAE_C2OperationModeManagement service

API version number	Remarks

B.3 UAE_RealtimeUAVStatus API

The API versions listed in table B.3-1 are withdrawn for the UAE_RealtimeUAVStatus API.

Table B.3-1: Withdrawn API versions of the UAE_RealtimeUAVStatus service

API version number	Remarks

Annex C (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2021-05	CT3#116-e		-	-	-	Skeleton for the new UASAPP TS	0.0.0
2021-05	CT3#116-e	C3-213503				Inclusion of C3-213539	0.1.0
2021-09	CT3#117-e	C3-214619	-	-	-	Inclusion of: C3-214294, C3-214295, C3-214296, C3-214297, C3-214487, C3-214299, C3-214300, C3-214488, C3-214489	0.2.0
2021-10	CT3#118-e	C3-215478				Inclusion of: C3-215442, C3-215443, C3-215444, C3-215445, C3-215446, C3-215447, C3-215448, C3-215449, C3-215450, C3-215451	0.3.0
2021-11	CT3#119-e	C3-216551	-	-	-	Inclusion of: C3-216211, C3-216212, C3-216213, C3-216214, C3-216215, C3-216216, C3-216217, C3-216218, C3-216219	0.4.0
2021-12	CT#94-e	CP-213206	-	-	-	Presented for information	1.0.0
2022-01	CT3#119-bis-e	C3-220456				Inclusion of: C3-220308, C3-220309, C3-220310, C3-220311, C3-220312, C3-220313, C3-220314, C3-220315	1.1.0
2022-02	CT3#120-e	C3-221557				Inclusion of: C3-221342, C3-221343, C3-221344, C3-221345, C3-221346, C3-221347, C3-221348, C3-221349, C3-221352, C3-221353, C3-221638, C3-221639, C3-221640	1.2.0
2022-03	CT#95e	CP-220162				Presentation to TSG CT for approval	2.0.0
2022-03	CT#95e	CP-220162				Approved by TSG CT	17.0.0
2022-06	CT#96	CP-221160	0001	1	F	Correcting the definition of a mandatory attribute in the OpenAPI file	17.1.0
2022-06	CT#96	CP-221160	0002	1	F	Updating the description fields for enumerations in the OpenAPI file	17.1.0
2022-06	CT#96	CP-221160	0003	1	F	Adding a missing reference number	17.1.0
2022-06	CT#96	CP-221151	0004	-	F	Update of info and externalDocs fields	17.1.0
2024-06	CT#104	CP-2421125	0031	1	F	Presence conditions of attributes in RTUavStatus object	17.2.0
2024-06	CT#104	CP-2421109	0038	-	F	Update of info and externalDocs fields	17.2.0

History

Document history		
V17.0.0	May 2022	Publication
V17.1.0	June 2022	Publication
V17.2.0	July 2024	Publication