**3GPP TSG-SA WG6 Meeting #52-bis-e S6-230453**

**e-meeting, 11th – 20th January 2023 (revision of S6-230301, 230019)**

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

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| ***Title:*** | Correction of various inconsistencies and unclarities | | | | | | | | | |
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| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
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| ***Work item code:*** |  | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | |  |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
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| ***Reason for change:*** | | Inconsistencies and unclarities are found in the TS. These are:   * A general reference to “Stage 3” in NOTE 1 in the clauses 7.4.3.1 and 7.4.3.8 is not appropriate. * Inconsistent refering to the unexisting term “USS/UTM navigated” C2 communication. * At completion of the C2 operation mode management procedure, the C2 operation mode management complete message is not only sent at successful completion of the procedure. * The NOTE in Table 8.2.1-1 refer to an API-operation that does not exist. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Inconsistencies and unclarities are removed. These are:   * The NOTE 1 in the clauses 7.4.3.1 and 7.4.3.8 is marked as Void. * The term “UTM-Navigated” C2 communication is used consistently. * The word “successful” is removed, as the C2 operation mode management complete message is sent at successful as well as unsuccessful completion of the procedure. * The NOTE in Table 8.2.1-1 refer to the API-operation Manage\_C2OperationMode. | | | | | | | | |
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| ***Consequences if not approved:*** | | The inconsistencies and unclarities will remain, possibly causing misunderstandings and incorrect implementations. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.4.1, 7.4.2.1, 7.4.2.2, 7.4.2.4, 7.4.2.5, 7.4.3.1, 7.4.3.5, 7.4.3.8, 8.2.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## \* \* \* First Change \* \* \*

### 7.4.1 General

This feature introduces the UAS application enablement services for supporting the selection and re-selection of C2 communication modes. In particular, the UAE layer provides support for the following operations:

- Support the switch between the Network-Assisted C2 communication and Direct C2 communication (e.g. when the direct link becomes feasible/available, or when a UAV is moving towards BVLOS or has poor direct link conditions, etc.) as described in clause 7.4.2.4.

- Support the switch between the Network-Assisted/Direct C2 communication and UTM-Navigated C2 communication (e.g. for air traffic control, the UAV is approaching a No Drone Zone, and detected potential security threats, etc.) as described in clause 7.4.2.5.

- Support the selection of the communication mode between: utilizing more than one C2 communication links, and among applicable C2 communication links, selecting a mode as the primary one as described in clause 7.4.2.3.

- Activation for the support of the above operations in the UAE Server in the UAE client is performed using procedure described respectively in clause 7.4.2.1 and clause 7.4.2.2.

Below, the different procedures for C2 communication mode selection and switching are described using UAE Client assisted and UAE Server controlled based mechanisms. Such functionality is supported by means of policies delivered to the UAV/UAV-C via the UAE layer and assisting the dynamic switching of C2 modes.

NOTE: For direct C2 communication mode, usage of ProSe/PC5 is not considered in the present specification (e.g. direct wireless communication over a technology outside the scope of 3GPP is assumed).

### 7.4.2 Procedures

#### 7.4.2.1 Management of C2 mode selection / switching capability

This procedure manages the C2 mode selection/switching capability at the UAE server, based on an application request from UAS application specific server (which can be the USS/UTM) to manage the C2 operation modes (direct, network-assisted) of C2 communication for a UAS.

Figure 7.4.2.1-1 illustrates the procedure where the UAE server receives an application request for managing the operation mode for C2 communications for a UAS.

Pre-condition:

- The UAV has received its UAS ID from the UAS application specific server.



Figure 7.4.2.1-1: C2 operation mode management request / response

1. The UAS application specific server sends to the UAE Server a C2 operation mode management request for managing the operation modes for the C2 communication for a UAS (consisting a UAV and a UAV-C) and to subscribe for UAE notifications.

2. The UAE Server sends to the UAS application specific server a C2 operation mode management response with a positive or negative acknowledgement of the request, based on capability of UAE server to undertake this task.

3. UAE server executes C2 communication modes configuration according to clause 7.4.2.2.

4. After execution of C2 communication modes configuration, the UAE server notifies the UAS application specific server with a C2 operation mode management complete.

#### 7.4.2.2 C2 communication modes configuration

This procedure enables the configuration of the UAE Client, based on an application request from UAS application specific server (which can be the USS/UTM) to manage the C2 operation modes (direct, network-assisted) of C2 communication for a UAS.

Figure 7.4.2.2-1 illustrates the C2 communication modes configuration procedure.

Pre-conditions:

1. The UAS UEs are connected to 5GS and authenticated and authorized by UAS application specific server as specified in clause 5.2 of 3GPP TS 23.256 [4].

2. UAE Server has established a UAE session with the respective UAE Clients as the UAE clients are successfully registered to the UAE server.

3. UAE Server has performed the C2 mode switching/selection capability initiation as in clause 7.4.2.1.



Figure 7.4.2.2-1: C2 communication modes configuration

1. The UAE Server sends a C2 communication modes configuration request including the UAS identifier, allowed C2 communication modes (e.g., direct, network assisted, UTM-Navigated), primary and optionally secondary C2 communication mode and policy for switching. In the case of removal of C2 communication mode configuration parameters from the UAV or UAV-C, then the request shall only include the UAS identifier.

2. The UAE Client stores or removes the C2 communication mode configuration parameters as per the information received in step 1.

3. The UAE Client sends a C2 communication modes configuration response to the UAE Server.

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

#### 7.4.2.4 UAE layer assisted dynamic C2 mode switching

This procedure provides a mechanism for supporting dynamic switching between direct and network assisted C2 communications, which may be required while the UAV flight is ongoing, due to possible change of network conditions, expected location/mobility of the UAV, unpredictable events etc.

Figure 7.4.2.4-1 illustrates the procedure where the UAE server supports the dynamic C2 mode switching for network-assisted C2 communications.

Pre-conditions:

1. UAE Server has activated the dynamic C2 mode switching capability, as described in clause 7.4.2.1

2. UAE Server has subscribed for using SEAL/LMS services and has configured the location event reporting, based on 3GPP TS 23.434 [5].

3. UAE Client has selected a C2 communication mode as described in clause 7.4.2.3, and UAV and UAV-C are engaged in C2 communication.



Figure 7.4.2.4-1: UAE-assisted dynamic C2 mode switching

1. The UAE Client detects a condition for switching C2 communication mode based on local conditions (e.g. using the C2 communication mode switching policy) or based on a command from the UAS application specific server (as described in clause 7.4.2.5). A C2-related trigger event report is sent from the UAE Client of the UAV and/or the UAV-C to the UAE Server, denoting a command from the UAS application specific server or an application QoS attribute change (experienced or expected) e.g. based on the experienced packet delay or packet loss for the Uu or direct link (e.g. packet loss greater than a pre-defined threshold).

2. Additionally, the UAE Server receives a location report for the UAV/UAV-C by the SEAL's LM server. The report can be either periodical or event-based (e.g. UAV moving towards an area covered by a different cell or different operator), as specified in 3GPP TS 23.434 [5] SEAL's LM server procedures (UAE Server acting as a VAL server).

3. The UAE Server determines the switching of the C2 mode from direct to network assisted or vice versa or to UTM-Navigated. If the switching is from direct to network assisted or vice versa, this is done by calculating the relative actual or expected UAV-to-UAV-C location, as well as other factors like QoS fulfilment/unfulfilment, augmented location, mobility/speed, direction, topography, weather conditions.

4. The UAE Server sends a C2 mode switching confirmation request to the UAS application specific server, which includes the UAS identifier as well as the cause for switching and the switching option (direct to network-assisted or network-assisted to direct or to UTM-Navigated). The UAE Server sends this request to obtain confirmation from the UAS application specific server before proceeding with switching to UTM-Navigated. This step is optional in the case of switching from direct to network assisted or vice versa.

5. Conditional on Step 3, the UAE Server receives from the UAS application specific server a C2 mode switching confirmation response indicating a positive or negative result for the requested change.

6. The UAE Server sends to the involved UAE Clients, a C2 operation mode switching message which provides an instruction to the UAV and UAV-C to switch to network-assisted mode or to direct mode or to UTM-Navigated. The UAV and UAV-C start C2 communication using the indicated C2 communication mode (e.g., direct, network assisted, UTM-Navigated).

7. If an emergency switch of the C2 communication is deemed necessary by the UAE Client (e.g. sudden loss of the active C2 link), the UAE Client changes the link prior to the steps 1-6, which are skipped. The UAE Clients send a C2 operation mode switching performed message to the UAE Server to confirm the switching of the C2 communication mode.

#### 7.4.2.5 UAS application specific server triggered C2 communication mode switching

This procedure provides a mechanism for supporting dynamic switching between direct or network assisted C2 communications to UTM-Navigated, initiated by the UAS application specific server (which can be the USS/UTM) after detecting a C2 switching condition which may be required while the UAV enters a no-fly zone. For example, the UAS application specific server needs to take over the control of UAV and fly it to safety (see 3GPP TS 22.125 [2] clause 4.2).

Figure 7.4.2.5-1 illustrates a UAS application specific server triggered C2 communication mode switching.

Pre-conditions:

1. UAE Server has activated the dynamic C2 mode switching capability, as described in clause 7.4.2.1.

2. UAE Client has selected a primary C2 communication mode as described in clause 7.4.2.3, and UAV and UAV-C are engaged in (e.g., direct or network assisted) C2 communication.



Figure 7.4.2.5-1: UAS application specific server triggered C2 communication mode switching

1. The UAS application specific client is instructed directly by a command from the UAS application specific server to switch to UTM-Navigated mode.

NOTE: This procedure between the UAS application specific server and the UAS application specific client is out of scope of the present document.

2. The UAE Client initiates the procedure described in clause 7.4.2.4.

### 7.4.3 Information flows

#### 7.4.3.1 C2 operation mode management request

Table 7.4.3.1-1 describes the information flow C2 operation mode management request from the UAS application specific server to the UAE server.

Table 7.4.3.1-1: C2 operation mode management request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| UASS ID | M | Identity of the UAS application specific server which requests the C2 operation mode management. This ID can be the USS/UTM identifier, when the UAS application specific server is the USS/UTM. |
| UAS ID | M | The identification of the UAS for which the C2 QoS management request applies. This could be in form of identifier for the UAS, e.g group ID; or collection of individual identifiers for the UAV and UAV-C, e.g. CAA level UAV ID, GPSI |
| C2 operation mode management container (see NOTE 2) | O | The C2 operation mode management container consists of the requirements and policy for C2 operation mode management |
| > C2 operation mode management requirement | M | Identification of the type of the C2 mode switching to be supported by the UAE server. This can be either from direct to network-assisted C2, or from network-assisted to direct C2 or to UTM-Navigated. |
| > Allowed C2 communication modes | M | direct, network assisted, UTM-Navigated |
| > Primary C2 communication mode | M | Primary C2 communication mode (direct, network assisted) |
| > Secondary C2 communication mode | O | Secondary C2 communication mode (direct, network assisted) |
| > Policy of C2 switching | M | Parameters for C2 switching  - QoS thresholds on active link  - QoS thresholds on target link |
| > C2 service area | O | The area where the C2 operation mode management request applies. This can be geographical area, or topological area in which the capability is active. |
| NOTE 1: Void.  NOTE 2: If C2 operation mode management container IE is not included, it indicates removal of the C2 operation mode management related information. | | |

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

#### 7.4.3.5 C2 mode switching confirmation request

Table 7.4.3.5-1 describes the information flow C2 mode switching confirmation request from the UAE server to the UAS application specific server.

Table 7.4.3.5-1: C2 mode switching confirmation request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| UAE server ID | M | The identifier of the UAE server which requests the C2 mode switching confirmation from USS/UTM |
| UAS ID | M | The identification of the UAS. This could be in form of identifier for the UAS, e.g. group ID; or collection of individual identifiers for the UAV and UAV-C, e.g. CAA level UAV ID, GPSI. |
| C2 operation mode switching type | M | The type of the C2 mode switching to be applied (direct to network-assisted, or network-assisted to direct, or to UTM-Navigated). |
| Switching cause | O | Cause information for initiating the switching (e.g. poor radio link quality) |

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

#### 7.4.3.8 C2 communication modes configuration request

Table 7.4.3.8-1 describes the information flow C2 communication modes configuration request from the UAE server to the UAE client.

Table 7.4.3.8-1: C2 communication modes configuration request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| UAS ID | M | The identification of the UAS for which the C2 QoS management request applies. This could be in form of identifier for the UAS, e.g. group ID; or collection of individual identifiers for the UAV and UAV-C, e.g. CAA level UAV ID, GPSI. |
| C2 operation mode management configuration (see NOTE 2) | O | The C2 operation mode management configuration information to be configured at the UAS |
| > C2 operation mode management requirement | M | Identification of the type of the C2 mode switching to be supported by the UAE server. This can be either from direct to network-assisted C2, or from network-assisted to direct C2 or to UTM-Navigated. |
| > Allowed C2 communication modes | M | direct, network assisted, UTM-Navigated |
| > Primary C2 communication mode | M | Primary C2 communication mode (direct, network assisted) |
| > Secondary C2 communication mode | O | Secondary C2 communication mode (direct, network assisted) |
| > Policy of C2 switching | M | Parameters for C2 switching  - QoS thresholds on active link  - QoS thresholds on target link |
| NOTE 1: Void.  NOTE 2: If C2 operation mode management configuration IE is not included, it indicates removal of the C2 operation mode management configuration at the UAS ID. | | |

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

### 8.2.1 General

Table 8.2.1-1 illustrates the UAE server APIs.

Table 8.2.1-1: List of UAE server APIs

|  |  |  |  |
| --- | --- | --- | --- |
| API Name | API Operations | Known Consumer(s) | Communication Type |
| UAE\_C2OperationModeManagement API | Manage\_C2OperationMode | UAS application specific server | Request/ Response |
| Notify\_SelectedC2Mode (NOTE) | UAS application specific server | Subscribe/notify |
| Notify\_C2ModeSwitching (NOTE) | UAS application specific server | Subscribe/notify |
| Notify\_C2OperationModeManagementComplete (NOTE) | UAS application specific server | Subscribe/notify |
| UAE\_RealtimeUAVStatus API | Subscribe\_RealtimeUAVStatus | UAS application specific server | Subscribe/notify |
| Unsubscribe\_RealtimeUAVStatus | UAS application specific server | Subscribe/notify |
| Notify\_RealtimeUAVStatus | UAS application specific server | Subscribe/notify |
| NOTE: The subscribe operation for Notify\_C2OperationModeManagementComplete, Notify\_SelectedC2Mode and Notify\_C2ModeSwitching is part of Manage\_C2OperationMode | | | |

## \* \* \* End of Change \* \* \*