**3GPP TSG-SA WG2 Meeting #13x S2-200xxxx**

**Source: Apple**

**Title: Solution of Key Issue #6: UAV Controller and UAV association**

**Document for: Approval**

**Agenda Item: X.X**

**Work Item / Release: FS\_ID\_UAS-SA2 / Rel-17**

*Abstract: This contribution proposes a solution for Key Issue # 6* *– UAV Controller and UAV association in TR 23.754.*

# 1. Introduction

We propose to include this solution for Key Issue 6 - UAV Controller and UAV association.

The Key issue#6 is about How are an UAV Controller and a (set of) UAV(s) associated and considered a UAS, e.g. to enable UTM flight mission authorization for the UAS, and to what extent is the 3GPP system involved in the association?

*START of CHANGE*

## 6.0 Mapping Solutions to Key Issues

Table 6.0-1: Mapping of Solutions to Key Issues

|  |  |
| --- | --- |
|  | Key Issues |
| Solutions | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 |  |  |  | X |  |  |  |
| 2 |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |
| X |  |  |  |  |  | X |  |
|  |  |  |  |  |  |  |  |

*NEXT CHANGE (All text is new)*

## 6.X Solution #X: UAV Controller and UAV Association

### 6.X.1 Introduction

This solution describes procedures in which UTM maintains the UAS configuration containing UAV, UAC and the location/area in which the UAS configuration may be valid. Based on certain factors (e.g. mobility, location, tracking information, etc.) the UTM may trigger the association or disassociation of the UAV from a UAC or UAS either via user plane (C2-Communication link) or via control plane (using UE Configuration Update procedure by AMF).

### 6.X.2 Functional Description

The solution considers the following assumptions:

UTM maintains a UAS configuration that contains the association of the UAV, UAC, association and the area in which the UAS is valid. The UAS configuration table is shared with AMF.

Table 6.X.2-1: UAS configuration

|  |  |  |  |
| --- | --- | --- | --- |
| **UAS Configuration** | **UAV Controller** | **UAV** | **Locations** |
| UAS 1 | UAV controller-A | UAV a/b/c | Area-A |
| UAS 2 | UAV controller-B | UAV d/e/f | Area-B |
| **……** | **…..** | **……** | …… |

The location column in the table defines an area in which the UAV can be operated by a particular UAC. This is applicable to UAV/UAC registered for business enterprise purpose. The location restriction may not be applicable for UAV/UAC registered for recreational purpose.

Location/Area may be geofence boundary, or a city or group of Tracking Areas/Cell IDs. The location area definition is implementation dependent.

The solution proposes the procedure how UAV Controller and UAV are associated and disassociated to a UAS configuration. In UAS system, there are some areas where the UAV(s) are controlled by the designated UAV Controller to ensure stability, reliability, latency, etc.

The UAS configuration may be updated by UTM in case of e.g. UAV moves out of the approved location area, UAC encounters a critical problem (crash, reset, etc).

### 6.X.3 Procedures

#### 6.X.3.1 UAV association update by UTM via AMF

The procedure in Figure 6.X.3-1 shows the procedure of a UAV association update by UTM via AMF:



**Figure 6.X.3.1-1: UAV association update by UTM via AMF**

**Pre-Conditions:**

- UAV, UAV Controller-A and UAV Controller-B have registered on 5GC.

- UAV and UAV Controller-A are authorised and considered as a UAS.

**Procedures:**

1. UTM maintains the UAS Configuration table. A copy of the UAS configuration table is also cached by AMF for the UAVs and UACs it serves.

2. UAV and UAV Controller-A are associated and registered on 5GC. UAV/UAV controller-A report Tracking information to UTM via the user plane.

3. UTM determines to update the association comparing the tracking information with UAS Configuration table. UTM triggers to disassociate with UAV Controller-A and associate with target UAV Controller-B. Following cause codes could be optionally provided to the UTM:

- Cause code#1: UAV moves from area-A to area-B which are covered by different UAV Controllers.

- Cause code#2: Current UAV Controller becomes unavailable unexpectedly.

- Cause code#3: TPAE requested.

4. UTM initiates Association Update Request to AMF with following information:

- UAV ID, Current UAV Controller-A ID and Target UAV Controller-B ID.

- Cause code.

5. AMF updates UAS configuration table.

6. AMF sends UE Configuration Update Command to UAV Controller-B with the related information for association:

- UAV ID, UAV Controller-B ID.

- Association Reconfiguration for association.

- Cause code.

7. UAV Controller-B sends UE Configuration Update Complete to AMF.

8. AMF sends UE Configuration Update Command to UAV with the related information for association:

- UAV ID, UAV Controller-B ID.

- Association Reconfiguration for association.

- Cause code.

9. UAV sends UE Configuration Update Complete to AMF.

10. AMF sends UE Configuration Update Command to UAV Controller-A with the related information for disassociation:

- UAV ID, UAV Controller-A ID.

- Association Reconfiguration for disassociation.

- Cause code.

11. UAV Controller-A sends UE Configuration Update Complete to AMF.

12. AMF sends Association Update Response to UTM:

- UAV ID, UAV Controller-B ID,

13. UAV and UAV Controller-B are associated and report the tracking information to network.

#### 6.X.3.2 UAV association update by UTM via C2-command

The procedure in Figure 6.X.3-2 shows an alternative solution for association update with C2 Command. The 3GPP signalling is not required during the association update procedure.



**Figure 6.X.3.2-1: UAV association update by UTM via C2-command**

1-3. The same steps as described in clause 6.X.3.1 steps 1-3.

4. UTM sends C2 Command with Association update request to UAV Controller-B with following information:

- UAV ID, UAV Controller-B ID.

- Association with cause code.

5. UAV Controller-B sends C2 Command with Association update response to UTM with following information:

- UAV ID, UAV Controller-B ID.

6. UTM sends C2 Command with Association update request to UAV with following information:

- UAV ID, UAV Controller-B ID.

- Association with cause code.

7. UAV sends C2 Command with Association update response to UTM with following information:

- UAV ID, UAV Controller-B ID.

8. UTM sends C2 Command with Association update request to UAV Controller-A with following information:

- UAV ID, UAV Controller-A ID.

- Disassociation with cause code.

9. UAV sends C2 Command with Association update response to UTM with following information:

- UAV ID, UAV Controller-A ID

10. UAV and UAV Controller-B are associated and report the tracking information to network.

## 6.X.4 Impacts on existing entities & interfaces

The solution has impacts in the following entities:

- AMF <--> UTM communication needs to be defined.

*End of CHANGES*