International Civil Aviation Organization

Third Meeting of the Surveillance Study Group (SURSG/3)

(Hong Kong China, 22– 24 March 2023)

Agenda Item 6: Discussion of technical issues and solutions in surveillance data sharing

DATA FORMAT FOR SURVEILLANCE DATA SHARING

(Presented by Hong Kong, China)

SUMMARY

This paper presents the proposal on the data format to be exchanged in the trial of the surveillance data sharing using SWIM under S3TIG for States' consideration.

1. INTRODUCTION

1.1 As a recommendation from the Study Report delivered under SURSG, the trial to be conducted under S3TIG would focus on the surveillance data sharing using ADS-B CAT 21 Version 2.1 to support ATFM operation ("the Trial").

1.2 While ADS-B CAT 21 Version 2.1 will be the raw data provided by the participating States, the payload contained within the SWIM data has not yet been defined.

1.3 AMQP 1.0 would be utilized in the Trial as the standardized messaging protocol for exchanging SWIM data, while the proposed formats of the payload is deliberated in the below sections, based on some potential formats.

2. DISCUSSION

Inclusion of surveillance data information into FIXM messages

2.1 FIXM is the global exchange standard capturing flight and flow information. In the APAC Flow extension package, an aircraft track type with position field is one of the potential candidates for carrying the surveillance data, see Figure 1 below.

2.2 With key players of ASEAN Demonstration (held in sequence in Thailand and Singapore in Nov 2019) expected to participate in the Trial, it is worth considering if FIXM with surveillance data information is to be used given existent format (i.e. FIXM) already with some provision for carrying surveillance data. While such a proposition could arguably reduce some development efforts, the adoption of an existent FIXM field to carry surveillance data might mean that only a small portion of information originated form ADS-B data can be carried via the FIXM format.

2.3 Furthermore, use of XML type message for surveillance data sharing with aircraft update rate could introduce significant data overhead, which is not desirable to the underlying CRV running of comparatively low bandwidth for most participating States.

2.4 Taking into consideration network bandwidth of CRV and backend processing efficiency, it is suggested that a format with less overhead could be considered for surveillance data sharing in the Trial.

Class	Definition	Reference/Remark
ApacAircraftTrackType	Class containing aircraft track data	This class is to be included in extension field under FlightType class.
Data Attribute	**Definition**	**Reference/Remark**
actualSpeed	Current aircraft ground speed	
flightLevel	Current flight level	flightLevel can be in the following forms, • Flight level; or • Altitude.
heading	Current aircraft heading	
position	Current aircraft position	position can be in the following forms, • Designator; • Latitude/Longitude; or • Relative point.
positionTime	Time when all data in this class is reported	

Figure 1: Aircraft Track Type under APAC Flow extension

Using JSON

2.5 JSON is a lightweight data interchange format and is widely used in the IT industry, in view of its interchangeability, ease to read and write by humans, ease to parse and generated by most modern programming languages, etc.

2.6 When comparing with XML, JSON provides less overhead. However, JSON formatted data structure is not standardized in the aviation industry, in particular for the surveillance data. If JSON is to be used in the Trial, a temporary data structure for all the participating States has to be developed, which eventually may not be reusable in the future.

2.7 Subject to the development time constraint for the Trial, a JSON capable surveillance data sharing service could be supplied by the SWIM service provider only for experimental or evaluation purposes.

Using ASTERIX

2.8 Making use of the original ASTERIX data as the payload will further reduce the overhead. A typical ASTERIX CAT 21 packets containing multiple messages and the typical size for a single message is less than 70 bytes, see Figure 2 below.

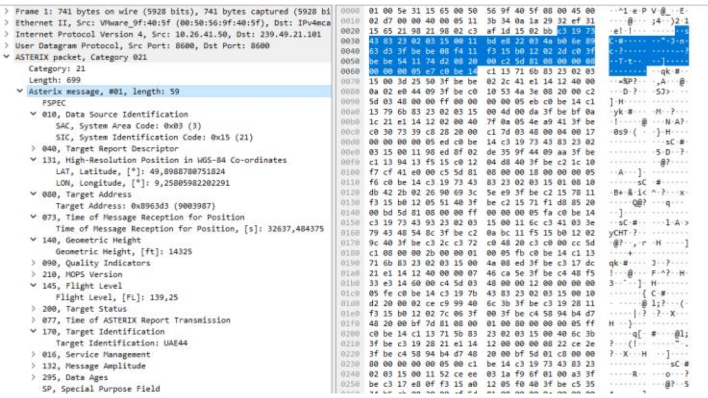

Figure 2: Data Capture of a typical CAT 21 message, hexadecimal message content highlighted in blue

2.9 The size of a sample data in JSON structure as converted from a CAT 21 message is about 1000 bytes, see Figure 3 below, which is over ten times the size of the ASTERIX message. It is possible to optimize the JSON structure by using shorter labels, but it is likely still significantly bigger than a length-optimized binary format as in ASTERIX.


```
{
        "acquisition_datetime": "2023-01-27T09:45:11.148Z",
        "acquisition_datetime_accuracy": 0.0078125,
        "altitudes": [{
                "altitude": 11576.300000000001,
                "altitude_accuracy": 43.814999999999998,
                "altitude_crs": "WGS84",
                "altitude_type": "ABOVE_ELLIPSOID",
                "determination_method": "GNSS_BASED"
        }, {
                "altitude": 11582.4,
                "altitude_accuracy": 45.719999999999999,
                "altitude_crs": "WGS84",
                "altitude_type": "ABOVE_MSL",
                "determination_method": "CALCULATED"
        }, {
                "altitude": 11582.4,
                "altitude_accuracy": 1000,
                "altitude_crs": "WGS84",
                "altitude_type": "ABOVE_MSL",
                "determination_method": "BAROMETRIC"
        }],
        "classification_info": {
                "classifications": [{
                        "id": "b3c1735c-8864-437c-0512-9b3fc08b0b65",
                        "probability": 100,
                        "subtypes": ["MEDIUM"],
                        "type": "AIRCRAFT"
                }]
        },
        "identifications": [{
                "type": "ID_ICAO",
                "value": "89618d"
        }, {
                "type": "ID_CALLSIGN",
                "value": "UAE17   "
        }],
        "operation_id": "6b08352f-c4b0-4e10-e289-4c8f30b3b964",
        "origin": "falke",
        "position": {
                "latitude": 51.485014781355858,
                "longitude": 9.4387605786323547,
                "position_accuracy": 1000,
                "position_crs": "WGS84"
        },
        "report_id": "c5386079-43df-4c6b-259e-edaa9a3b5157",
        "velocity": {
                "altitude": 0,
                "horizontal_accuracy": 0.00010691140599179602,
                "latitude": 0.00091140894085862273,
                "longitude": -0.0021671279260416141,
                "vertical_accuracy": 4.4132500000000006
        }
}
```


Figure 3: Data Capture of a JSON structure as converted from a typical CAT 21 message

Suggestions

2.10 Using the original ASTERIX data format as the payload for SWIM data exchange becomes a preferred option, with the following advantages:

a) There is no need for us to convert the ASTERIX data back and forth into another format for data exchange; and

b) As the payload, the overhead will be the minimal.

<u>Proposed AMQP message header</u>

2.11 Based on the ASEAN Demonstration, the following AMQP headers are proposed for carrying the surveillance data payload.

Header Name	Description
SOURCE	Originator of the message. E.g. VHHH_CAD_SWIM
GEMS_MESSAGE_TYPE	CAT21
GEMS_MESSAGE_VERSION	2.1
DATA_SOURCE	CAT021 Item I021/010 Data Source Identification, i.e. the System Area Code SAC and System Identification Code SIC as a hexadecimal string
SERVICE_ID	CAT021 Item I021/015 Service Identification as string
TIMESTAMP_POS	CAT021 Timestamp for position data: If time of applicability is available via the aircraft's onboard synchronized time source, this field corresponds to Item I021/071. If the avionics are synchronized to a time source, the time of message reception of position Item I021/073 is used.
TIMESTAMP_VEL	CAT021 Timestamp for velocity data: If time of applicability is available via the aircraft's onboard synchronized time source, this field corresponds to Item I021/072. If the avionics are synchronized to a time source, the time of message reception of velocity Item I021/075 is used.
TIMESTAMP_INGRESS	Unix epoch timestamp of the reception of data by EMS for performance monitoring
RECIPIENT_LIST	List of countries receiving the data, e.g. NZ – New Zealand OP – Pakistan RP – Philippines VH – Hong Kong China VT – Thailand WS – Singapore Z – China

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) provide support to the proposal; and

c) discuss any relevant matter as appropriate

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