International Civil Aviation Organization

Second Meeting of the Surveillance Study Group (SURSG/2)

(Video Teleconference, 15– 17 March 2022)

Agenda Item 5: States' experience for Surveillance data sharing

Implementation of FF-ICE Interoperability using GUFI in SWIM

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SUMMARY

This paper presents ROK's Efforts to Implement FF-ICE Interoperability using GUFI in SWIM Environment.

1. INTRODUCTION

1.1 In the FF-ICE environment, with the introduction of Flight Information Exchange Model(FIXM), which is a global exchange standard capturing Flight and Flow information, XML-based FF-ICE message would substitute a legacy FPL. FIXM uses the Globally Unique Flight Identifier (GUFI) as an integral component towards achieving this goal and solving the problem of "Inconsistent Flight Information.

1.2 In 2021, at the 1st SWIM Workshop, ROK presented ROK's SWIM Journey on SWIM Service Implementation for Flight and Surveillance Information.

1.3 This paper presents ROK's Efforts to Implement FF-ICE Interoperability using GUFI in SWIM Environment. And, this includes introduction of the GUFI to the surveillance information domain, implementation of SWIM surveillance and flight services, and usage of the GUFI to provide reliable traceability of relevant FPLs.

2. BACKGROUNDS

2.1 All Purpose Structured Eurocontrol Surveillance Information Exchange (ASTERIX) is a standard for the exchange of air traffic services (ATS) information, especially a surveillance data. ASTERIX is a binary data exchange format. It has many different categories, and surveillance ground station facilities use different category type for their specific purposes. The mandatory and optional items for each category are all different, and this normally depends on manufacturers.

2.2 At the earliest stage, in 2012, at the 23th meeting of the APAC Air Navigation Planning and Implementation Regional Group (APANPIRG/23), guidance materials on ASTERIX Cat. 21 Messages & advice to military authorities regarding Sharing of ADS-B Data was adopted.

2.3 ICAO APAC SWIM TF(SWIM/TF) and Surveillance Study Group (SURSG) has conducting study find an optimal architecture and model and any other related matters for surveillance data exchange in the SWIM environment.

3. ISSUES

3.1 Surveillance data and Flight Plan(FPL) would work together very closely even in the FF-ICE environment. It is expected that the surveillance data and the FPL will be more tightly bound as FF-ICE introduces Trajectory-based Operation (TBO) and manages a trajectory throughout the entire journey.

3.2 FPL may change conditionally depending on the traffic volume or meteorological condition in the FF-ICE/R2 phase (post-departure) and FF-ICE components such as Air Traffic Flow Management(ATFM) and other related systems would require real-time surveillance data for their operation. Importance of reliable binding between surveillance data and FPL would be highlighted.

3.3 Traditionally, to match surveillance data to a specific FPL, matching algorithm depends on mutable attributes (e.g., callsign, departure/arrival aerodrome, Estimated Off-Block Time (EOBT), Date of Flight (DoF), SSR). But, conducting co-relation with mutable attributes are not able to provide reliable traceability of related FPLs for each surveillance target.

3.4 The FF-ICE environment where interaction of systems and operations are highly-automated and intervention of a human operator is minimized requires reliable co-relation and system-wide interoperability between information and systems on different information domain.

3.5 Development of Information Exchange Models(XMs) enables the operation mentioned in the section 3.4, and the ICAO promotes the member states to conduct digital transformation for their ATM system and migrate from the legacy data to schema-based information exchange model. Currently there are Aeronautical Information Exchange Model (AIXM), FIXM, and ICAO Weather Exchange Model (IWXXM),

3.6 It is expected that surveillance information domain would also be one of the important information domains in the FF-ICE environment. However, there was less concern about how to easily use surveillance information in conjunction with other information domains (e.g., flight information domain).

3.7 As ASTERIX doesn’t have a unique identifier and even not in schema-based format, there is a difficulty in interoperability between other information domains. In the FF-ICE environment, current surveillance data would be hard to be coordinated with the FF-ICE messages. Using current matching algorithm with the mutable attributes could cause inconsistency (e.g., mismatch with FF-ICE messages) and would seriously impair the reliability, especially in the machine-to-machine(M2M) processing environment.

3.8 Study Report on Surveillance Data Sharing (Draft) defines a Surveillance Central Data Processor (SCDP) that converts other categories to Cat. 21 format, and it is not appropriate because of the reasons as follows:

1) Could break data integrity and consistency, and
2) Better make sense to develop a schema-based exchange model (i.e., Surveillance Information Exchange Model(SIXM));

3.9 It would be required to expand the usage of GUFI to surveillance data because of these reasons as follows:

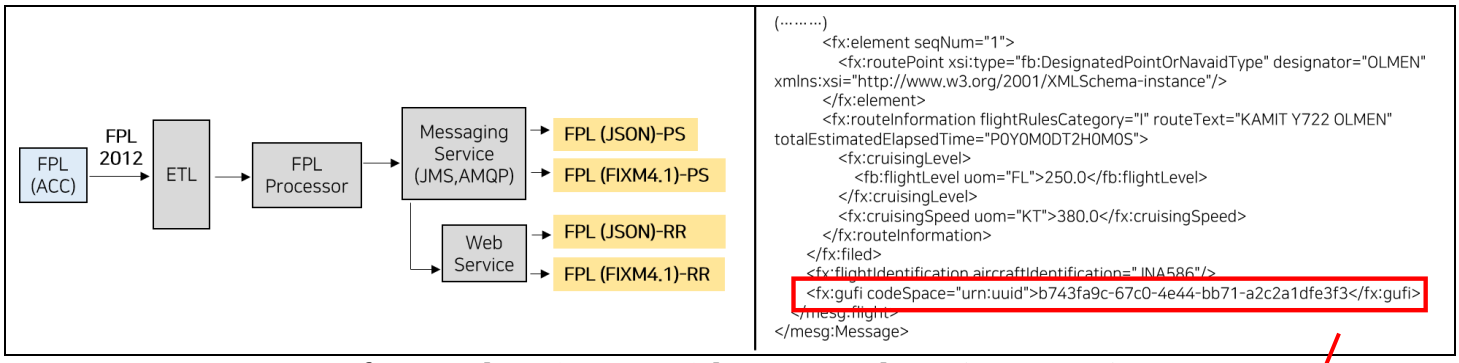
1) To ensure referential integrity between FF-ICE messages and surveillance data, and
2) To improve the consistency of surveillance data in the cross-border data exchange environment;

4. SOLUTION

4.1 ROK has been researching to find a way to improve the usage of surveillance data in SWIM. And KAC introduces the GUFI to the surveillance data. It enables intuitive and unambiguous association surveillance data with FPL without inconsistency and redundancy.

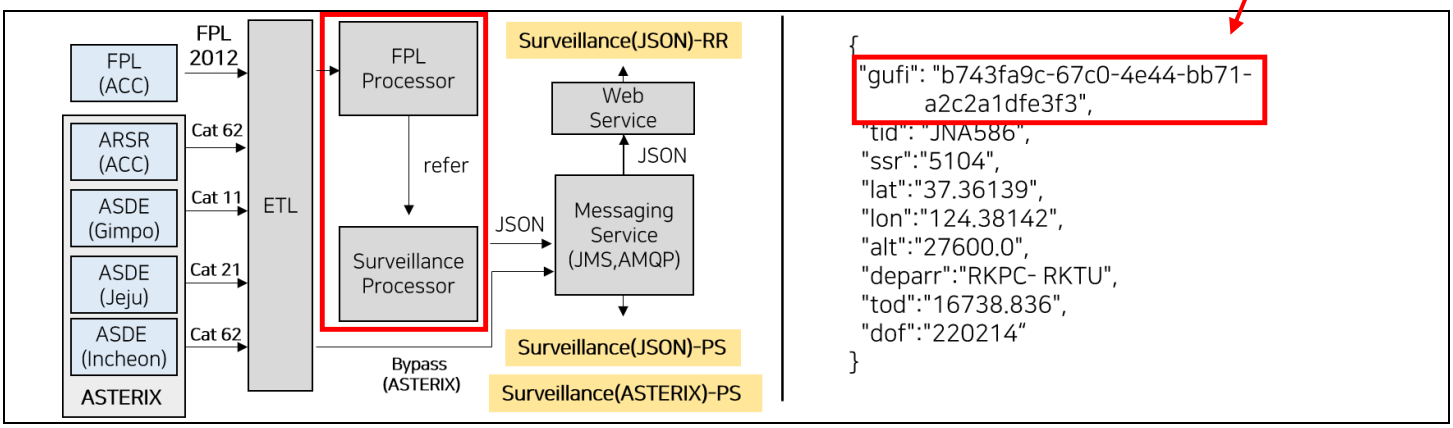
4.2 Since 2016, for ROK SWIM R&D, KAC developed mediation services and information services as follows:

1) FPL mediation service (FPL 2012 to FIXM v 4.x)
2) FPL Messaging / Web Services
3) FPL History Web Services



<Left: Data Flow Diagram / Right: Converted FPL (FIXM v 4.1)>

4) Surveillance mediation service (ASTERIX Cat 62, 21, 19, 11, 10, 9 to JSON)
5) Surveillance Messaging / Web Services
6) Surveillance History Web Services (for each flight)



<Left: Data Flow Diagram / Right: Converted Surveillance Data (JSON)>

4.3 GUFI was not introduced to a surveillance service at the beginning of R&D. Callsign, DoF, departure/arrival aerodrome were used to query each flight's relevant FPLs. Co-relation using those items caused mismatch problem, and did not provide reliable traceability of relevant FPLs.

4.4 Introduction of GUFI to the surveillance data solved those problems mentioned in 3.2. To assign GUFI to the surveillance data, KAC developed middleware on the surveillance information service side, which receives FPL from FPL information service, conducts mapping, and assigns GUFI to the

respective ASTERIX data. As the result, with the GUFI, co-relation between FPL and surveillance data becomes simple and reliable.

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"dof":"220214“
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"deparr":"RKPC- RKTU",
"tod":"16738.836",
"dof":"220214“
}</td></tr>
<tr><th colspan="2">FPL Information Service</th></tr>
<tr><th colspan="2">Request URL</th></tr>
<tr><td>/flight/{dep}/{arr}/{callsign}/{dof}</td><td>/flight/{gufi}</td></tr>
<tr><td colspan="2"><?xml version="1.0" encoding="UTF-8" standalone="yes"?>
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<mesg:flight flightType="S">
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(….)

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</mesg:flight>
</mesg:Message></td></tr>
</table>

5. LESSON-LEARNED

5.1 ROK’s research finding shows that the introduction of GUFI to the surveillance information domain provides an intuitive way to integrate surveillance information with flight information.

5.2 The GUFI can be extended to the surveillance domain, as 1) integral component towards achieving this goal and solving the problem of "Inconsistent Surveillance Data" and 2) enabler of intuitive co-relation to flight information.

5.3 Surveillance information service provider requires to consume a FF-ICE message (i.e., FF-ICE) from a FF-ICE message provider (or distributor), assign GUFI to the surveillance data, keep tracking of GUFI-Target pair within geographical boundary.

5.4 A method of introduce the GUFI in the surveillance information domain are as follows:

1) In the ASTERIX environment, add the GUFI to the header of the message in the Pub/Sub pattern (in this case, each message ought to have single surveillance target); and
2) In the schema based environment (e.g, JSON, or XML), add the GUFI to the key-value pair

6. ACTION BY THE MEETING

6.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate