International Civil Aviation Organization

Third Asia/Pacific FF-ICE Ad Hoc Group Meeting and Workshop (FF-ICE/3)

Bangkok, Thailand, 16 to 18 December 2025

Agenda Item: Overview of Synchronous and Asynchronous REQ/REP Message Exchange Pattern in Support of FF-ICE/R1 Implementation

LESSONS LEARNED ON IMPLEMENTATION OF FF-ICE SERVICES USING R/R MEP

(Presented by the Republic of Korea)

SUMMARY

This paper presents the outcomes and lessons learned from the PoC conducted jointly by the Korea Aerospace Research Institute (KARI) and Korea Airports Corporation (KAC) to explore the implementation of FF-ICE services based on the R/R MEP.

1. INTRODUCTION

1.1   There have been several FF-ICE–related global demonstrations conducted in the APAC region. One of these demonstrations was conducted in 2020, jointly by the Republic of Korea, China, and Japan, during SWIM TF/4, as part of the deliverables under Task 2.1.3 – Service Implementation and Validation. However, the FF-ICE services used in these demonstrations were all implemented based on the Publish/Subscribe (P/S) Message Exchange Pattern (MEP).

1.2   In the meantime, EUROCONTROL published the FPFDE NFPM Implementation Guidelines (2023) and is preparing for the official operational deployment of FF-ICE services within the European region. It is noteworthy to notice that several FF-ICE services, such as the Filing Service, are designed to support the R/R MEP.

Note: Service specifications for EUROCONTROL's FF-ICE services can be found in the EUROCONTROL SWIM Registry.

1.3   In addition, at SWIM TF/10 meetings, the APAC Common SWIM Services were discussed. Among the services defined, FF-ICE services (e.g. the Filing Service) are designed to support both the R/R and P/S MEP. This raises an important question: how could the R/R MEP be implemented in the APAC region?

1.4   In this context, the Korea Aerospace Research Institute (KARI) and Korea Airports Corporation (KAC) implemented an FF-ICE simulator and conducted a Proof of Concept (PoC) to verify how FF-ICE operation could be achieved between R/R MEP based FF-ICE services.

2. DISCUSSION

Reference

2.1   EUROCONTROL has a relatively high level of maturity in FF-ICE and is already operating FF-ICE services based on the R/R MEP; therefore, the following materials were referenced.

   a)   [Implementation Strategy for FPFDE NFPM](#);

   b)   [FPFDE NFPM Implementation Guidelines](#);

   c)   [NM-26.0 RELEASE NOTES](#); and

   d)   [EUROCONTROL SWIM Registry (FF-ICE Service Specification)](#).

   Note: click link to see more information.

Gap Analysis

2.2   To implement R/R MEP-based FF-ICE service, following prerequisite were considered:

   a)   Whereas EUROCONTROL defines synchronous and asynchronous R/R MEP, and implemented R/R MEP in their SWIM, but in the APAC region, there is not yet in guidance material regarding R/R MEP; and

   b)   Whereas EUROCONTROL uses Simple Object Access Protocol (SOAP) to enable R/R MEP, but ICAO APAC SWIM Implementation Guidance Document (IGD) (Draft) recommends using Representational State Transfer (REST) API.

Design Decisions

2.3   To implement R/R MEP-based FF-ICE service, following prerequisite were considered.

   a)   Synchronous R/R MEP: REST API; and

   b)   Asynchronous R/R MEP: Synchronous R/R MEP (REST API) + P/S MEP (Message Broker) (i.e. In the R/R MEP guidance material in the APAC region, this is defined as - Synchronous REST with Asynchronous Event Delivery using Message Queue).

2.4   In case of asynchronous R/R MEP, it is inspired by the Eurocontrol's implementation case of asynchronous R/R MEP.

How it works	a) Synchronous part: The server sends HTTP request, and the counterpart returns reply. If the status of the information reply is OK, the server extracts the information on how to consume the asynchronous reply message, the pattern continues with the asynchronous part b) Asynchronous part: The server connects to the broker and consumes the asynchronous reply message

Implementation of FF-ICE Service

2.5   To conduct PoC, following FF-ICE services were developed:

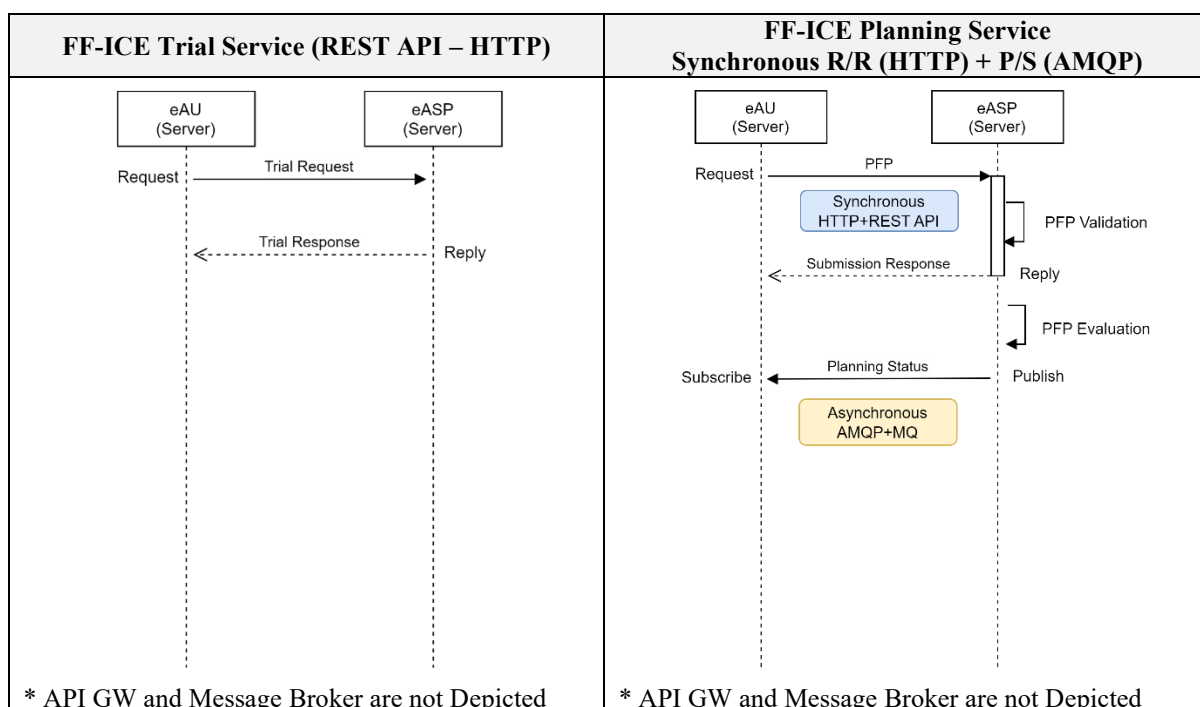| Service	MEP
GUFI Service	Synchronous R/R
FF-ICE Filing Service	Asynchronous R/R
FF-ICE Data Publication Service	P/S
FF-ICE Trial Service	Synchronous R/R
FF-ICE Flight Data Request Service	Synchronous R/R

FF-ICE Planning Service	Asynchronous R/R
~~FF-ICE Notification~~	~~Out of the scope of the PoC~~

Note: FF-ICE services mentioned above are defined in the APAC SWIM Common Services (APAC Common SWIM Information Services, WP11, SWIM TF/10).

Dataflow Diagram of R/R-based FF-ICE Service

2.6   **Appendices A and B** show the detailed dataflow diagram of FF-ICE Trial Service (Synchronous R/R MEP) and FF-ICE Filing Service (Asynchronous R/R MEP) in the FF-ICE simulator.

2.7   Simplified dataflow diagram of FF-ICE Trial Service (Synchronous R/R MEP) and FF-ICE Planning Service (Asynchronous R/R MEP) in the FF-ICE simulator are as follows:

FF-ICE Trial Service (REST API – HTTP)	**FF-ICE Planning Service** **Synchronous R/R (HTTP) + P/S (AMQP)**
 * API GW and Message Broker are not Depicted	 * API GW and Message Broker are not Depicted

Note: in case of FF-ICE Trial Service, Submission Response is included in the Trial Response as an element.

Lessons Learned

Immediate Feedback and Message Delivery Awareness

2.8   R/R MEP provides immediate response to submissions, allowing the eAU to intuitively recognize whether the message has successfully reached the eASP.

Session Overhead and Potential Traffic Inefficiency

2.9   In the FIXM schema, up to 2,000 recipients could be added within a single message. In this case, R/R MEP requires technically establishing 2,000 separate sessions to submit single message. This approach may result in excessive network traffic and resource consumption.

Need for Regional Guidance Material for R/R MEP, and its Enablers

2.10   There is a need to define a guidance material, which includes consistent convention of REST API usage, its enablers (e.g., API GW or EMS) to enable R/R MEP for SWIM services in the APAC region. Conducting such activities would enhance interoperability and ensure harmonized implementation across regional member states.

Suitability of Using This Asynchronous R/R MEP Approach to APAC Region
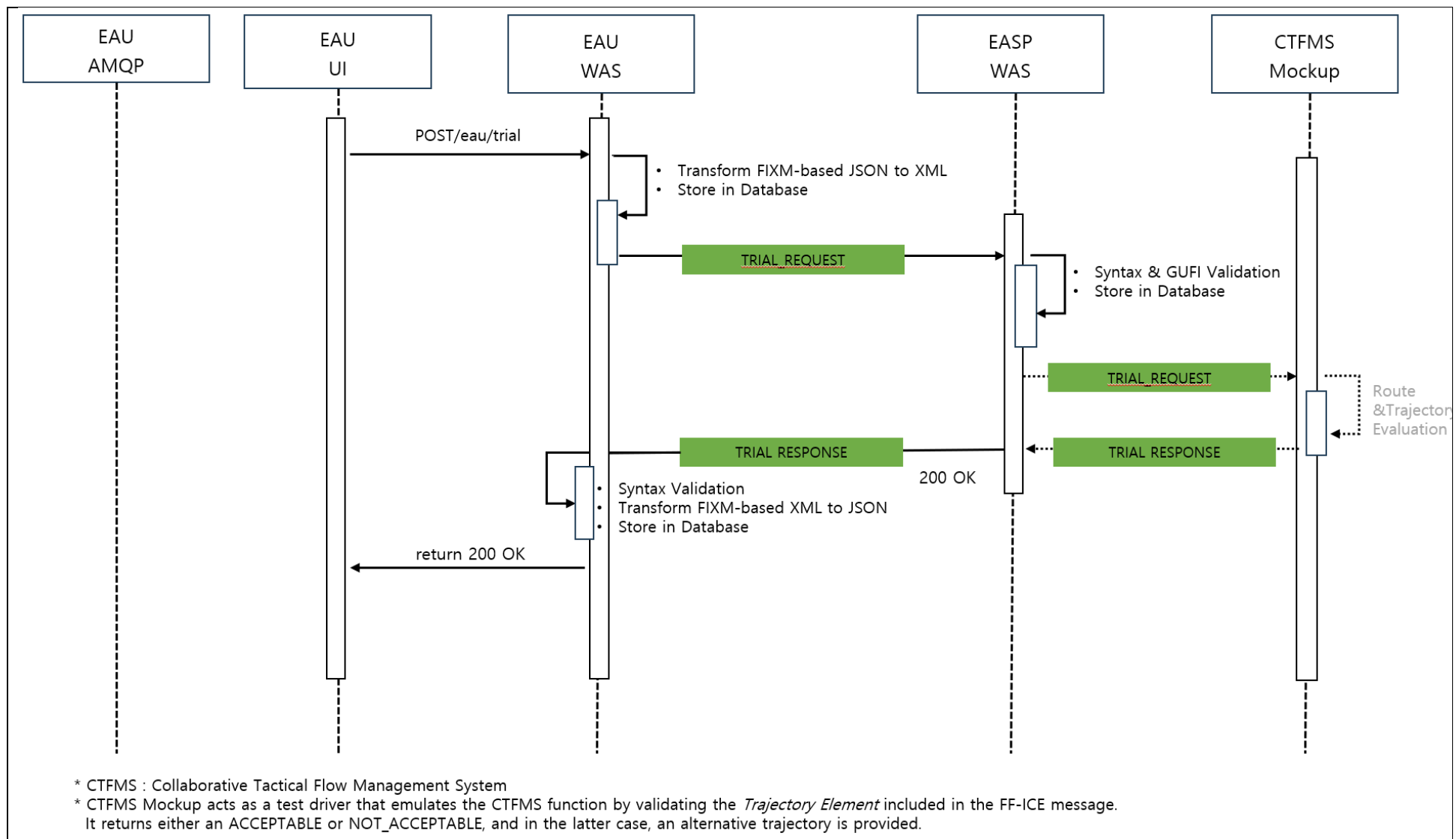
2.11   This implementation is based on EUROCONTROL's implementation case, which operates in a centralized environment (e.g. NM). In contrast, the APAC region will have a distributed environment, so the APAC FF-ICE Ad Hoc Group needs to consider these environmental constraints when defining the APAC FF-ICE framework (e.g. which specific MEP should be used to enable each FF-ICE service, and what expectations are placed on the FF-ICE Ad Hoc Group regarding how APAC SWIM will operate).

3.   ACTION BY THE MEETING

3.1   The meeting is invited to:

   a)   note the information contained in this paper;

   b)   review the progress, objectives and future plan of SIPG; and

   c)   discuss any relevant matter as appropriate.

DATAFLOW DIAGRAM OF FF-ICE TRIAL SERVICE IN FF-ICE SIMULATOR

EAU AMQP	EAU UI	EAU WAS	EASP WAS	CTFMS Mockup

POST/eau/trial

- Transform FIXM-based JSON to XML
- Store in Database

TRIAL_REQUEST

- Syntax & GUFI Validation
- Store in Database

TRIAL_REQUEST

Route &Trajectory Evaluation

TRIAL RESPONSE

TRIAL RESPONSE

200 OK

- Syntax Validation
- Transform FIXM-based XML to JSON
- Store in Database

return 200 OK

* CTFMS : Collaborative Tactical Flow Management System
* CTFMS Mockup acts as a test driver that emulates the CTFMS function by validating the *Trajectory Element* included in the FF-ICE message.
  It returns either an ACCEPTABLE or NOT_ACCEPTABLE, and in the latter case, an alternative trajectory is provided.

DATAFLOW DIAGRAM OF FF-ICE PLANNING SERVICE IN FF-ICE SIMULATOR