SWIM Routing, Message Properties & Message Topics

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Terms

- Message Broker
  - A type of software that facilitates information exchange between different applications, systems, and services. It acts as an intermediary, routing messages from information Providers to Information Consumers, ensuring they are delivered correctly, reliably and efficiently while supporting loose coupling, synchronous and asynchronous communication.
  - Message Brokers evolved to support more open messaging protocols and high reliability. Once the speed of networks became faster than disks, message brokers no longer became bottlenecks, but the fastest part of an information exchange system next to the network.

- Enterprise Messaging Service (EMS)
  - A collection of one or more message brokers connected across locations and platforms, making up a single information exchange nervous system that clients connect to.

- Global EMS (GEMS)
  - Globally accessible EMS

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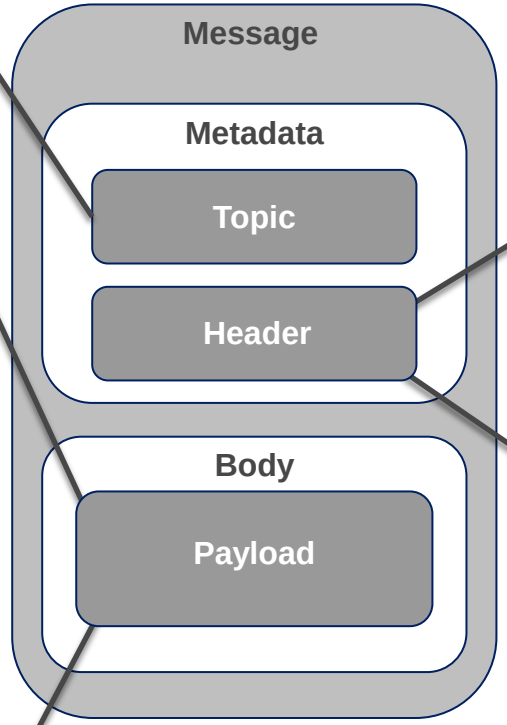
Message Model

Jakarta/1/**CALLSIGN/JAPANAIR/0/**FLT/FLIGHT_PLAN/FFICER1_FFP/FILE**/ICAO/WSSS**/0/WSJC/…

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<?xml version="1.0" encoding="UTF-8"?>
<ffice:FficeMessage xmlns:fb="http://www.fixm.aero/base/4.3"
xmlns:ffice="http://www.fixm.aero/app/ffice/1.1"
xmlns:fx="http://www.fixm.aero/flight/4.3"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.fixm.aero/app/ffice/1.1
FiledFlightPlan.xsd ">
 <ffice:extension/>
 <ffice:filingStatus>
<ffice:expectedEvaluationTime>2001-12-
31T12:00:00</ffice:expectedEvaluationTime>
<ffice:explanation>ffice:explanation</ffice:explanation>
<ffice:extension/>
<ffice:originator/>
<ffice:trajectoryPurpose>ATC_CHANGE</ffice:trajectoryPurpose>
<ffice:value>ACCEPTABLE</ffice:value>
 </ffice:filingStatus>
 <ffice:flight>
<fx:aircraft/>
<fx:arrival/>
<fx:dangerousGoods/>
<fx:departure/>
<fx:emergency/>
<fx:enRoute/>
<fx:extension/>
<fx:flightConstraint/>
<fx:flightIdentification/>
<fx:flightPlanOriginator/>
<fx:flightPlanSubmitter/>
…
```

Name	Value
SOURCE_TYPE	Source Domain
SOURCE	Source Id
INFO_DOMAIN	FLT
REQUEST_TYPE	FLIGHT_PLAN
MESSAGE_TYPE	FFICER1_FFP
TIMESTAMP Date Sent	
EVENT	F
RECIPIENTS WSSS,…	
RelevantASPs	ASPs
MessageId	
CorrelationId	
SequenceNumber	

Message Properties and Topics

- Message Property
  - A data element name and value pair. There can be many message properties. There are different types of message properties: product, protocol, interface (e.g., JMS) and user defined.
- Message Header
  - The collection of message properties of all types for a message. Along with the topic and payload, this makes up a message model. Sometimes a footer is also supported.

- Message Topic
  - A hierarchical, ordered list of string values like a URL path or file path, typically using a forward slash "/" delimiter. Note there are no names present.
  - Very simple example: "flightplan/filing/WSJC"
- Message Topic Model
  - A topic design specifying what each ordered data value within a topic represents.
  - Very simple example: (object)/(action)/(FIR)

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Message Properties

1. Message property names can require significant additional space
2. Are extensible, but additional space will be needed for new names and values
3. Matching a message's message properties for routing or filtering
    1. Requires a naming convention to prevent collisions & preserve interoperability across messaging protocols
    2. Requires a message property dictionary to ensure proper usage
    3. Can be complex and compute intensive as multiple name-value pairs must be examined
4. Some message brokers do not support general routing via message properties directly, by design

Message Topics

1. Message topics take up a minimum of space allowing
2. Are extensible, but require additional space for the values
3. Matching a message's message topic to a topic subscription for routing or filtering
    1. Does not require a naming convention to prevent name collisions
    2. Requires a topic model to ensure proper usage
    3. Topics have the same proven structure as file and URLs paths
    4. Allows for simple parallel processing that enables hardware acceleration
4. Are supported by virtually all messaging protocols and message brokers

Background of Message Topics

- In 1999, the MQTT messaging protocol was developed. This lightweight, high performance open messaging protocol supported topics, but not message properties.
- JMS was released in 2001 when message topics were already rising to prominence. However, some message broker products did not yet support them, but most supported message properties (though not MQTT). Although topics became the primary routing mechanism, message properties were added for message routing in JMS at the consumer side (selectors) for such message brokers. Some message broker-type products still use message properties for routing, but this is usually to compensate for an inflexible topic implementation.
- Topic routing was quickly adopted in the financial trading industry at this time, especially at global investment banks. This was due to the higher efficiency, lower overhead and higher performance of topic processing, especially in terms of parallel processing.
- In 2019, MQTT 5.0 added support for message properties, making it appropriate for enterprise messaging.
- Today, topic routing is central to SOA and Event-Driven Architectures (EDA) and it is increasingly being used at ANSPs, airlines, airports (IoT, video, AI), ATM infrastructure, travel experience, connected car/bus, retail order processing, payment systems, block chain, and even real-time pricing for grocery shelves.
- In January 2025, the WMOs WIS2 became operational using a global topic model for distributing MET information globally.

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Routing Service (with topics)

1. GW EMS
    1. Consume a message from an Edge EMS Queue (via a Bridge Service)
    2. Read the message topic
        1. Send the message with the same topic within the GW EMS
        2. The GW EMS applies access controls and routes the message using the topic

2. Routing messages across the architecture
    1. A set of routing rules needs to be managed and mapped to the EMS products in use
    2. Ideally, these are topic subscriptions, which are supported directly in most EMSes

FF-ICE/R1 Filing Service – Demo from Last Week

- eAU
  - Send an FFP message to an eASP
- eASP
  - Process the FFP
  - Send a Submission Response message
  - Send a Flight Status message

- But How…

FF-ICE/R1 Filing Service – Demo (How)

- Notes
  - *for the moment, ignore MEPs and protocols*
  - *a header (message properties) is sent in all messages*
- eAU
  - Subscribe to Submission Response messages *by topic*
  - Subscribe to Flight Status messages *by topic*
  - Send an FFP message to an eASP *on a topic*
- eASP
  - Subscribe to FFP messages *by topic*
  - Process a consumed FFP message …
  - Send Submission Response message(s) *on a topic*
  - Send a Flight Status message(s) *on a topic*

- Show Me…

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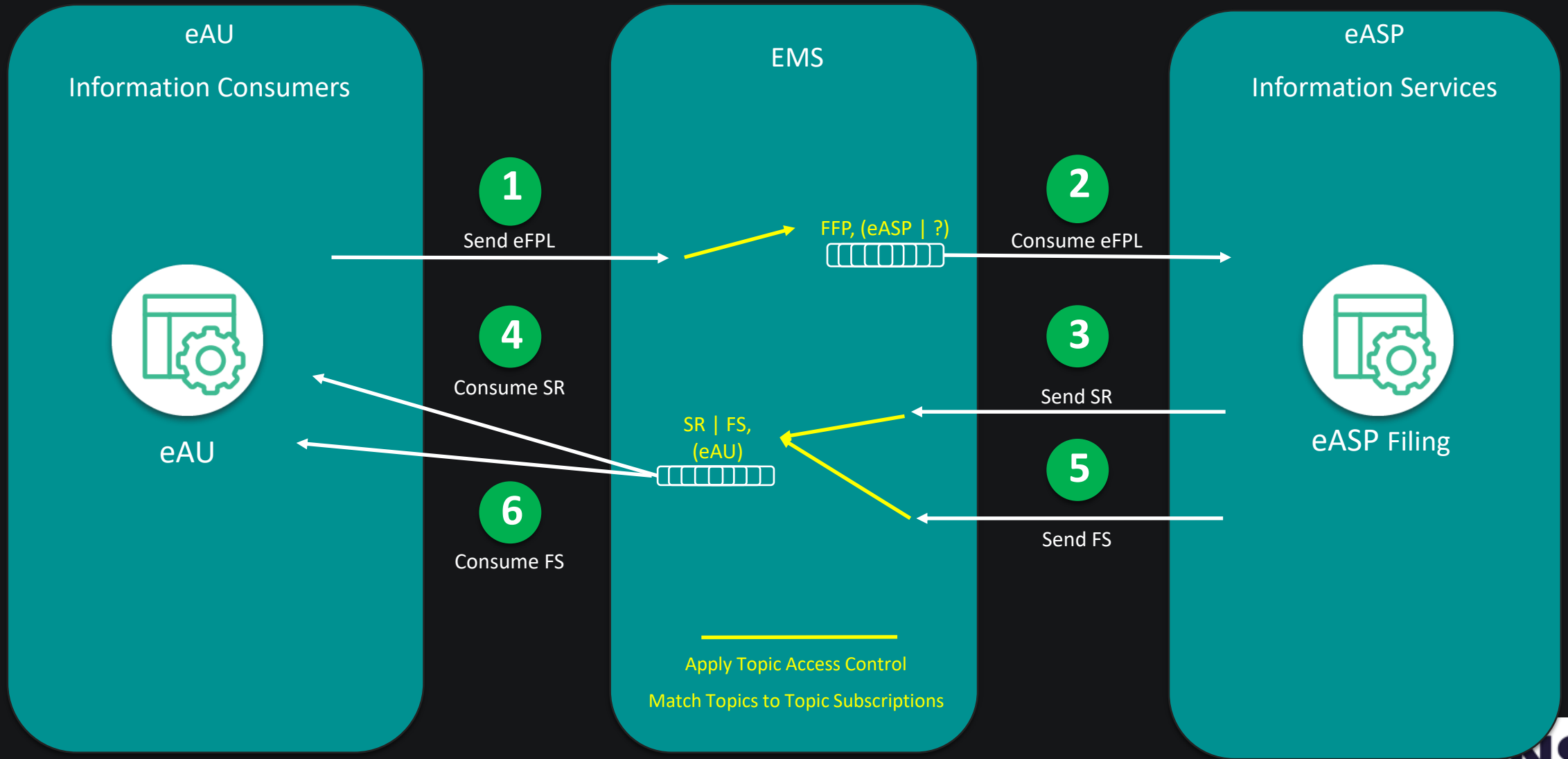
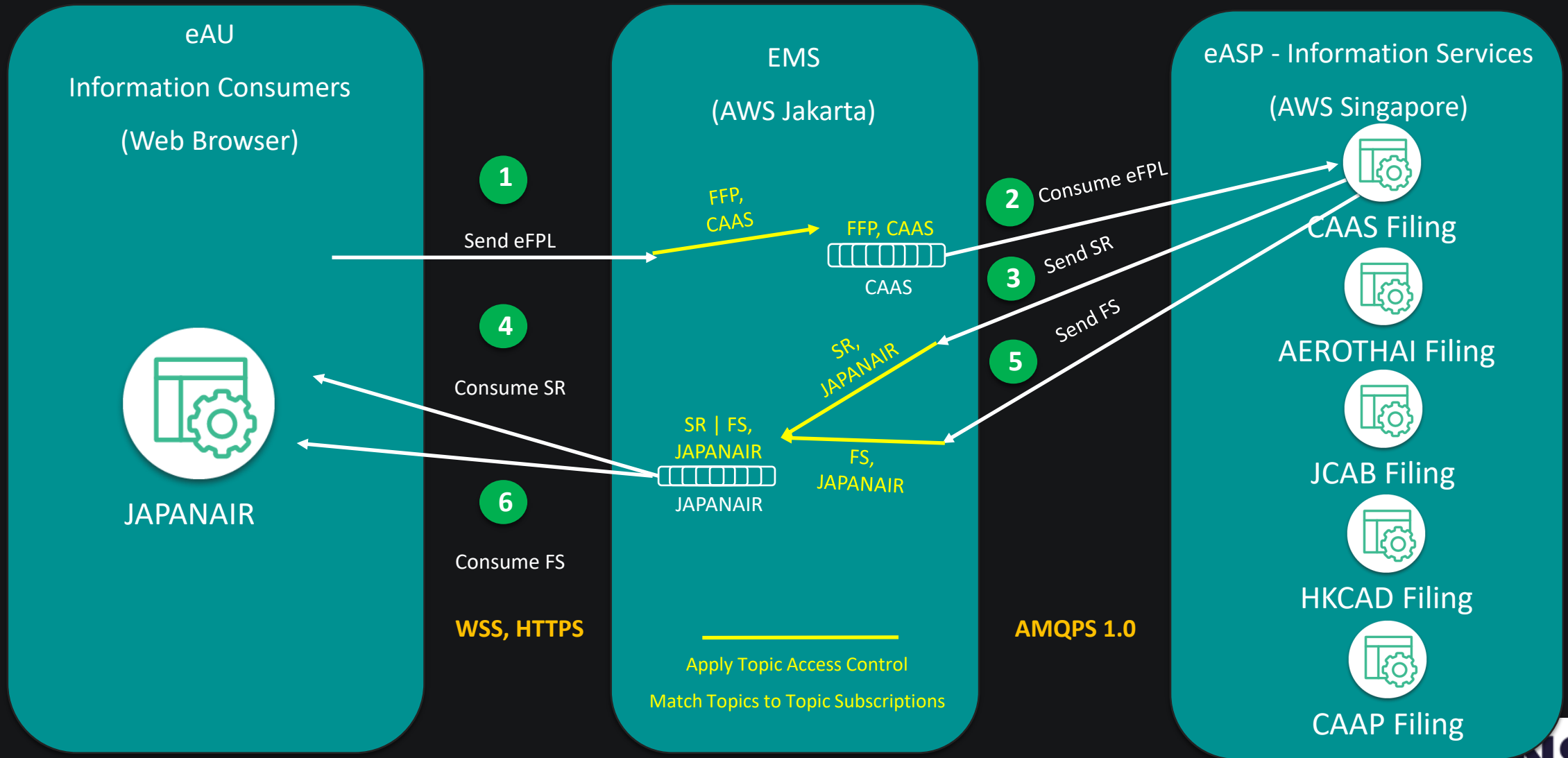
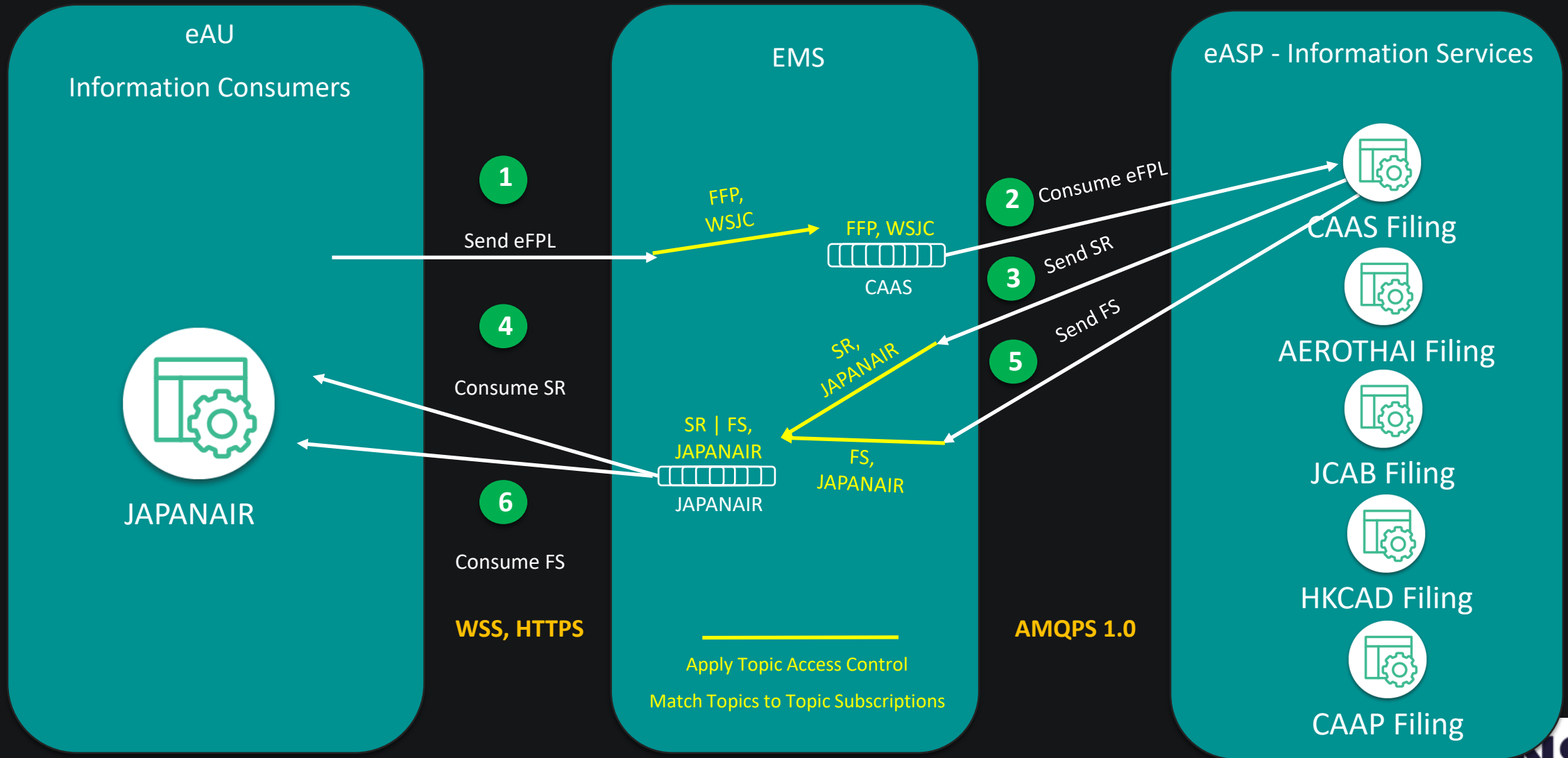
Message Routing



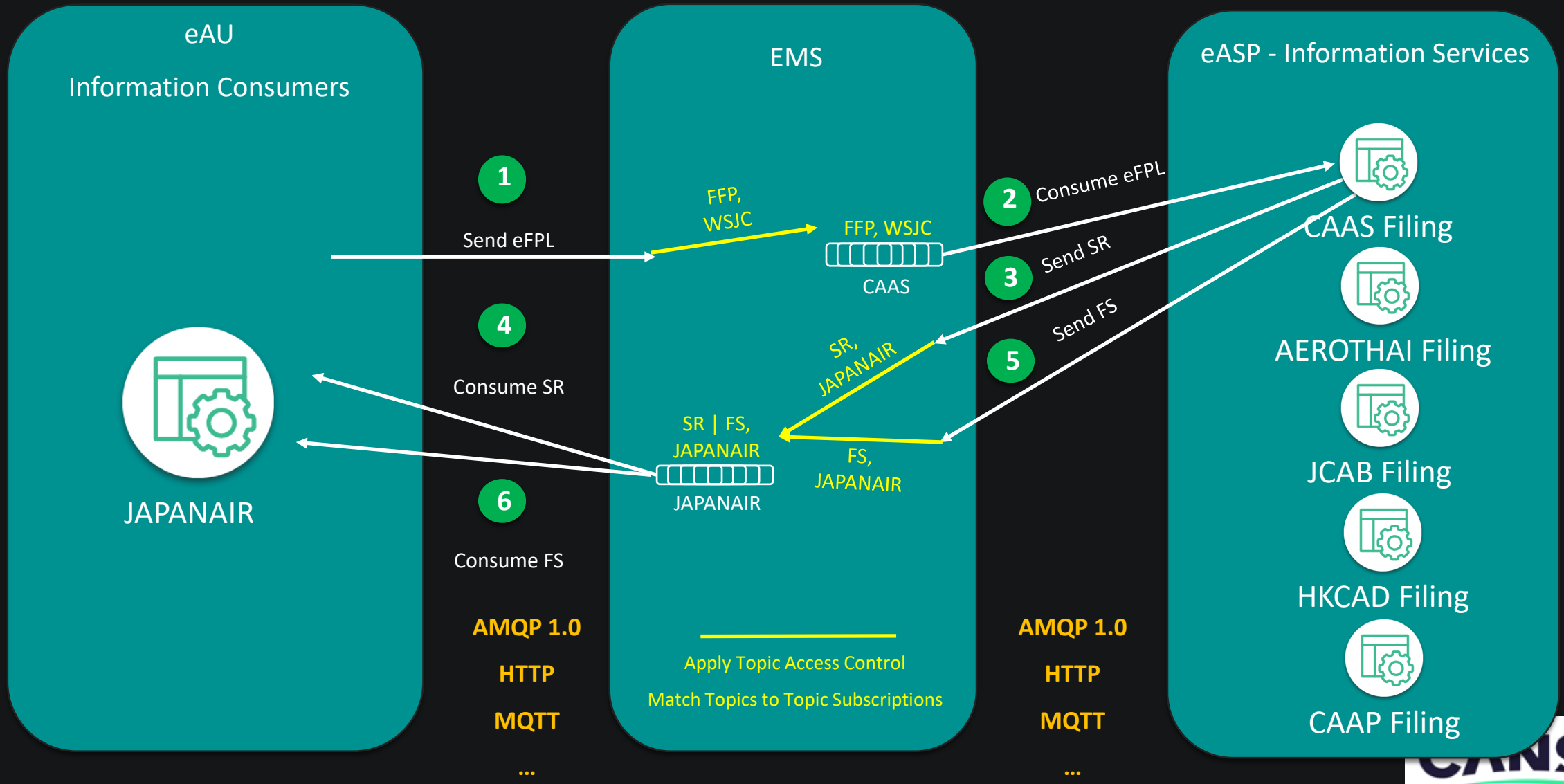
Message Routing (Recipient) – FFP with CAAS



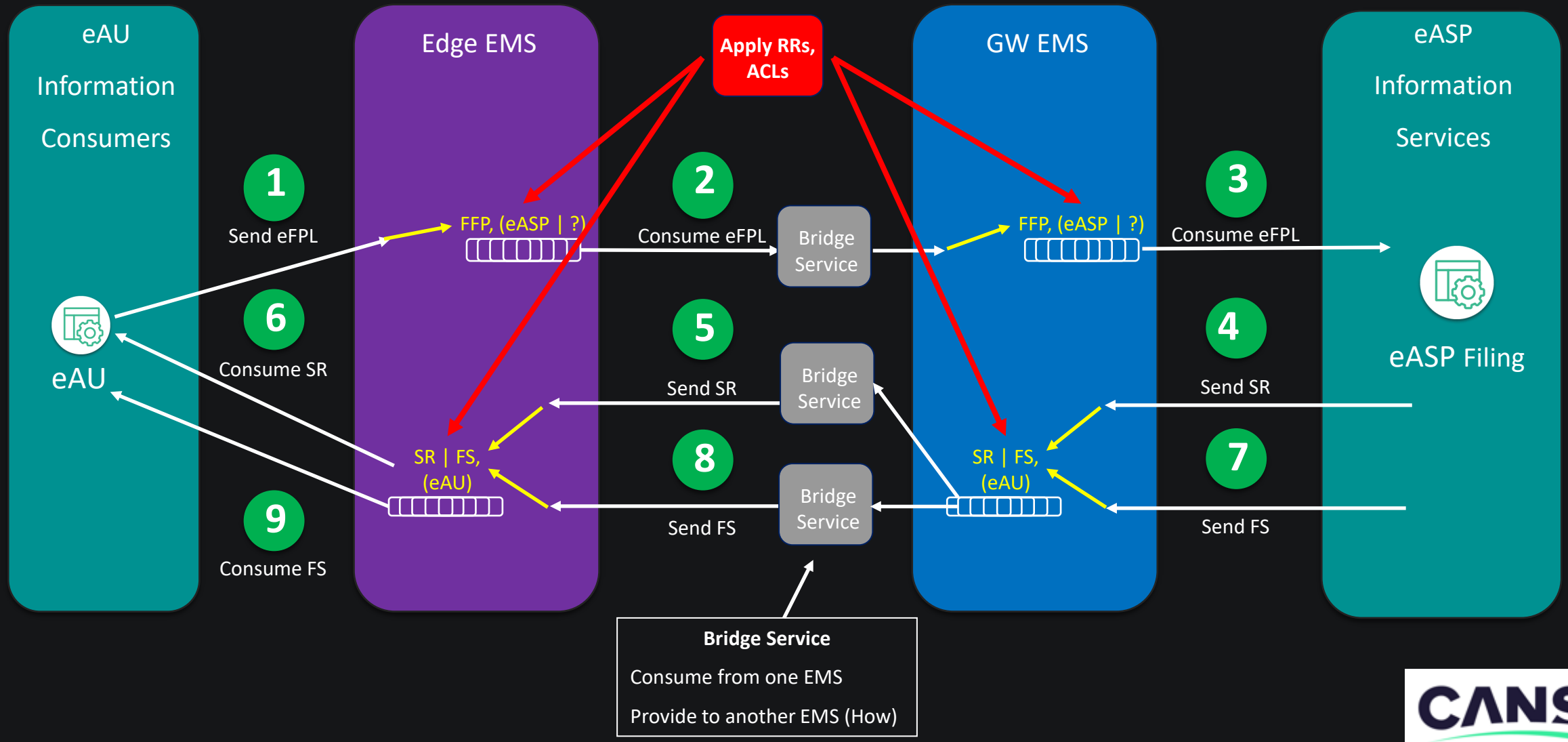
Message Routing (Context) – FFP with WSJC



Message Routing – Multiple Protocols



Message Routing Across GWs



Message Topic

Example

Jakarta/1/**CALLSIGN/JAPANAIR/0/**FLT/FLIGHT_PLAN/FFICER1_FFP/FILE**/ICAO/WSSS**/0/WSJC/xxx.xxx/1.0

	Topic Element		Example Values	Notes
Versioning	Topic Model Name	/	Jakarta	Topic Schema
	Topic Model Version	/	1	Topic Schema Versioning
Source	**Source** Domain	/	CALLSIGN	FIXM - fb:identiferDomain
	Source Id	/	JAPANAIR	FIXM - fb:identifer
	Source User Id	/	0	Purpose: Entitlement
Context	Information Domain	/	FLT	Purpose: Entitlement
	Request Type	/	FLIGHT_PLAN	Purpose: Entitlement
	Message Type	/	FFICER1_FFP/FPU/FC/SR/FS	FficeFFP, …
	Event	/	F=File, U=Update, C=Cancel, S-Status	Purpose: Entitlement
Recipient ?	**Recipient** Domain	/	ICAO	FIXM - fb:identiferDomain
	Recipient Id	/	WSSS	FIXM - fb:identifer
	Recipient User Id	/	0	Purpose: Entitlement
Info Domain Context	FIR	/		
	GUFI	/		
	Operator FPL Version			

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Message Header

Topic Example

Jakarta/1/**CALLSIGN/JAPANAIR/0/**FLT/FLIGHT_PLAN/FFICER1_FFP/FILE**/ICAO/WSSS**/0/WSJC/xxx.xxx/1.0

Message Property Name	Description
SOURCE_TYPE	Source Domain
SOURCE	Source Id
INFO_DOMAIN	FLT
REQUEST_TYPE	FLIGHT_PLAN
MESSAGE_TYPE	FFICER1_FFP
TIMESTAMP	Date Sent
EVENT	F
RECIPIENTS	WSSS,…
RelevantASPs	ASPs

Message Header+

Topic Example

Jakarta/1/**CALLSIGN/JAPANAIR/0/**FLT/FLIGHT_PLAN/FFICER1_FFP/FILE**/ICAO/WSSS**/0/WSJC/xxx.xxx/1.0

Message Property Name	Description
hdrName	Header Name
hdrVersion	Header Version
swimSrcType	Source Domain
swimSrc	Source Id
swimDomain	FLT
swimReqType	FLIGHT_PLAN
swimMsgType	FFICER1_FFP
swimTimeStampe	Date Sent
swimEvent	F
fficeRecipients	WSSS,…
fficeRelevantASPs	ASPs

Message Property Name	Description
swimMsgId	Id
swimCorrelationId	Correlation Id
swimSeqNum	Sequence Number

The Challenge

We are attempting to:

1. Develop, test, operate, maintain and govern the most difficult distributed and federated features of individual message broker products that have the luxury of extreme homogeneity.
2. We must make this work across a diverse, and likely changing, set and number of message broker products, product versions and related capabilities, such as
    1. Bridging message broker instances, with redundancy, redelivery handling and WAN optimization
    2. Dynamic message routing
    3. Message deduplication
    4. Automatic loop detection
    5. Traceability
    6. Integrated seamless HA and DR with the above
    7. Message priority
    8. and many others
3. Solace took years to hone and perfect these features
4. This is why we need to keep the GWs as simple as possible. Same for the Edge-GW interface & service.

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