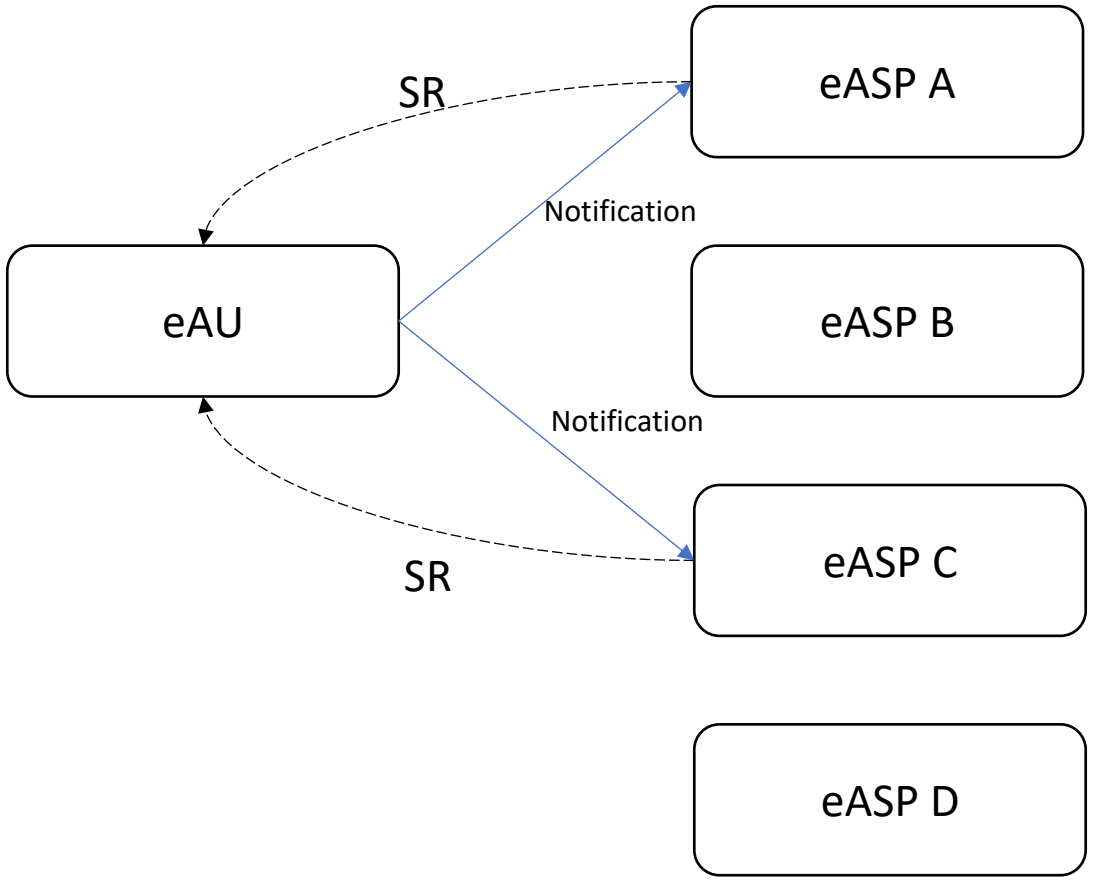
Asynchronous Request Reply Topic-Based Routing

CAAS
Civil Aviation Authority of Singapore

Business Use-case

SWIM TF/11 WP17

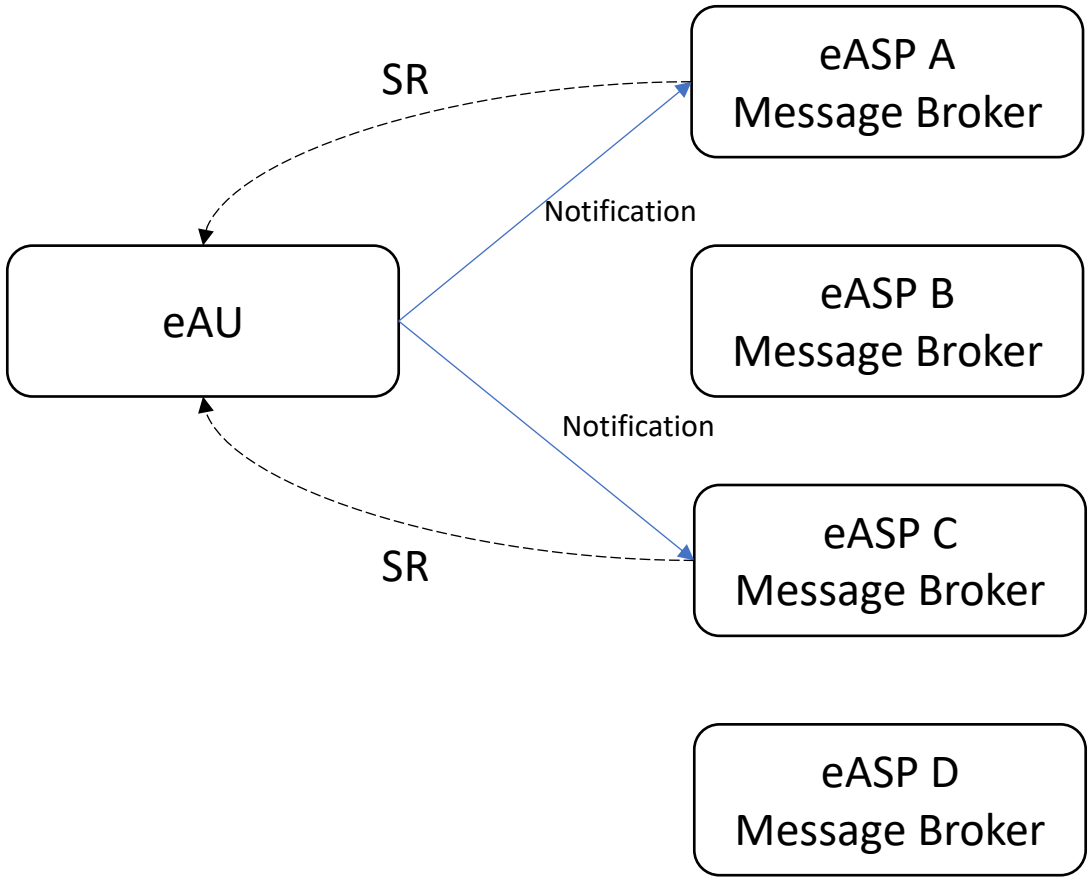
- **Notification Service – Dissemination of Flight Departure Notification by Departure eASP**



Technical Implementation

SWIM TF/11 WP17

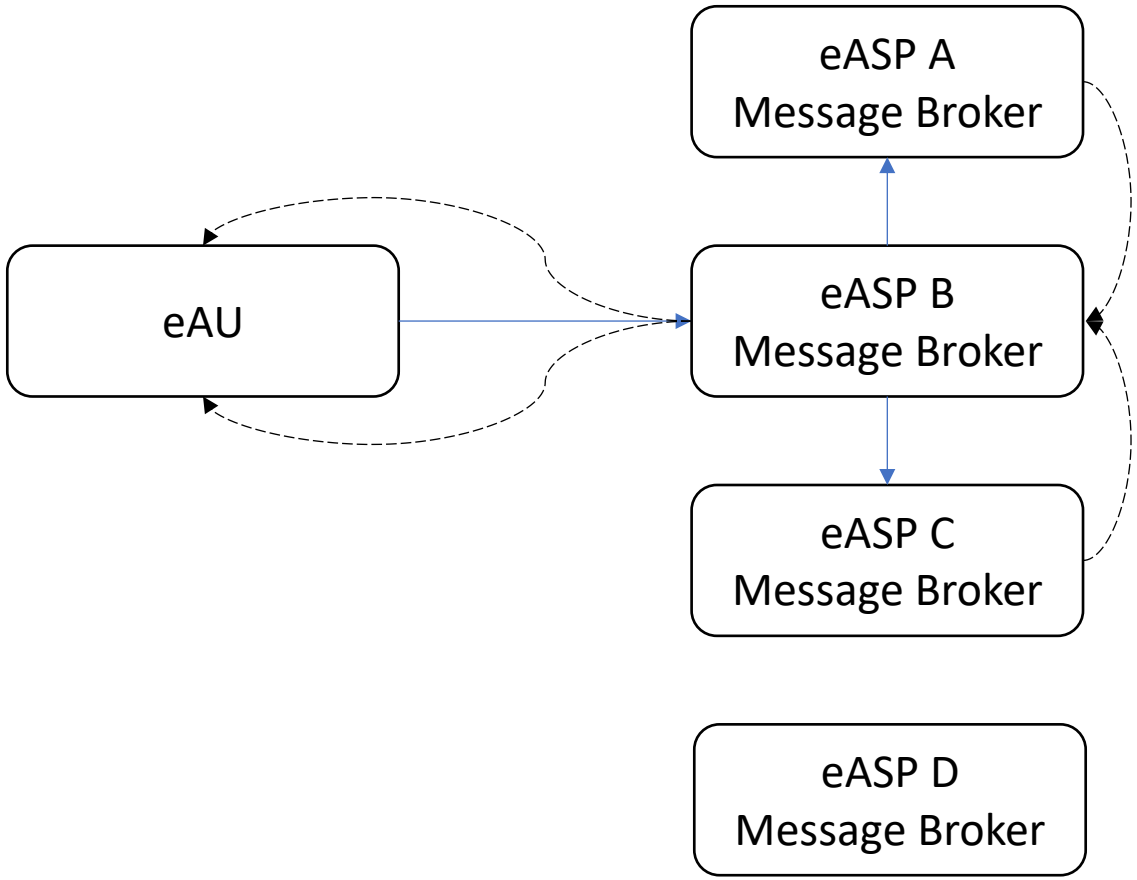
- **eAU can send directly to each eASP**
- **The replies (Submission Responses) will come back directly to eAU**



Technical Implementation

SWIM TF/11 WP17

- **Alternatively, it could send via an eASP who would send it on to other eASP**
- **The replies (Submission Response) will come back via the same route**
- **This is the architecture APAC has chosen via the hierarchical architecture**



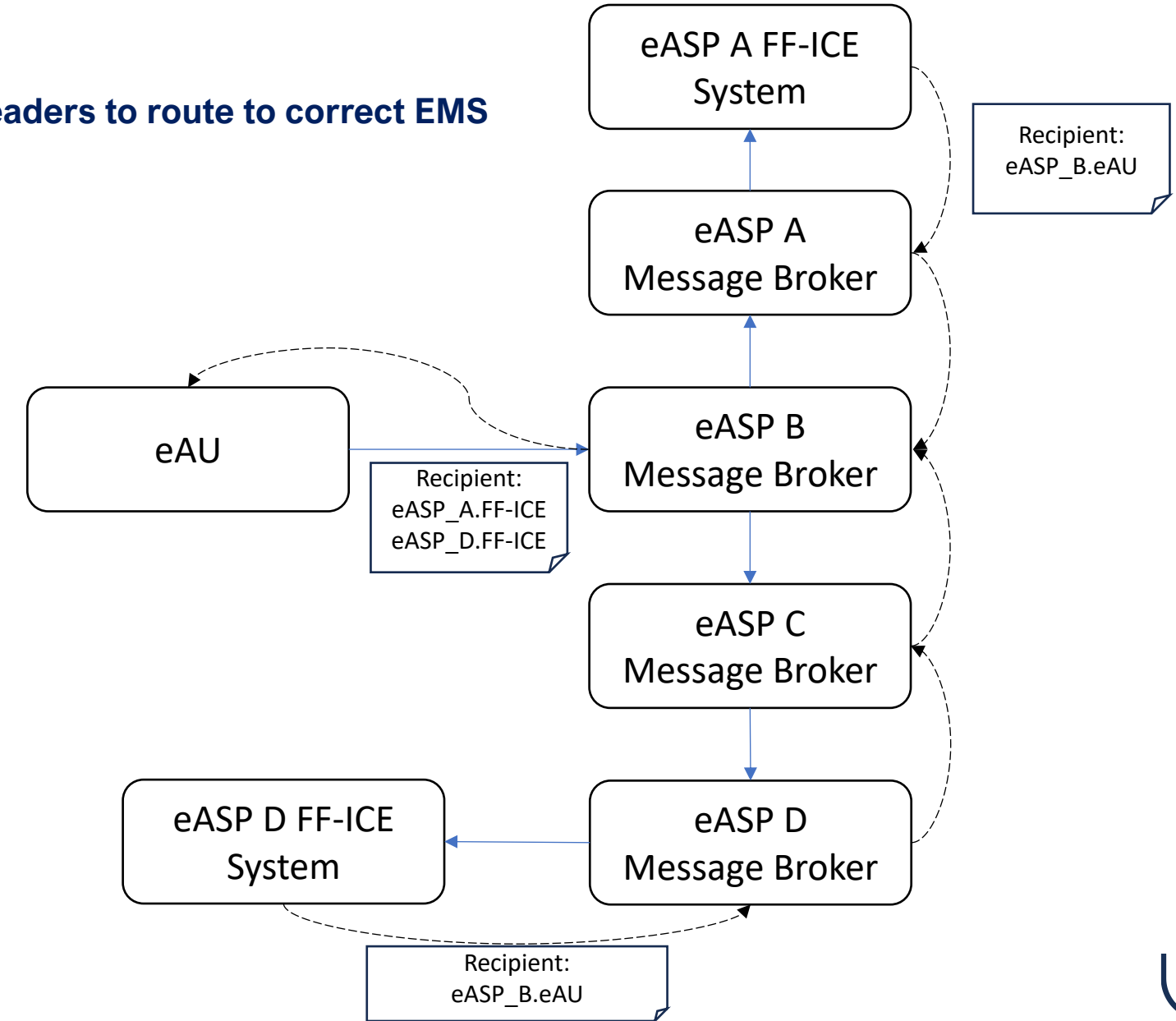
Technical Implementation

Message Header-Based Routing

- **eAU sends one message only**
- **EMS needs to process custom message headers to route to correct EMS**
- **Routing tables required to route correctly.**

Routing table for Broker B		
From	To	Routing
eASP_B.*	eASP_A.*	eASPB_A.Out
	eASP_C.*	eASPB_C.Out
	eASP_D.*	

Routing table for Broker C		
From	To	Routing
eASP_C.*	eASP_D.*	eASPB_D.Out
	eASP_A.*	eASPB_B.Out
	eASP_B.*	



AMQP 1.0 Headers

Message Header-Based Routing - Message Properties

CAAS
Civil Aviation Authority of Singapore

Field	Type	Description	Usage
message-id	string	Unique identifier for the message, useful for duplicate detection	Detect duplicates; Traceability
user-id	binary	Authenticated user ID of the original publisher	Traceability
to	string	Target address for the message	
subject	string	Message summary or title	
reply-to	string	Address for replies	
correlation-id	string	Used to correlate request/reply pairs	
content-type	string	MIME type of message body (e.g., application/json)	TRACK_JSON
content-encoding	string	Encoding of message body (e.g., base64)	TRACK_RAW
absolute-expiry-time	timestamp	Message expiration time	Prevents stale messages from circulating
creation-time	timestamp	When the message was created	Traceability
group-id	string	Publisher-defined grouping identifier for sequencing	
group-sequence	uint	Sequence number within a group	
reply-to-group-id	string	Groups responses to related messages	

AMQP 1.0 Headers

Message Header-Based Routing - Custom Message Headers

Header Name	Values	Descriptions
APAC_SOURCE	RJ_JAL	Name of message publisher
APAC_RECIPIENT_LIST	RJ_JCAB,VH_HKCAD,WS_CAAS	Name list of recipients
SYSTEM	RJ_JAL	Name of system
APAC_CATEGORY	FIXM	Name of information exchange model (FIXM)
APAC_CATEGORY_VERSION	FIXM_4_3_FF_ICE	Version of information exchange model (FIXM 4.3 version for FF-ICE Messages)
APAC_MESSAGE_TYPE	FILED_FLIGHT_PLAN	Message type of information exchange model (FIXM FF-ICE message types)
FFICE_PHASE	FILED	Flight plan phase of FF-ICE (PRELIM or FILED)
SIGNATURE	Digital Signature and Certificate	Digital Signature
DEP_AIRPORT	RJAA	Departure Airport
ARR_AIRPORT	VTBS	Arrival Airport
AIRLINE	JAL	Name of airline
ACID	JAL707X	Aircraft Identification
GUFI	0248982c-4384-49f4-bdb3-7956bd553383	Globally Unique Flight Identifier
EOBT	2025-05-08T05:00:00Z	Estimated Off-Block Time
APAC_TIMESTAMP	RJ_EEMS_OUT:1746671426209	Timestamp of the message out or in the system

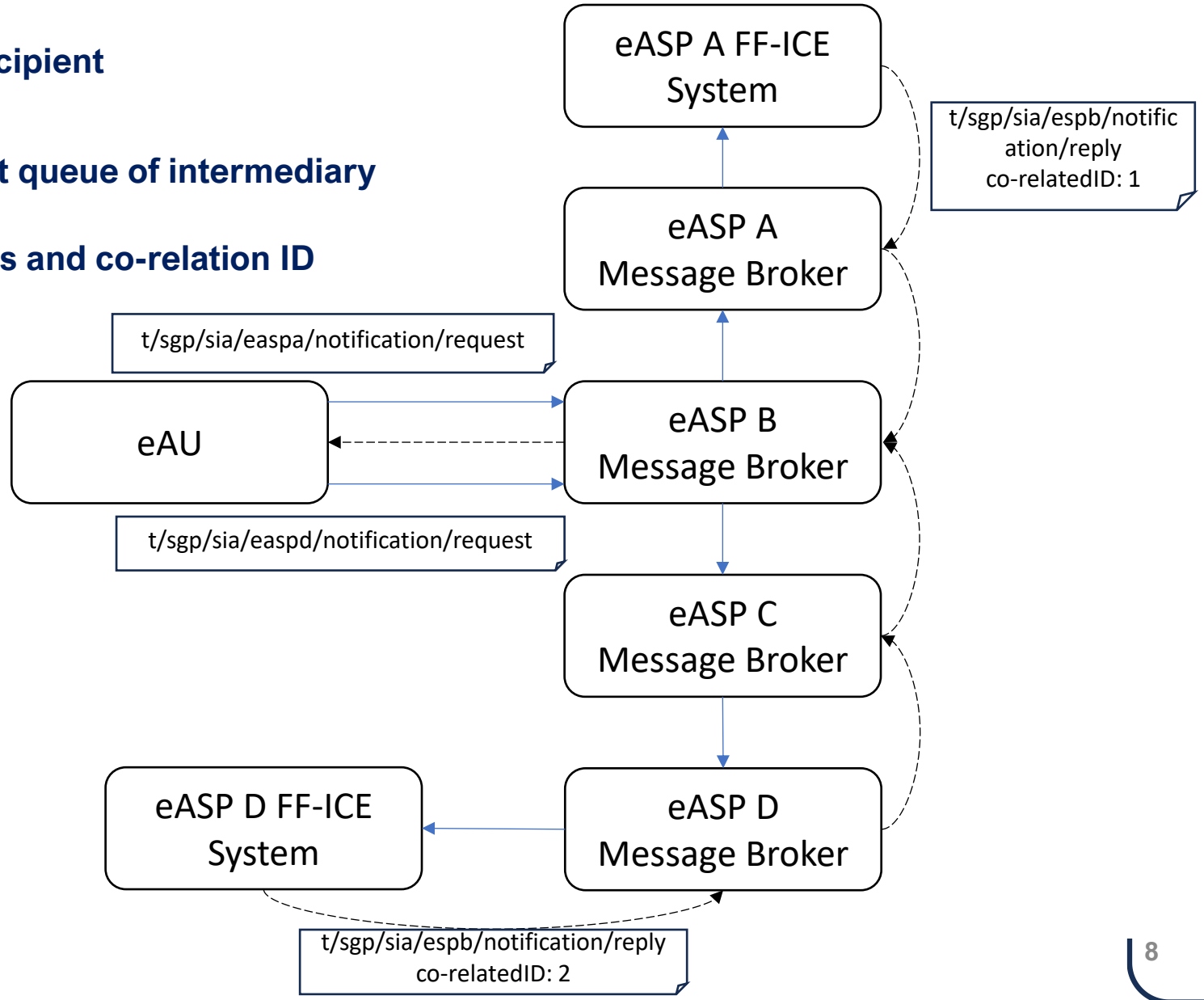
Technical Implementation

Topic-Based Routing

- **eAU sends one message for each desired recipient**
- **Topic Address will contain the recipient ID**
- **Topic Address can be subscribed by relevant queue of intermediary brokers**
- **Return address contained in reply-to headers and co-relation ID**

Queue on eASP B Broker	Topics Subscribed
eASPB_A.Out	t/*/*/espa/*
eASPB_C.Out	t/*/*/espc/* t/*/*/espd/*

Queue on eASP C Broker	Topics Subscribed
eASPB_B.Out	t/*/*/espa/* t/*/*/espb/*
eASPB_D.Out	t/*/*/espd/*



AMQP 1.0 Headers

Topic-Based Routing Message Properties

CAAS
Civil Aviation Authority of Singapore

Field	Type	Description	Usage
message-id	string	Unique identifier for the message, useful for duplicate detection	Detect duplicates; Traceability
user-id	binary	Authenticated user ID of the original publisher	Traceability
to	string	Target address for the message	Topic Address
subject	string	Message summary or title	
reply-to	string	Address for replies	Reply address for Async R/R
correlation-id	string	Used to correlate request/reply pairs	Correlation ID for Async Request
content-type	string	MIME type of message body (e.g., application/json)	For indicating content type, JSON or XML
content-encoding	string	Encoding of message body (e.g., base64)	Indicating message encoding, if compression is used.
absolute-expiry-time	timestamp	Message expiration time	Prevents stale messages from circulating
creation-time	timestamp	When the message was created	Traceability
group-id	string	Publisher-defined grouping identifier for sequencing	
group-sequence	uint	Sequence number within a group	
reply-to-group-id	string	Groups responses to related messages	

Technical Implementation

Topic-Based Routing

- **Topic Nomenclature**
  - Instead of headers, the necessary metadata can be included as part of topic, depending on information service.
  - Topic Structure
    - First few levels are to be standardized and agreed upon:
      - **t/<region name>/<icaoindicator prefix>/<abbreviation of service provider>/<abbreviation of recipient>/<service category>/<service name>/<category version>/…..**
      - **e.g: t/apac/ws/vh/ffice/notification_req/v1/**
    - Subsequent Levels can include necessary metadata from message payload:
      - **/<departure airport>/<destination airport>/<airline>/<aircraftID>/<gufi>/<eobt>**
      - **e.g: /wsss/vtbs/sia/sia123/0248982c-4384-49f4-bdb3-7956bd553383/1780282357**
    - Full topic representation example:
      - t/apac/ws/vh/ffice/ notification_req /v1/wsss/vtbs/sia/sia123/0248982c-4384-49f4-bdb3-7956bd553383/1780282357

Topic Nomenclature

Singapore's Version

Level	Topic Level Name	Description	Example
1	Type of Address	Indicate type of topic	't' – pub/sub topic 'tr' – request/reply topic
2	Country Code	The country code according to ISO 3166-1 alpha3.	sgp tha
3	Organisation	Company, corporation, agency, or an institution.	caas
3a	Recipient Country	Recipient country – For Async Request/Reply Information Services Only (Level 1 – 'tr')	tha
3b	Recipient Organisation	Recipient org – For Async Request/Reply Information Services Only (Level 1 – 'tr')	aerothai
4	Environment	It is often necessary to have multiple environments to work on. For example, production, testing, offline and others	"prod" = Production "dev" = Development "uat" = UAT / Testing "off" = Offline
5	System Name	System Name with optional service group name	atfm-fpl
6	version	Indicate the version of the API or event.	v1
>=7	System Specific Topic Hierarchy	Hierarchy and topic field is determined by system. Recommendation is {noun}/{verb}/{property}	.../fpl/publish/3.8/3.9 .../publishfpl/3.8/3.9 where 3.8 and 3.9 are examples for lat and long respectively

Comparison

Message-Header Routing	Topic-Based Routing
Provider only need to send message once	Provider need to send same message more than once
No topics address need to be designed, only use queues	Topics address need to be designed. Topic and queue configuration required.
EMS need to handle custom message headers	Only use default AMQP 1.0 headers
Difficult to scale up when adding new message brokers – update of message header list, potential code change of provider	Easy to scale up when adding new message brokers – change of configuration in broker
Regional inter-operability issues possible due to custom headers	Default headers used, inter-operability between regions possible

Questions?


Thank you!
CAAS
Civil Aviation Authority of Singapore