Task 2: Refine the Revised APAC SWIM Hierarchical Architecture - Progress Update

1. INTRODUCTION

At the Second Working Session of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/2), building on the outcomes of the 10th SWIM Task Force (SWIM TF/10) meeting, a revised APAC SWIM hierarchical architecture was proposed. This revision aims to optimize regional message routing, node interconnection, and technical infrastructure integration. Due to issues such as inconsistent routing mechanisms, unclear multi-queue configurations, and missing logic for message priority handling in the original architecture, Task 2 was established as a priority task. Its purpose is to refine the architectural design and validate key technical solutions, providing core technical support for integrating the APAC SWIM Technical Infrastructure (TI) and addressing issues related to reliability, efficiency, and compatibility in regional message transmission

2. DISCUSSION

Based on input documents such as SWIM TF/10 WP/17, clarify technical details of the revised hierarchical architecture, defining the scope and boundaries of message transmission in the Edge-Gateway-Gateway-Edge chain .According to the revised hierarchical architecture, each EEMS needs to be connected to 2 GEMS, each GEMS needs to be connected to at least two other GEMS, and the EEMS and GEMS of a participant need to be deployed independently.

Objectives of Task2 are to refine the revised APAC SWIM hierarchical architecture, clarify message transmission logic between Edge EMS and Gateway EMS, and provide clear architectural guidance for integrating the technical infrastructure.

Address key technical challenges, including: determining the routing mechanism (Message Topics vs. Message Properties), designing multi-queue configuration strategies (by data domain or QoS level), implementing message priority handling logic, and formulating message retry and rerouting rules .

Validate the feasibility of the above technical solutions through testing, laying the groundwork for subsequent APAC SWIM integration .

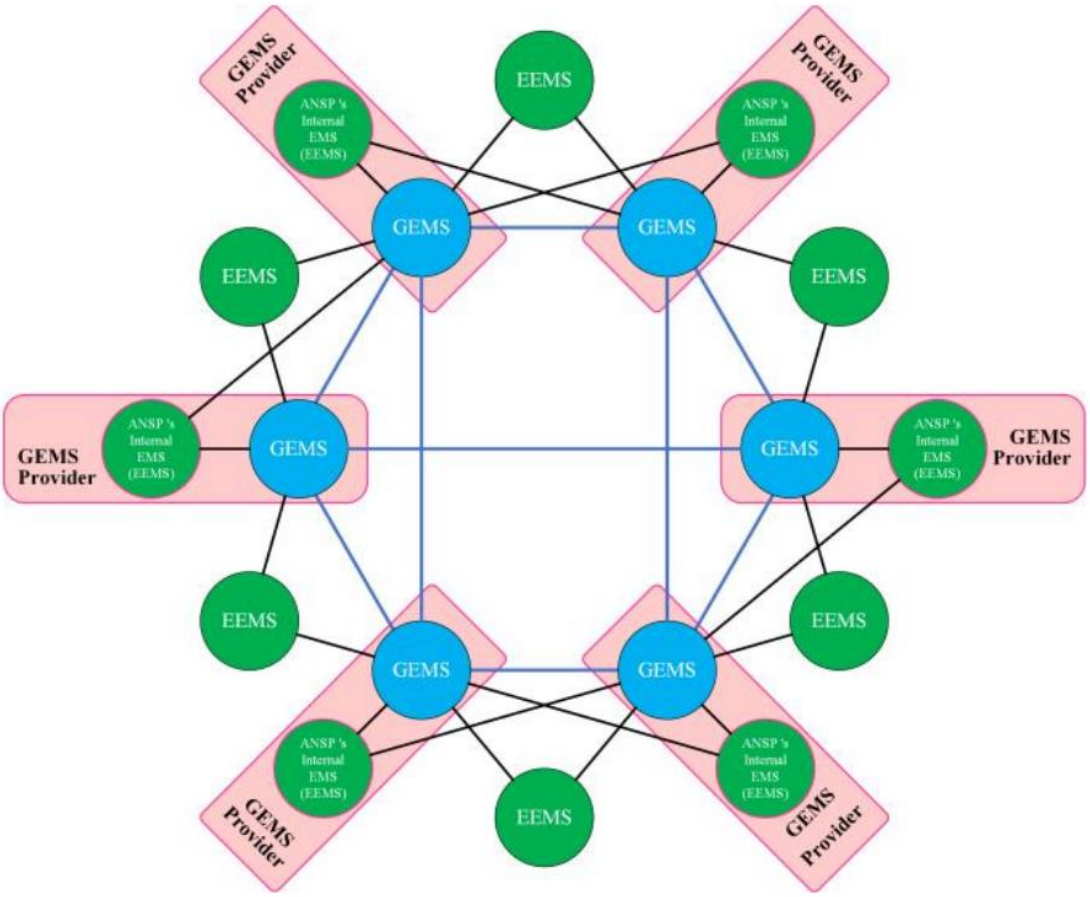


Fig 1. The Revised Hierarchical Architecture

Based on the current discussion, there are currently three options.

Data Replication Solution

All GEMS jointly establish a virtual data pool to host all SWIM (System Wide Information Management) data in the APAC (Asia-Pacific) region, and the data of each GEMS maintains consistency.Each GEMS subscribes to all information from its connected GEMSs. Each EEMS subscribes to all messages and filters messages based on the recipients or subscribes to matching messages and forwards them to recipients

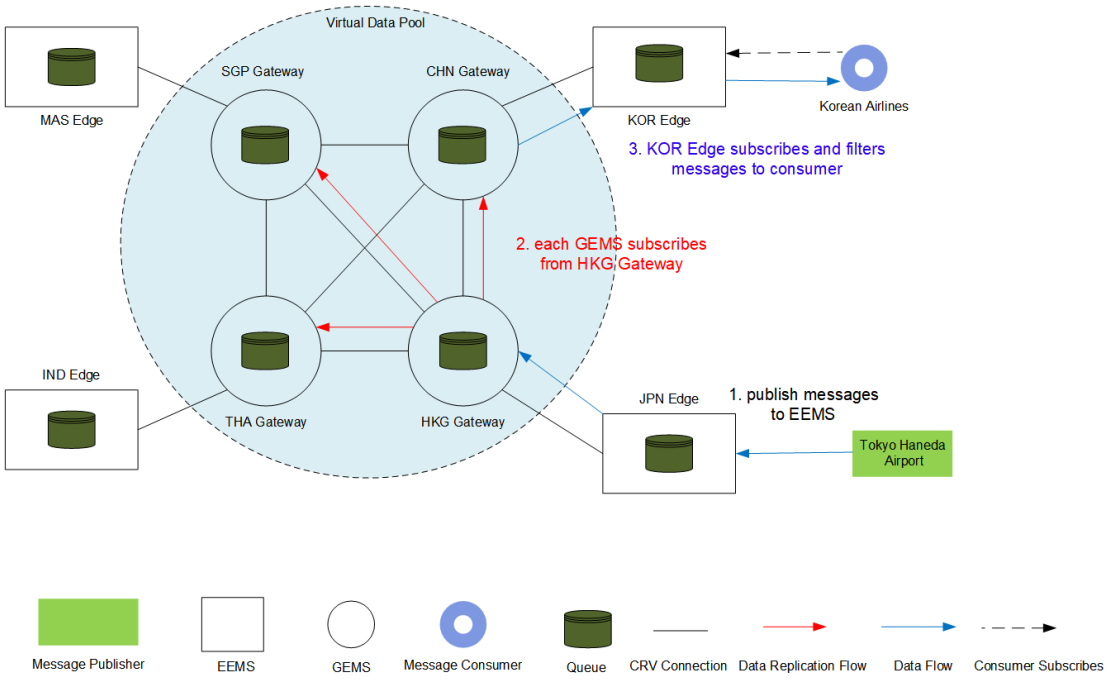
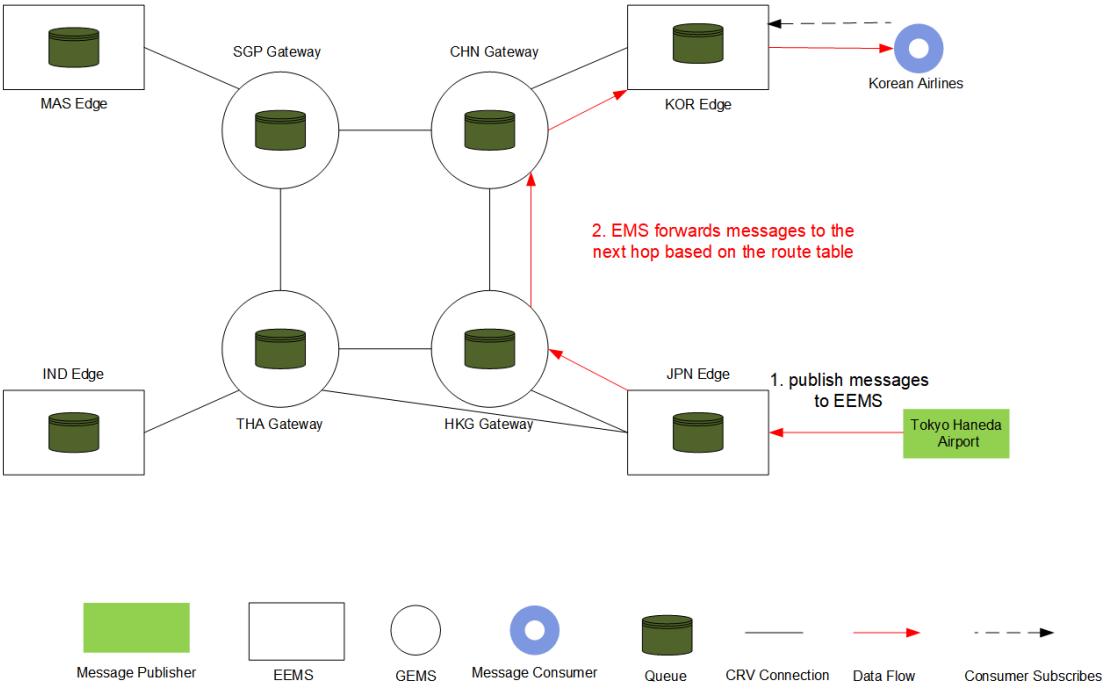


Fig 2. The Architecture of Data Replication

Static Routing Solution

Maintain a global static routing table that covers the paths passing through GEMS from any EEMS to other EEMS (multiple paths can be included for active-standby switchover). The message sender adds the message recipient's ID to the message's TOPIC, and the EMS forwards the message to the next hop based on the routing table information until it reaches the target EEMS.



Route Table

Source EEMS	GEMS1	GEMS2	GEMS3	Destination EEMS	Link Status
Edge_JPN	Gateway_HKG	Gateway_CHN	/	Edge_KRO	primary
Edge_JPN	Gateway_THA	Gateway_SGP	Gateway_CHN	Edge_KRO	backup

Fig 3.The Architecture of Static Routing

Dynamic Routing Solution

Implement a data packet routing mechanism at the application layer that is similar to that of the IP layer，For example Apache Qpid Dispatch Router(QDR) is an open source(Apache License 2.0), lightweight AMQP application layer message router for building scalable, available, and interconnected messaging networks. A running application instance of Dispatch Router is required for each gateway (or edge) EMS to build topologies of multiple routers network. Clients, message brokers and routers are connected to build an internet-scale messaging network with uniform addressing. Messages can be flexibly routed between any AMQP-enabled endpoints, including clients, servers, and message brokers. Besides best path routing, redundant network paths are provided to transmit around failures.

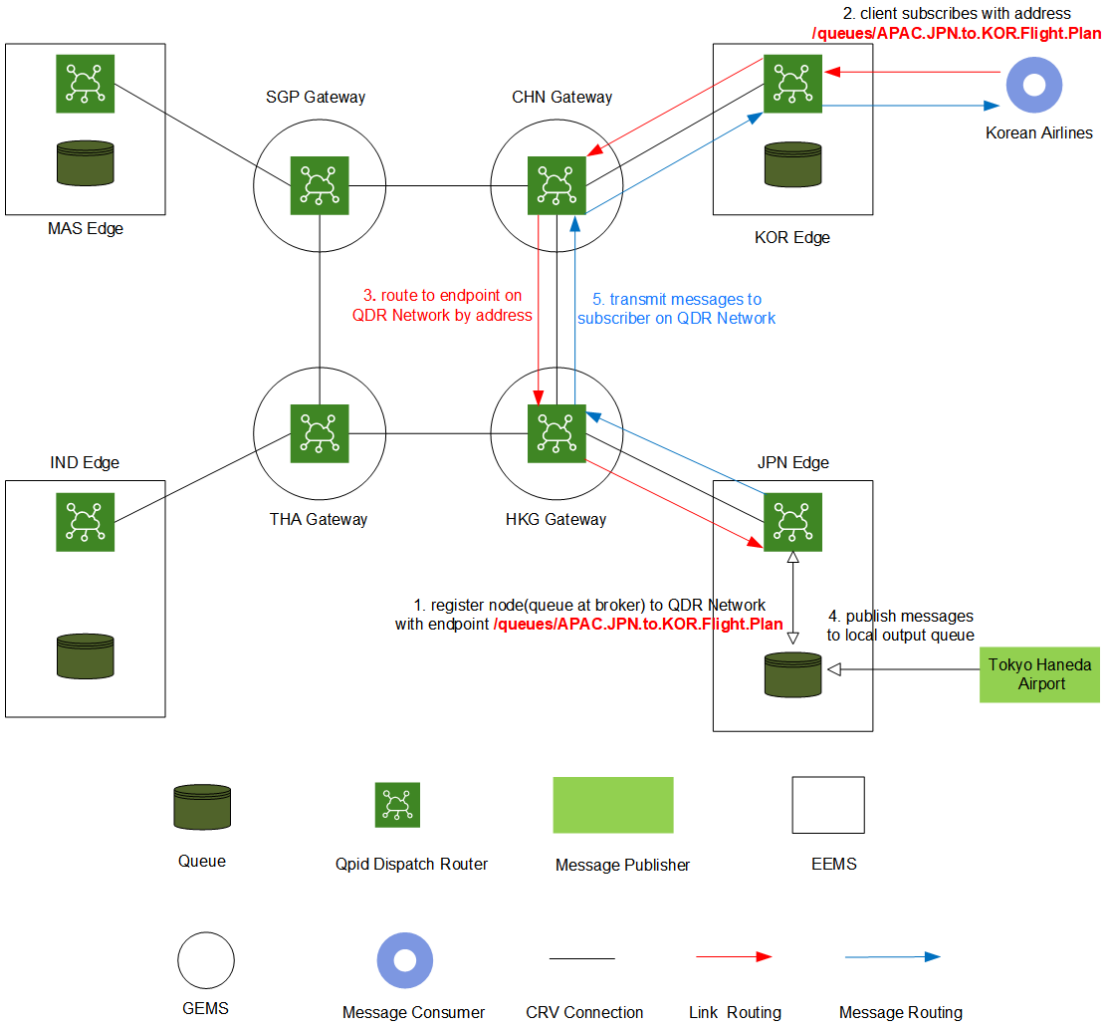


Fig 4. The Architecture of Dynamic Routing

All three solutions have their own advantages and disadvantages, as detailed below:

Tab 1 Comparison of Advantages and Disadvantages of Different Solutions Across Various Dimensions

Dimension	Solution Type	Advantages	Disadvantages
Performance	Data Replication	No routing or addressing overhead	High bandwidth and EMS resource consumption; low data utilization
	Static Routing	Low bandwidth resource consumption; Path with Refined Adjustments	Routing time consumption exists; manual planning required for resource consumption
	Dynamic Routing	Low bandwidth resource consumption; Flexible path adaptation to changes	Routing time consumption exists; Reduced predictability of resource consumption due to dynamic routing
Technical Architecture	Data Replication	No routing rules required; Simple business logic; High scalability	High requirements for GEMS connectivity; Need to prevent routing loops and duplicate deliveries ;(No successful cases exist in the SWIM domain?)
	Static Routing	Intuitive routing rules; Similar to the current	Need to maintain a global routing table; Heavy

		AFTN/AMHS data exchange mode; No need to build a full GEMS connection network	workload for adjustments when EMS nodes change
	Dynamic Routing	Automatic path calculation; similar to the IP-layer data packet routing mechanism; No need to build a full GEMS connection network	Certain uncontrollability in data routing

It should be clearly stated that the participants of TASK2 unanimously agree that all three solutions have numerous issues that need to be addressed in the subsequent detailed design. To save time and resources, if feasible, one of the three solutions should be selected as the primary research direction for subsequent work.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and
b) In conjunction with the development trends of APAC SWIM and CRV, comment on the three solutions
c) provide recommendations for solution selection.