Gateway EMS

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CAAS
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Topics for discussion

- APAC SWIM Implementation Pioneer Group Architecture
- Groupings for Gateway EMS communities
- Functional Requirements for EMS Gateway
- Non-Functional Requirements for EMS Gateway
- Testing requirements and procedures for onboarding a Gateway EMS.
- Runtime Governance for Gateway EMS

APAC SWIM Implementation Pioneer Group Architecture

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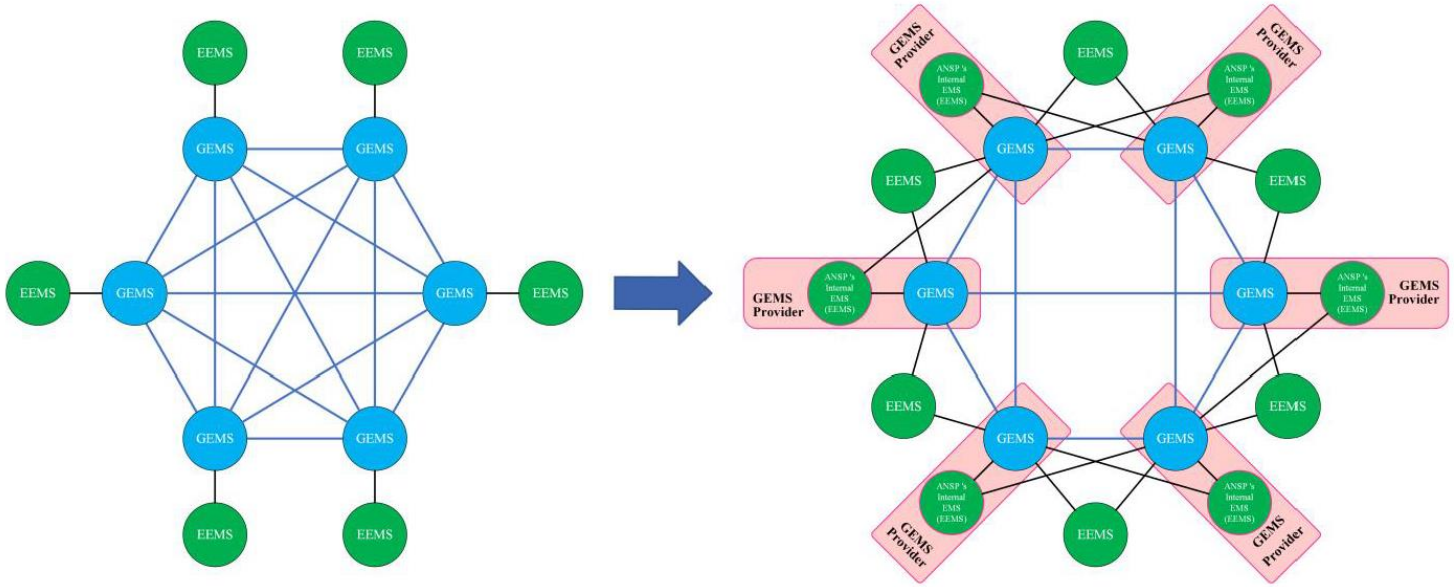
APAC SWIM Implementation Pioneer Group Architecture

- Issues were raised by Republic of Korea at SWIM TF/9 WP/10
- Solutions were proposed by China and Hong Kong at SWIM TF/10 in WP/17 and by Japan in WP/14



APAC SWIM Implementation Pioneer Group Architecture

Problem Raised by ROK – SWIM TF/9 WP/10	Proposed Solution by China – SWIM TF/10 WP/17	Proposed Solution by Japan – SWIM TF/10 WP/14
Priority messaging is not possible depending on the importance of the information	Different queues can be setup according to the nature and/or importance of the information, e.g. surveillance data is separated from FF-ICE message. Priority segregation could be applied at the messaging level by assigning AMQP priorities.	Deliver surveillance messages using a separate queue and logical network Set a message TTL for surveillance messages
Guaranteed message delivery is destroyed when malfunctioning of a message broker occurs in the message delivery chain	Critical messages which require a guaranteed message delivery could be configured with message durability and persistence in the message broker. Concept of staging database between incoming queue and outgoing queue could be implemented to act as a buffer for reliable messaging.	Set up a persistent or replicated message queue Support automatic failover and failback

APAC SWIM Implementation Pioneer Group Architecture

Problem Raised by ROK – SWIM TF/9 WP/10	Proposed Solution by China – SWIM TF/10 WP/17	Proposed Solution by Japan – SWIM TF/10 WP/14
Compensation transactions cannot be performed to compensate transaction failure in the message delivery chain	Retry logic for failed message deliveries could be implemented. A record forward failure list could be used for traceability.	Implement retry logic for failed message deliveries Record Forward Failure List for traceability
Detouring cannot be performed if a failure occurs in the message delivery chain	Clustered servers could be setup for publisher, Edge EMS and Gateway EMS to provide redundancy. Each Gateway EMS should have multiple connections to multiple Gateway EMSes. Each Edge EMS should have two connections to two different Gateway EMSes.	Set a backup EMS for each publisher and Edge EMS Each Gateway EMS has at least two connections to other Gateway EMS

APAC SWIM Implementation Pioneer Group Architecture

Problem Raised by ROK – SWIM TF/9 WP/10	Proposed Solution by China – SWIM TF/10 WP/17	Proposed Solution by Japan – SWIM TF/10 WP/14
The edge node does not know which message to resend when message loss occurs	A mixed use of publish-subscribe pattern and request-reply pattern could supplement information gap when message loss has occurred. Message acknowledgement could be used to notify the publisher that a message was successfully delivered to the consumer, such as response messages used in FF_ICE.	Publish the Forward Failure List, making it accessible to publishers Subscriber responds “Submission Response” to the publisher

Groupings for Gateway EMS communities

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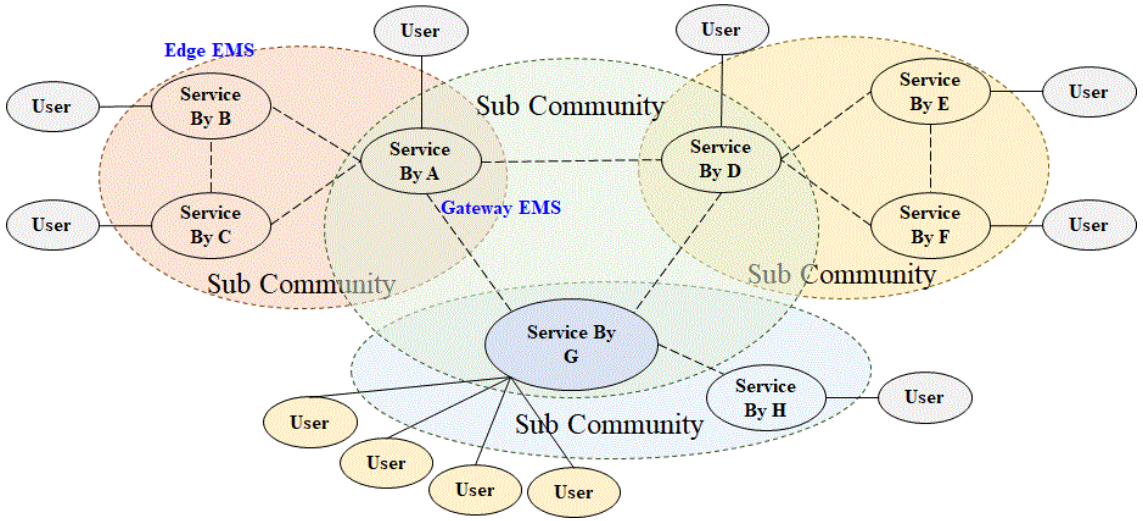
Groupings for Gateway EMS communities



- Model of the hierarchical architecture
- Determine total number of Gateway EMS
- Allocation of sub-communities
  - Is it necessary at this point or should we allow each state to decide for themselves which GEMS to connect to?
  - Paper from Korea (SWIM TF/9 WP/10) China/HK (SWIM TF/10 WP/17) and Japan (SWIMTF/10 WP/14) recommends connection to 2 or more GEMS for redundancy.

Groupings for Gateway EMS communities

Edge EMS	Core-EMS 1	Core EMS 2
Malaysia – CAAM	Singapore – CAAS	
Japan – JCAB/ENRI	Hong-Kong – HKCAD	
Republic of Korea – KAC	China – ATMB	
India (?)	Thailand - Aerothai	

EMS Requirements - Functional

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Gateway EMS Minimum Functional Requirements

Functionality	Proposed by Japan – SWIM TF/10 WP/14	Proposed by China – SWIM TF/10 WP/17
Message Persistence	Ensure messages are stored reliably until they are successfully delivered Support durable (replicated) queues and persistent message storage	
Acknowledgment & Confirmation	Implement publisher acknowledgments to confirm message reception Support consumer acknowledgments to confirm message subscription	
Retry & Redelivery Policies	Support automatic message retries upon failure Implement exponential backoff and dead-letter queues for failed messages	

Gateway EMS Minimum Functional Requirements

Functionality	Proposed by Japan – SWIM TF/10 WP/14	Proposed by China – SWIM TF/10 WP/17
High Availability & Redundancy	Deploy in a clustered mode to avoid a single point of failure Ensure failover/failback mechanisms and redundant EMSs for resilience	The Gateway EMS and the ANSP's internal EMS shall be kept independent. That is, Gateway EMS providers also need to operate their own Edge EMS and establish connections with multiple Gateway EMSes, including their own Gateway EMS. The connections between Gateway EMSes need to be redundant. One Gateway EMS should be connected to at least 2 - 3 other Gateway EMSes and ensure network connectivity and real-time monitoring. The Gateway EMS Provider shall be able to support 7×24-hour monitoring and maintenance to ensure the stability and continuity of the Gateway EMS operation.

Gateway EMS Minimum Functional Requirements

Functionality	Proposed by Japan – SWIM TF/10 WP/14	Proposed by China – SWIM TF/10 WP/17
Routing & Security	Ensure messages are stored reliably until they are successfully delivered Support durable (replicated) queues and persistent message storage	The Gateway EMS' message routing should be easily modifiable based on business scenarios, with possible routing methods including maintained static routing tables and/or dynamic routing tables for message delivery, load balancing, or bypassing faulty nodes. The Gateway EMS Provider needs to have necessary security protection capabilities and measures to ensure network security and data security.

Gateway EMS Minimum Functional Requirements

Functionality	Proposed by Japan – SWIM TF/10 WP/14	Proposed by China – SWIM TF/10 WP/17
Monitoring & Logging	Provide real-time monitoring for message status and EMS health Enable logging and auditing for troubleshooting and compliance	
Network Failure Handling & Auto-Recovery	Detect network failures and re-establish connections automatically Implement message deduplication to prevent duplicate processing	The Gateway EMS Providers should establish collaborative emergency response procedures among themselves and its downstream Edge EMSes. In case of necessity, they should be able to carry out fault transfer and emergency response in a timely manner.

Gateway EMS Minimum Functional Requirements

Functionality	Proposed by Japan – SWIM TF/10 WP/14	Proposed by China – SWIM TF/10 WP/17
Protocol Translation		Message processing should support data transmission protocols (such as AMQP, RESTful API, and WCS/SOAP) as predefined. Gateway EMS should support as many protocols as possible and preferably with support for protocol conversion
Additional Messaging Functionality		If Gateway EMS provides AMHS/SWIM conversion capabilities, including protocol conversion, data model transformation, address mapping, service level adaptation, and security-related conversions, it can better serve the connected stakeholders.

Gateway EMS Minimum Functional Requirements

- Based on APAC Hierarchical Architecture
- Only for following Message Exchange Patterns
  - Publish-Subscribe
  - Asynchronous Request-Reply Messages
- SWIM-AMHS Protocol Translation can be done as an external SWIM Service.
  - AMHS Addressing does not work well when translated to SWIM Environment (Point-to-Point addressing system)
- Data Model Translation can be done as an external SWIM Service.
  - Often requires contextual knowledge of data model
  - Overload EMS with unnecessary business logic and data models
  - EMS should concentrate on its primary function, which is to serve as a message exchange mechanism.

EMS Requirements – Non-Functional

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Gateway EMS Minimum Non-Functional Requirements

- SWIM TF/10 WP/17 – Improvement of the Hierarchical Architecture for Regional SWIM Implementation and Requirements for Gateway EMS
- SWIM TF/10 WP/31 – Recommended Technical Performance Requirements for EMS

Metric	WP/17	WP/31
Bandwidth	> 1.64 Mbps for flight plans	>576.741 kbps for surveillance data
Latency	Operational : Seconds Non-Operational : Minutes	< 235ms
Availability	> 99.9%	

Gateway EMS Minimum Non-Functional Requirements

- Bandwidth, Availability and Latency metrics dependent on use-case.
- Initial agreed scope
  - All information exchange not for aircraft separation
  - Availability set at ≥ 99.0%
- Proposed Use Case categories by Hong Kong and China in SWIM TF/10 WP/17
  - Surveillance Data
  - Flight Plan Data
  - Meteorological Data
  - Aeronautical Information Data missing from considerations

Gateway EMS Minimum Non-Functional Requirements

- Gateway EMS expected to process more traffic than Edge EMS
  - Will require more stringent performance standards.
    - Greater bandwidth requirement
    - Lower latency requirement
  - Latency measure is from the time a message arrives at the EMS till the time the message is transmitted from the EMS.
  - Proposal for Bandwidth of the GEMS?
  - Proposal for Latency requirement of the GEMS?

Testing and Onboarding Procedures

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Testing requirements and procedures for onboarding a Gateway EMS.

- Connectivity testing
  - Between the new Gateway EMS and the other connected Gateway EMS
  - Between all connected its connected edge EMS
- Latency Testing
  - Ensure large enough sample size to get a statistically significant result
  - Ensure different size of payload
  - Average result <= agreed latency value
- Bandwidth Testing
- Cybersecurity Testing
  - EMS provider to conduct cybersecurity testing based on own national standards.
  - Follow preliminary Trust Framework Instance Model
    - Certificate Policy(CP) map against ACCP
    - Information Security Management System(ISMS) map against MAIS

Runtime Governance for Gateway EMS

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