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Airport Information Sharing Concept Architecture Development

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Develop an airport network framework architecture that enables seamless exchange of real time information among stakeholders for the improvement of NAS operations.

**Objectives**
- Increase airport capacity
- Improve gate turn around time
- Improve on time departures
- Improve NAS efficiency and safety
- Optimize Airline, ANSP, Airport operations.
- Increase collaborative information

**Benefits**
- ATM optimization based on full view, real time airport information and increased system predictability
- Operational improvements by implementing advances in networking and Communications technologies
- Context Awareness – Total view of airport state (facilities/assets, operations, users)
- Improve airport tenant decision making capabilities.

Enable Seamless Information Exchange and activate new NAS Capabilities
Airport Information Sharing Architecture: Objectives

**Optimize**
- Information sharing
- Airport surface ops
- Air traffic management
- Safety processes
- Business operations

**Enable**
- Net/Data-centric collaboration
- Total airport management
- Data reliability and timeliness
- Network resilience

**Integrate**
- Data sources
- Ground and air-ground networks
- ATM tools

**Demonstrate**
- Prototype template
- System/subsystem performance
- Airport resource sharing policies
**Global Airport Architecture System View Framework - Conceptual**

- **Airport Network System (ANS):** Repository of relevant global airport information supporting ATM/ATC, AOC, FOC, Airports, Passenger
  - ANS Implementation - options
    - Publish/Subscribe Cloud Enabled – NAS users connect and access information
    - Distributed servers forming a SOA
    - Cloud Computing Environment
  - Data exchange model required (FIXM, WXXM, AIXM)

- **Airport System Information (ASI):** Repository of relevant airport information supporting ATM/ATC, AOC, FOC, Airports, Passenger
  - ASI Implementation - options
    - Publish/Subscribe Cloud Computing Enabled – Connects to ANS for information dissemination
    - Airport tenant publishes to ASI
  - Data exchange model required
Global Airport Architecture System View Framework - Logical

[Diagram showing various components and services related to airport architecture, including Airline OCC (Hybrid Cloud), Flight Database, FBO (Hydrogen/Catering Fuel) Services, Airfield/Terminal Services, Air Traffic Management, and FAA Telecommunications Infrastructure (FTI).]
Data Load Model

Services identified:
- SWIM (APDS, SMES TAIS, TBFM, flight data, weather)
- Airspace user (CDM, scheduling, flight status, OOOI, ground services, logging, NOTAM/NOTOC)
- Airport authority (gate management, slot, CDM, facility status and reporting, airfield status, security)
- ANS to ASI dialogue (ANS report, ASI report, ANS to ASI sync)

For each service:
- Service name and description
- Source
- Destination
- Message name
- Instantiation interarrival distribution (seconds)
- Size distribution (bytes)
- Class of Service
- Availability

<table>
<thead>
<tr>
<th>Service_Name</th>
<th>Service_Description</th>
<th>Source</th>
<th>Destination</th>
<th>Message_Name</th>
<th>Instantiation_Interarrival_Distribution (seconds)</th>
<th>Size_Distribution (Bytes)</th>
<th>CoS</th>
<th>Latency (RCP)</th>
<th>Availability</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>Flight_ID</td>
<td>Update of flight/aircraft identification: GUFI/ACID/UUID/Aircraft type/Equipage</td>
<td>AOC/FOC services</td>
<td>ANS</td>
<td>ID_Update</td>
<td>1 message/flight</td>
<td>100</td>
<td>ATM</td>
<td>10</td>
<td>0.9999</td>
<td>Assumed very small message size. Worst case that it is updated once per flight</td>
</tr>
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</table>
Testbed Description

Background:
• A spiral testing approach has been designed to validate increasingly realistic aspects of information sharing in the airport network
• In the first spiral, a message broker implementation to instantiate the ANS and ASI functionality is tested for feasibility

Objectives:
• Validate a message brokering in client-server architecture and IPv6 addressing
• Use sample messages from the data load model (e.g. ASDE-X surface event)
• Use AMQP protocol for subscription, publication, consumption (and, in R/R, acknowledgement)
• No network routing or traffic load effects
• Test message delivery latency depending on:
  – Message size (5 kB+)
  – Exchange pattern (Request/Response or Publish/Subscribe)
• Creates the baseline in “ideal network conditions” to add realistic nation-wide network traffic in future test spirals
Testbed Configuration - Components

**Trial Configuration**

- Test employed emulated architecture configuration
- IPv6 Network with segmented addressing domains
- System Components
  - ODROID-C2 Single Board Computers running Linux OS
  - Netgear Switch
National Aeronautics and Space Administration

Testbed Configuration – Test Tools

Sample file: ASDEX Surface event (5 MB)
Testbed Configuration - Scenarios

1. Queue Publication (Request/Response Pattern)

- One message goes to one consumer
- If there are no consumers available at the time the message is sent it will be kept until a consumer is available
- If a consumer receives a message and does not acknowledge it before closing then the message will be redelivered to another consumer

2. Topic Publication (Publish/Subscribe Pattern)

- One message goes to all subscribers
- Only subscribers with an active subscription at the time the broker receives the message will get a copy of the message
Testbed Configuration - Results

1. Queue Publication (Request/Response Pattern)

2. Topic Publication (Publish/Subscribe Pattern)
Conclusions

• Airport information sharing architecture designed to exchange real time information among stakeholders for improvement to NAS operations.
• Architecture enables global airport interconnection of multiple airport facilities
• Conducted laboratory test of Airport System Information and Airport Network System concepts using Active MQ
• Results show the message broker solution can support file exchange in line with the data modeling
  – As implementation practice, file fragmentation should be minimized
• Next step: try this service in a realistic network environment (routing, traffic load, network outages)