Enabling TBO

Mediating to FIXM from multiple data sources to enable SWIM

Presented to: ATIEC 2016

By: Nadine Alameh (Snowflake Software) & Samet Ayhan (Boeing BR&T)

Date: 22nd September 2016
Overview

• Context

• UAS TBO Introduction

• FIXM Mediation and Exchange

• Lessons Learned & Conclusion
Context

• It often takes considerable time and effort converting and harmonizing flight data for use in applications.

• The introduction of FIXM and the concept of Flight Object Exchange Service make it easy to mediate data into a single model.

• This drives the focus to be on utilizing the data in sophisticated applications.
TBO UAS Overview (1/2)

• General
  – FAA funded project
  – Collaborative R&D project with industry partners

• Goal
  – Investigate Trajectory Negotiation processes and concepts to resolve conflicts focusing the en-route phase of flight (manned & unmanned) in Class A airspace
    • Information Management integrated with MG environment using FIXM 3.0.1
TBO UAS Overview (2/2)

Use Cases and Scenarios
(1 mth)
- Flight Planning and Filing
- FMS Upload
- Enroute transit

Modeling & Simulation
(2 mths)
- Explore TBO benefits on larger scale environment within a closed system
- Explore Trajectory communication/definition issues between multiple Ground-Based Systems of varying fidelity
- Ability to make rapid changes in Environment and Setup
- Prepare background traffic and FMS flight Plans for lab exercises
- Risk-Reduction for Scenario/Scripting

Progressively more
Realistic Systems/Scenarios

Laboratory Exercises
(3 mths)
- FMS implementation of Flights
- Real Conflict-Detection Systems
- Real Information Exchange between Systems
- Mimic Live-Flight Scenarios as much as possible
- Risk-Reduction for Live Flight Exercise

Live/Laboratory Flight
(2 mths)
- Demonstrate TBO and Information Exchanges with Real Aircraft
TBO UAS Mini Global Integration

- Integrated to Global Enterprise Messaging Service
- Information exchange based on international data models and standards (e.g., FixM)
- Information exchange across multiple GEMS providers
- Publication and receipt of FixM flight objects to FOXS
- Integration of CDS conflict reports with TBO tools and systems

- Trajectories generated by real aircraft avionics
- Aligned with prior FAA UAS research
- Enables paradigm shift to TBO
Architecture

Boeing SIL EMS

Mini Global GEMS*

FTB Mini Global Viewer
(Mosaic)

FTB Flight Object Exchange Service (Harris)

FTB Conflict Detection Service (Adacel)

*Note: GEMS shown as a simplification. Boeing Global SIL is on ramped to Service By Harris.
IASL Test Flights Overview

_Aircraft 1_: UAS001 (IASL)
- Departure Airport: Boeing Field, Seattle (KBFI)
- Arrival Airport: Gary, Indiana (KGGY)

_Aircraft 2_: TBO002 (sFMS)
- Departure Airport: Burns, Oregon (KBNO)
- Arrival Airport: Blue River, BC, Canada (CYCP)

_Aircraft 3_: TBO003 (sFMS)
- Departure Airport: Rome, Oregon (KREO)
- Arrival Airport: Calgary, Canada (CYYC)
Demonstration Details

Conflict cleared by flight plan amendment or level change

Conflict cleared by trajectory edit
Live Flight Overview

• Conducted on Nov. 6\textsuperscript{th}, 2015
  – Departure Airport: St. Louis Missouri (KSTL)
  – Arrival Airport: Stockholm, Sweden (ESSA)
  – Aircraft: Boeing Executive Fleet B737 (N834BA)

• Data collection from live aircraft

• Procedure
  – Intent received from aircraft, trajectory generated
  – Published to MG as FIXM flight object, also to CDS
  – Conflicts with sFMS instances
  – Conflicts resolved
Mediating to FIXM

- **Data mediated from proprietary XML formats to FIXM:**
  1. GE FMS Aircraft State data.
  2. Predicted trajectory generated using Boeing Trajectory Prediction Engine (TPE).
  3. TAAM simulated aircraft position reports in the form of ASDI.

- **Data mediated to FIXM 3.0.1 core.**
- **Used for the exchange of trajectory and flight position information.**
Exchanging FIXM

• Data taken from JMS topics and made available to stakeholders via:
  – Web Services
  – HTTP POST

• Spatiotemporal filtering available via Web Service interface.
Benefits

• **Mediation used COTS software configuration only.**
  – Enabling development focus on data utilization, not data transformation and management.

• **Benefits provided by using FIXM:**
  – Common understanding.
  – Increased interoperability.
  – Flexibility and adaptability.
  – Increased dynamism and distribution across flight operation.
Lessons Learned

• FIXM Recommendations:
  – Stricter cardinality of elements and attributes
  – Need for globally applicable business rules
  – Further alignment with other standards
  – Clearer usability guidance
  – Tighter schema restrictions and constraints
  – Informed FIXM development particularly trajectory descriptions
Conclusions

• Successfully demonstrated how flight data from different feeds can be mediated to FIXM using COTS products.

• Data made available in FIXM was proven to improve TBO applications and provides new and innovative opportunities for utilizing the data.

• Transformation of legacy formats and utilization of FIXM lead to recommendations report.
Questions?

nadine.alameh@snowflakesoftware.com

samet.m.ayhan@boeing.com