Enabling TBO

Mediating to FIXM from multiple data sources to enable SWIM

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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.
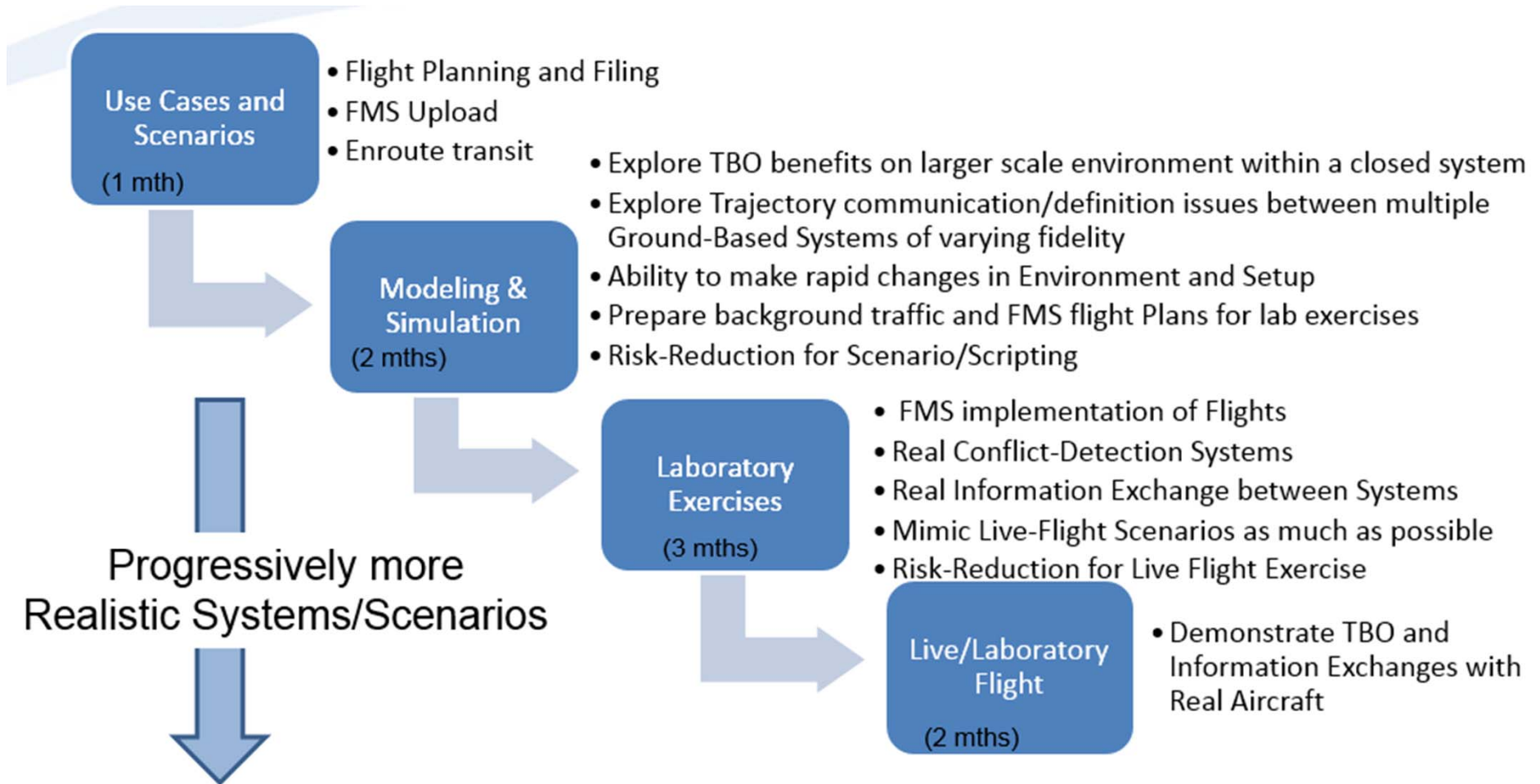
TBO UAS Overview (1/2)

- **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
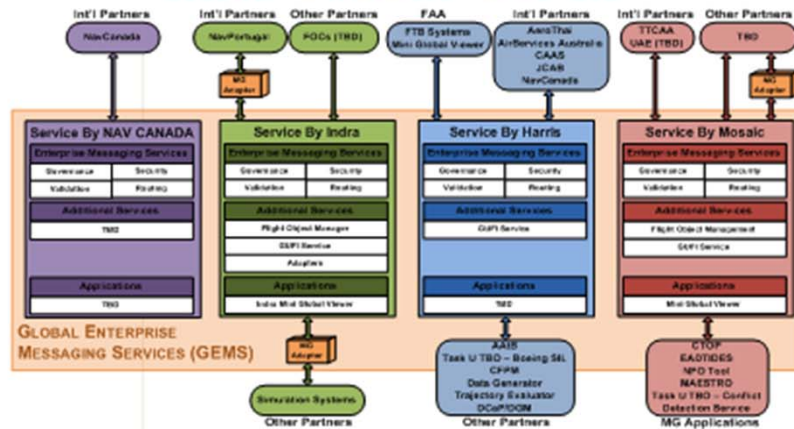
TBO UAS Overview (2/2)

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

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

Progressively more Realistic Systems/Scenarios

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TBO UAS Mini Global Integration

Mini Global SWIM

- 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
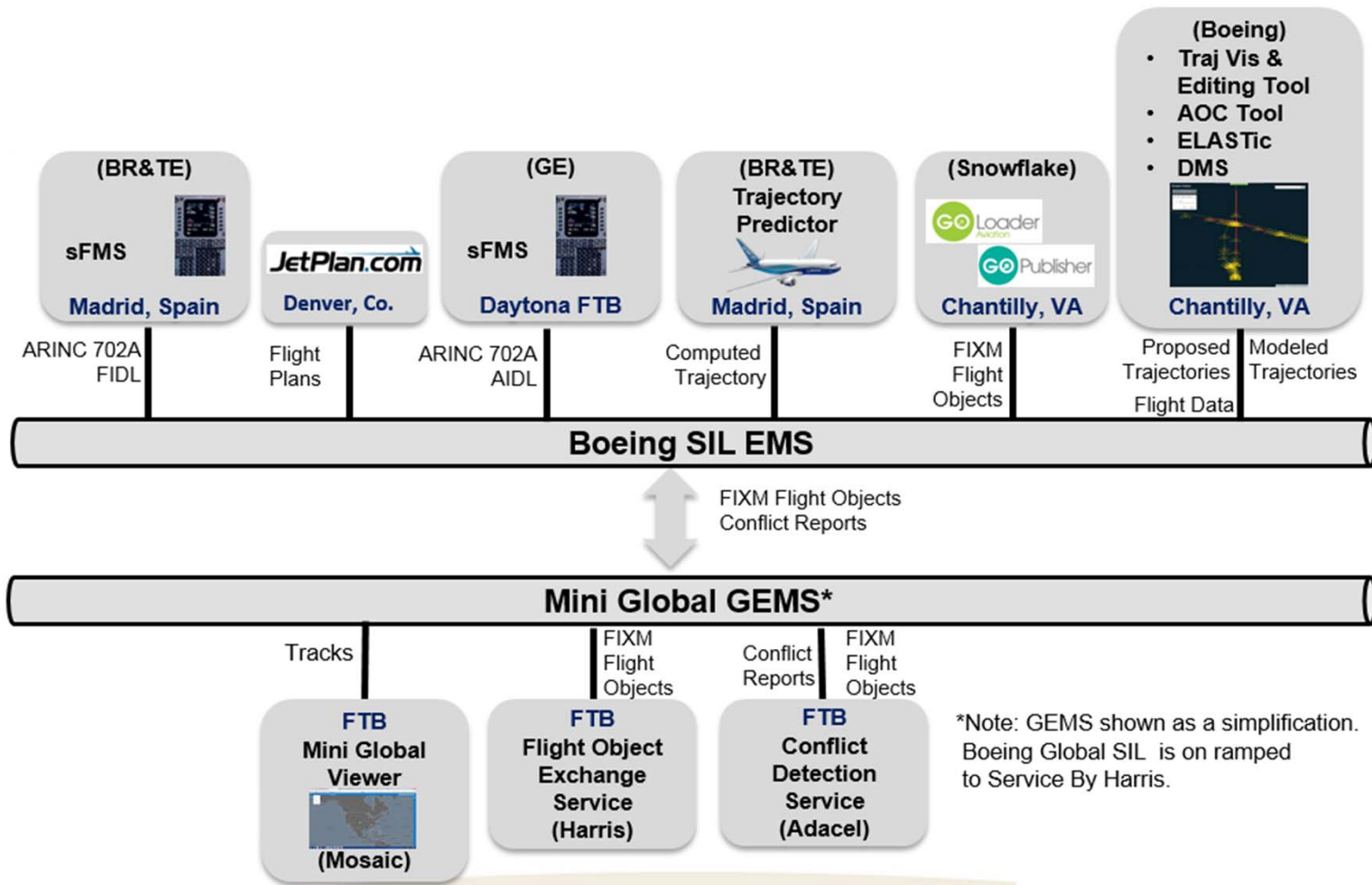- Integration of CDS conflict reports with TBO tools and systems

TBO
Trajectory Based Operations

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

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Architecture

IASL Test Flights Overview

Aircraft 1: UAS001 (IASL)
   Departure Airport: Boeing Field, Seattle (KBFI)
   Arrival Airport: Gary, Indiana (KGGY)
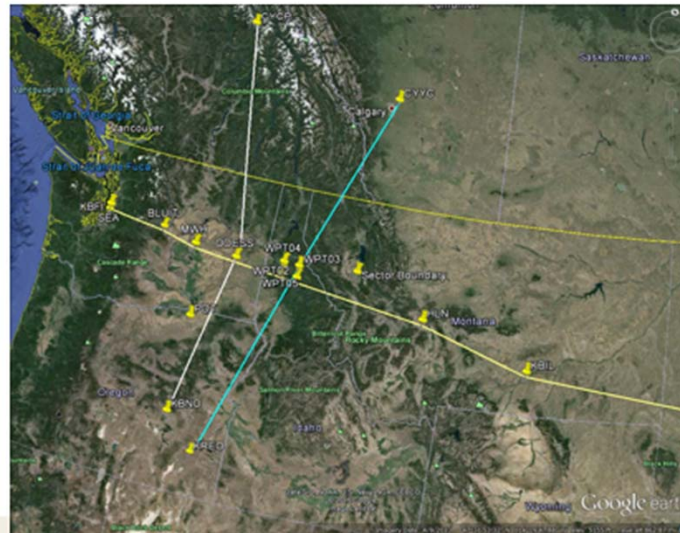*Aircraft 2*:   TBO002 (sFMS)
   Departure Airport: Burns, Oregon (KBNO)
   Arrival Airport: Blue River, BC, Canada (CYCP)
Aircraft 3:   TBO003 (sFMS)
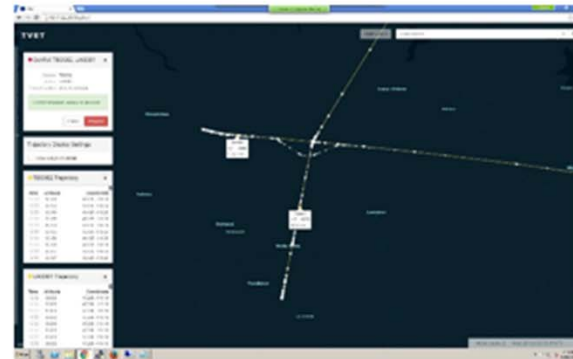   Departure Airport: Rome, Oregon (KREO)
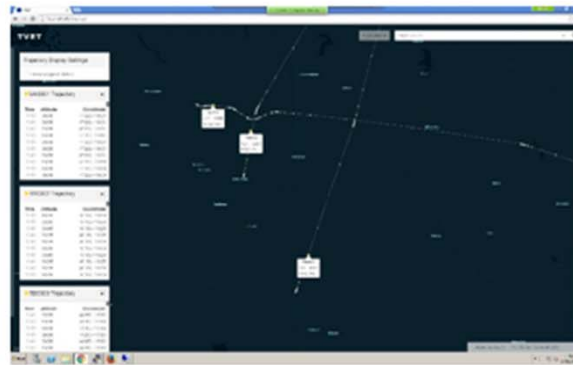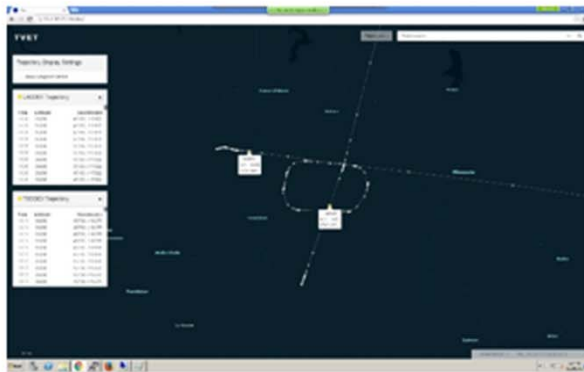   Arrival Airport: Calgary, Canada (CYYC)

Demonstration Details

Conflict cleared by flight plan amendment or level change


Conflict cleared by trajectory edit

Live Flight Overview

- **Conducted on Nov. 6th, 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.**
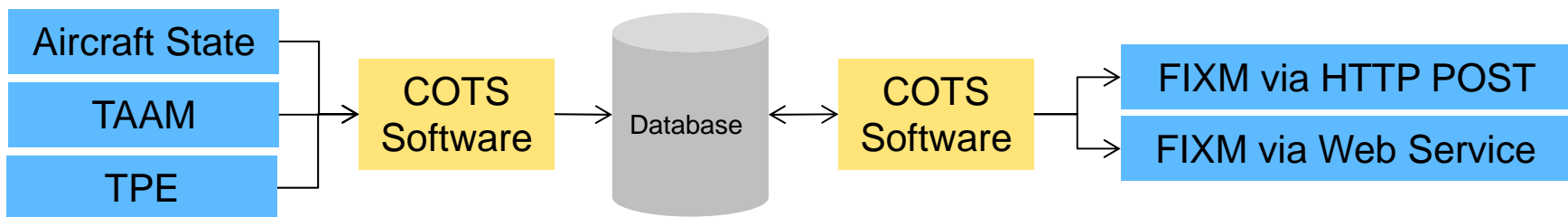
Exchanging FIXM

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

- **Spatiotemporal filtering available via Web Service interface.**
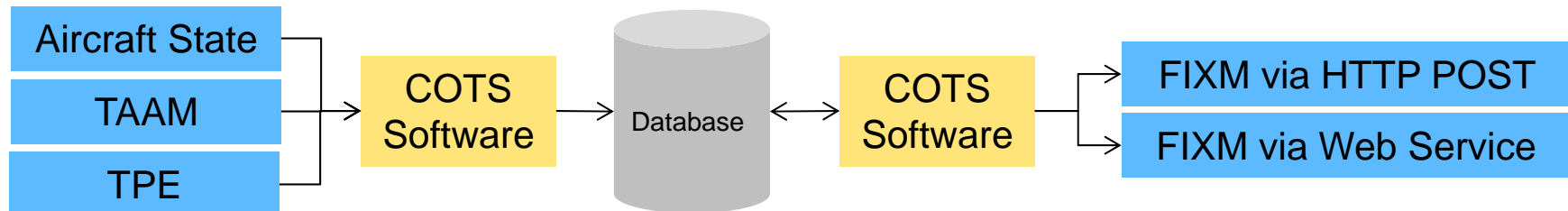
Benefits

- **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

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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?

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