COE CST Seventh Annual Technical Meeting

Interoperable Air and Space Traffic Management

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Agenda

- Team Members
- Task Description
- Goals
- Results
- Conclusions and Future Work

Team Members

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

- Principal Investigator: Sven Kaltenhaeuser
- Team: Frank Morlang, Tanja Luchkova, Jens Hampe, Dr. Dirk-Roger Schmitt

- Organization
  - DLR German Aerospace Center, Institute of Flight Guidance
    Associate Member of the COE CST

Task Description

- With global growth of the commercial space industry there is a developing demand for space flight operations in and over Europe. Air Traffic Management (ATM) is playing a key role to address this challenge.
- The goal is to prepare the European ATM system to enable a safe integration of space vehicle operations (SVO) in a sustainable and efficient way. To enable global operations, interoperability of implemented technologies and procedures is an essential requirement and a specific focus of the DLR work program.

Goals

- Categorization of relevant space flight operations and assessing their impact on European airspace using the DLR Space and Air Traffic Management (SATM) testbed.
- Development of measures and procedures for enabling efficient ways to optimize airspace usage for space flight operations while minimizing airspace segregation.
- Development of concepts and prototypes for a seamless, safe and secure implementation of space flight operations into the ATM flight planning and control processes using System Wide Information Management (SWIM) and related open and standard mainstream technologies.

Results

Traffic impact analysis framework

Definition of airspace capacity

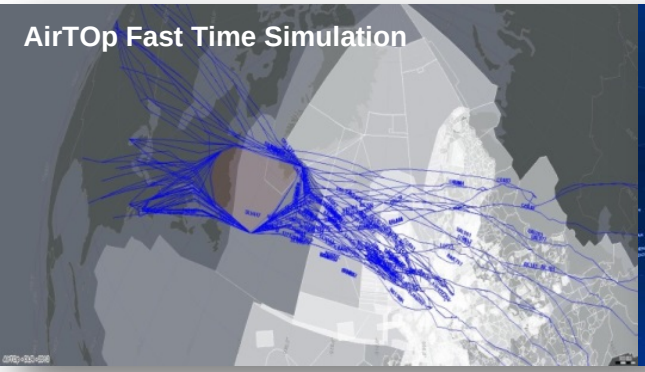
- Max number of aircraft per unit of time that can be safely handled by controllers
- Assumptions about the influence of the SV operations on the European airspace capacity

Airspace restrictions and hazardous areas

- Dynamical movement of the hazardous areas around the space vehicle
- Air traffic data

Three scenarios: baseline and two comparison scenarios

- Historical traffic data used from Eurocontrol for research purposes only
- Each traffic scenario contains around 24,000 flights in 24 hours traffic scenario over Europe


AirTOp Fast Time Simulation

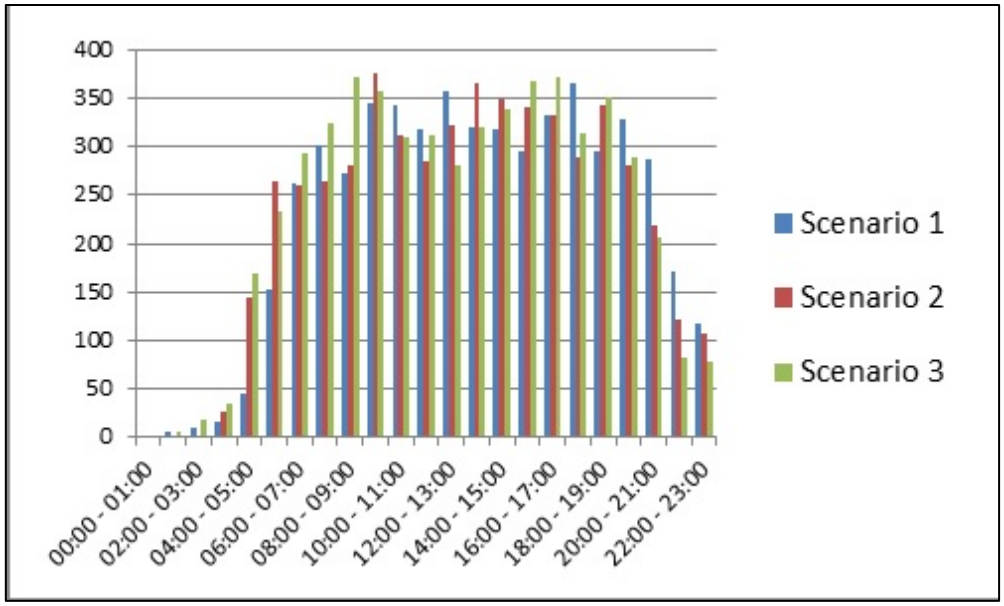

Air Traffic Management and Operations Simulator (ATMOS)


Space Flight Simulator

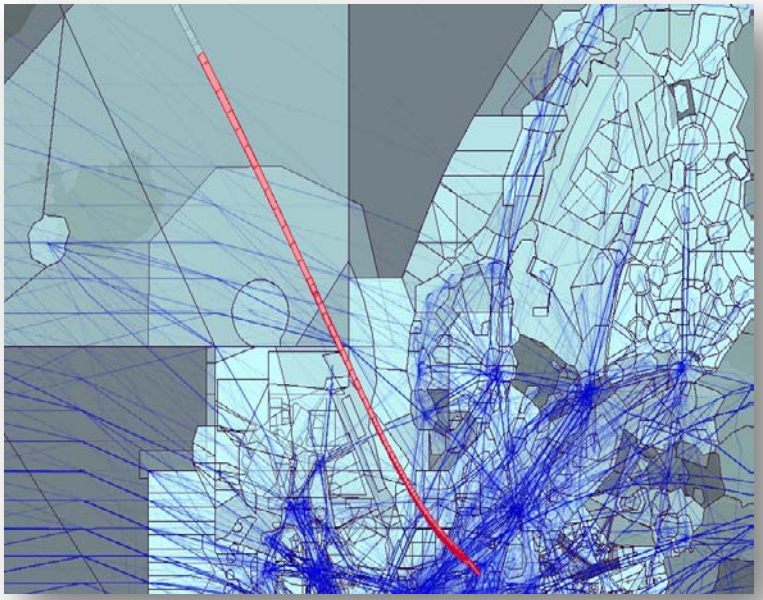
Results

Traffic impact analysis for SpaceLiner use case

A traffic impact analysis has been prepared and conducted for the suborbital SpaceLiner point-to-point return trajectory towards a European landing site.



Entry count for scenarios 1, 2 and 3 during the rolling hour

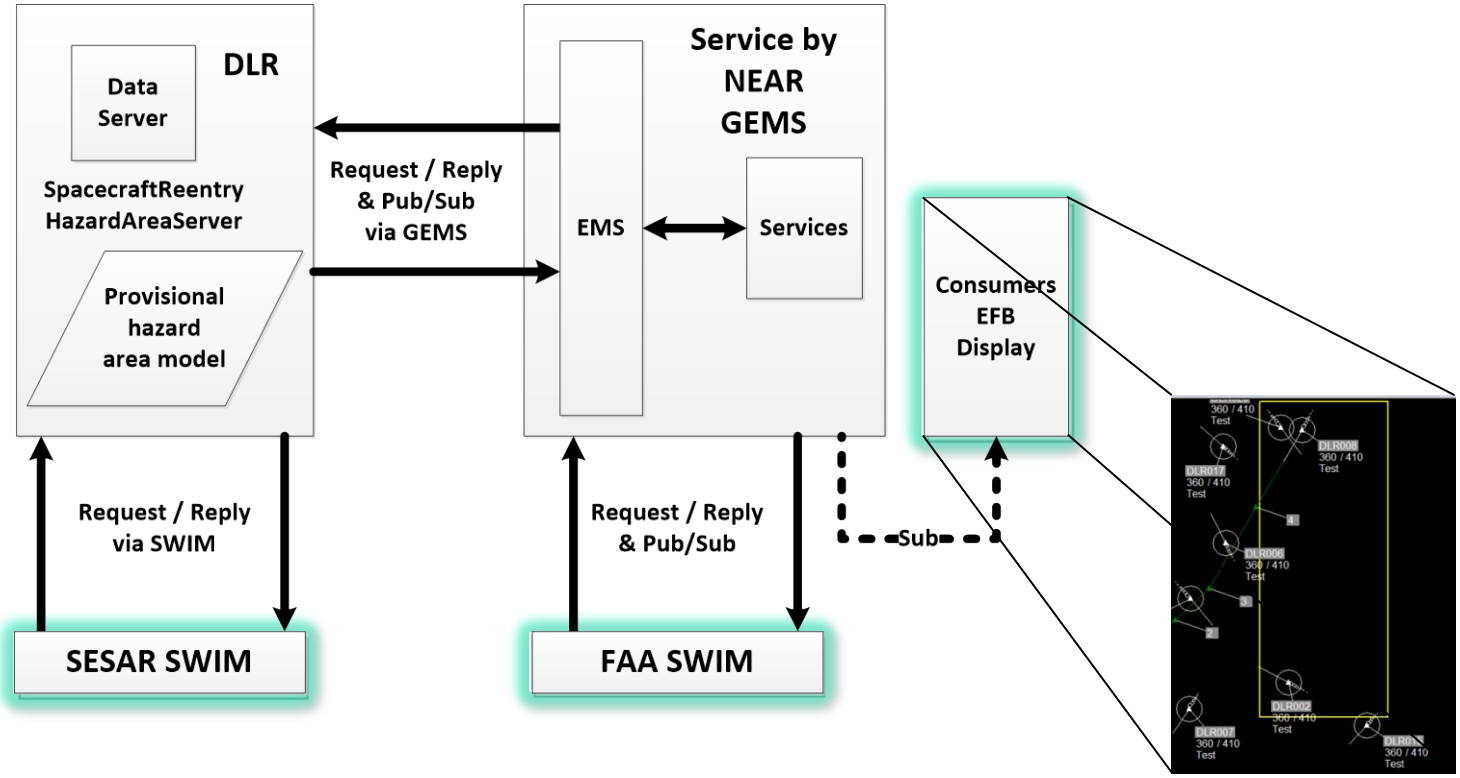


Trajectories in and around the HA

Results

Interoperable SWIM HazardAreaService

A functional and interoperable SWIM service prototype has been developed. It was tested together with Embry Riddle Aeronautical University for provision of Reentry Hazard Area data in a SESAR SWIM←→FAA SWIM environment.



2015 SESAR SWIM Master Class contribution by DLR in cooperation with Embry Riddle University (ERAU)

Results

Latest publications:

- Kaltenhäuser Sven et al. (2017) Facilitating Sustainable Commercial Space Transportation Through an Efficient Integration into Air Traffic Management, New Space Journal, August 2017, ahead of print.
- Kaltenhäuser, Sven (2017) A concept for improved integration of Space Vehicle Operation into ATM. 33rd Space Symposium, 3.-6. April 2017, Colorado Springs, CO, USA
- Morlang, Frank et al.(2017) Why a future commercial spacecraft must be able to SWIM, Journal of Space Safety Engineering, Volume 4 , Issue 1 , 5 - 8
- Luchkova, Tanja und Kaltenhäuser, Sven und Morlang, Frank (2016) Air Traffic Impact Analysis Design for a Suborbital Point-to-Point Passenger Transport Concept. 3rd Annual Space Traffic Management Conference, 16.-18. Nov. 2016, Daytona Beach, FL, USA.
- Drescher, Jürgen, Morlang, Frank, Hampe, Jens, Kaltenhäuser, Sven, Jakobi, Jörn, Schmitt, Dirk-Roger (2016) Commercial Space Transportation and Air Traffic Insertion - SESAR Requirements and the European Perspective. In: Proc. 32nd Space Symposium, Technical Track, Colorado Springs, Colorado, USA. Space Foundation, Colorado Springs, CO, USA
- Kaltenhäuser, Sven und Morlang, Frank und Luchkova, Tanja und Hampe, Jens und Schmitt, Dirk-Roger (2016) Evolving Air Traffic Management towards an efficient integration of hypersonic air transportation. 2nd Symposium on Hypersonic Flight, 30. Jun. - 01. Jul. 2016, Rom, Italy

Conclusions and Future Work

- The introduction of trajectory based operations and system wide sharing of real time air traffic data opens up new ways for an integrated and interoperable Space and Air Traffic Management. The working principles of such procedures have been demonstrated successfully. It is a foundation for a sustainable integration of space vehicle and air traffic operations.
- Next Steps
  - Refinement of traffic impact analysis framework and additional analysis of relevant space vehicle trajectories
  - Applying advanced ATM concepts such as Flexible Use of Airspace, Flight Centric ATC and Dynamic Sectorization
  - Enhanced functions for space flight SWIM services including all ATM planning and execution levels.