Overview of FAA Process for Airspace Management During Planned and Uncontrolled Reentries

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Daniel Murray

Ed Gannon

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Overview

- The US has developed operational and procedural expertise for integration of launch and reentry operations in the National Airspace System.

- Space Shuttle missions, commercial reentries of Dragon Capsule and numerous launch systems provided opportunities to evolve the processes.

- The FAA continues to refine the current processes and recognizes the need to address emerging issues from expanding space activities.

Planned/Uncontrolled Reentries

- Current approaches based mostly on recent experience:

- Planned Reentries
  - 22 NASA Space Shuttle reentries between 2005 and 2011
  - GeoEye *Orbview-3,* December 2010
  - 4 SpaceX *Dragon* reentries since 2010

- Uncontrolled Reentries
  - NASA *UARS*, September 2011
  - DLR *ROSAT*, October 2011
  - RSA *Phobos-Grunt*, January 2012

Launches and Planned Reentries

- FAA relies on agreements developed by its air traffic control (ATC) facilities and the launch or reentry operator to establish requirements and define procedures for airspace management
  - Content of agreements is developed on a case-by-case basis.
  - All agreements must contain, at a minimum, requirements for:
    - Notification by the operator to the appropriate ATC facility of the intent to conduct an operation,
    - Communication between the operator and the ATC facility as necessary before, during, and after an operation, and
    - Planning by the operator and the ATC facility for contingencies and emergencies.

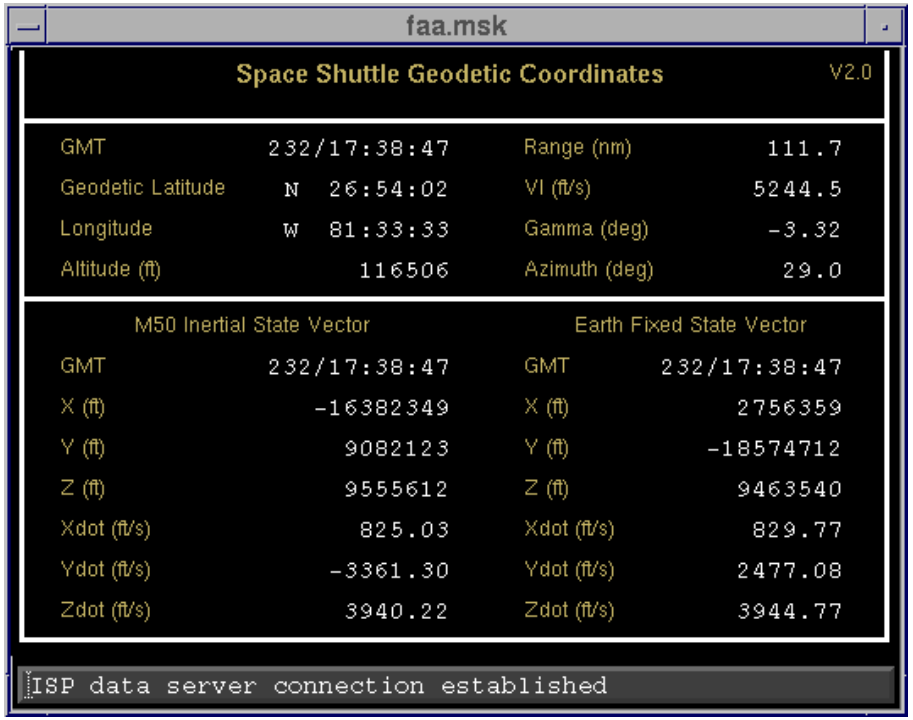
Air Traffic Management Approaches

- Generally, the FAA protects against potential contingencies using preemptive airspace closures
  - Volumes of airspace sized to contain the hazards associated with a space vehicle failure during launch or reentry are closed to all traffic in advance of the operation and remain closed as long as the potential for the hazard exists

- The FAA uses the following airspace management tools to segregate air traffic from the affected airspace
  - Temporary Flight Restrictions (TFRs),
  - Altitude Reservations (ALTRVs),
  - Special Use Airspace (SUA), and
  - Tactical approaches

Lessons Learned From *Columbia*

- Effective airspace management around space operations requires increased situational awareness
  - *Columbia* identified the need to develop capabilities to:
    - Accurately model a space vehicle accident
    - Identify potentially affected airspace
    - Assess impacts on air traffic
    - Quickly distribute information to affected parties
  - The FAA must work closely with space vehicle operators throughout operational planning and execution



Process for Planned Reentry

- Publish NOTAMs and System Impact Report
- Apply standard separation defined in FAA Order 7110.65 for the type of operation, airspace, and category of aircraft from the boundary of the danger area
- Establish hotline with vehicle operator for certain operations to expedite cancellation of restrictions on airspace

Realtime Monitoring/Execution

- Process developed for Space Shuttle reentries has been applied to Dragon reentries
  - Use hotline and realtime digital data stream to monitor vehicle's progress throughout the operation against pre-planned mission event timelines.
  - The FAA is prepared to protect airspace based on receipt of an accident notification from operator over the hotline
  - Procedures developed and validated through a number of exercises that simulate accidents. Exercises have prepared the affected ATC facilities for contingency actions.
  - Prototype software for reentry debris prediction developed and used operationally

International Coordination, Part 1

- The FAA coordinates US launches and reentries affecting another country's airspace where agreements have been established
- For one-time events, procedures are worked out via teleconference or meetings between the FAA, other affected Air Navigation Service Providers (ANSPs) and the space operator
- For repeated events, the FAA requires the space operator to develop an agreement with the appropriate ANSP
  - Agreement documents ANSP's notification and coordination requirements and establishes necessary procedures

International Coordination, Part 2

- For a foreign launch or reentry operator planning to conduct an operation that may affect FAA airspace, the FAA expects to receive the following, at a minimum, as soon as possible:
  - Expected time of the operation (i.e. launch or reentry window dates, times, and durations)
  - Alternate/backup dates and times
  - Locations of any hazard areas, including latitude/longitude coordinates, times at which they should become active, and duration for which they should be active

Potential Improvements

- Opportunities through Next Generation Air Transportation System (NextGen) initiatives

- Research and development with other US government partners
  - Aircraft vulnerability testing
  - Aircraft vulnerability modeling

- Commercial Space Transportation Center of Excellence
  - Research and development of integrated space and air traffic modeling and simulation capabilities

Uncontrolled Reentries

- FAA is continuing to explore the issues
- A number of challenges associated with unplanned reentries exist that still need to be addressed
  - The information that can be provided to describe the timing and location of the event is subject to considerable uncertainty
  - The FAA's ability to respond can be limited by short notice and a lack of automation with which to assess the situation, consider potential actions, and if necessary, implement those actions