



**Federal Aviation
Administration**

Commercial Space Transportation (AST)

Commercial Space Transportation RE&D Program

To: REDAC NAS Ops Subcommittee

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Director Commercial Space Integration

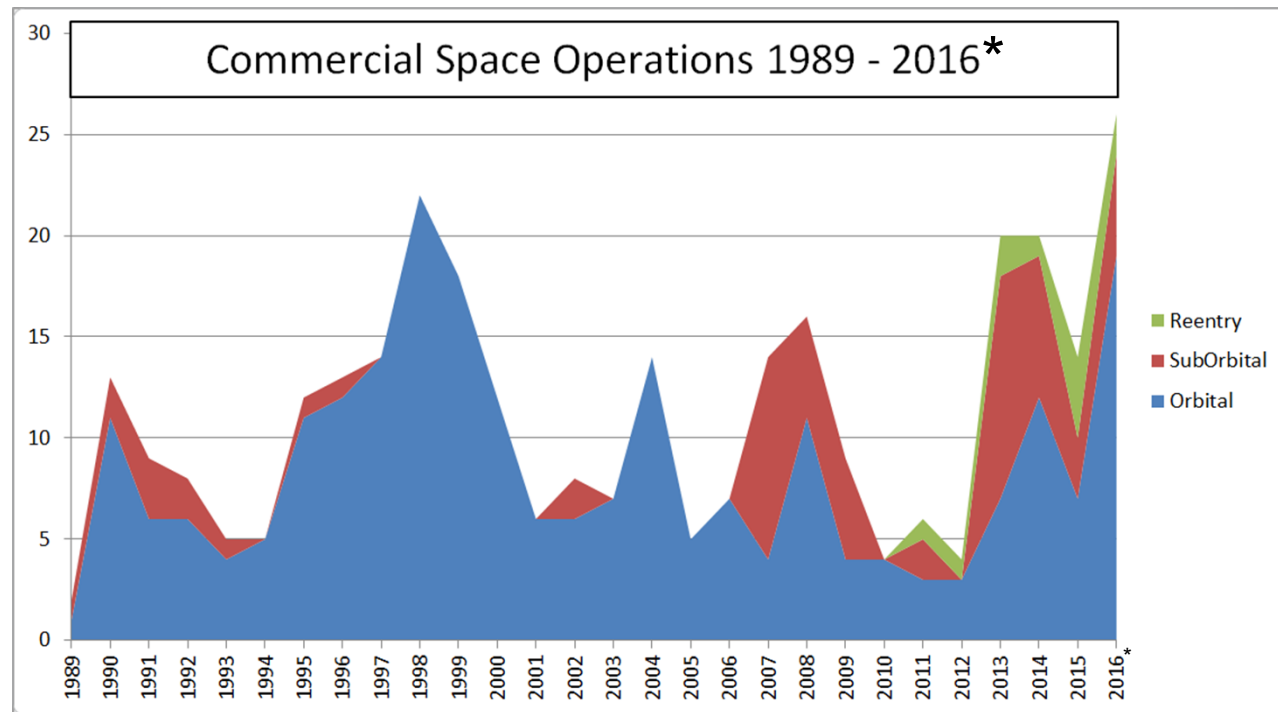
FAA Office of Commercial Space Transportation

Date: August 9, 2016



The FAA has a Long History with Commercial Space Transportation Operations

- The Office of Commercial Space Transportation (AST) was formed *in 1985* (in the Office of the Secretary); joined FAA as line of business in 1995
- Commercial Space Transportation regulations in place since the 1990s – 2000s
- > 290 authorized launches & reentries
 - No public safety impacts
- Airspace “integration” methods date back to:
 - Space Shuttle (orbital flights)
 - Ansari X-Prize (sub-orbital flights)



* Projection

Current Realities



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Current Realities



NASA Commercial Services Programs



Large Satellite Deployment Business



Small Satellite Deployment Business



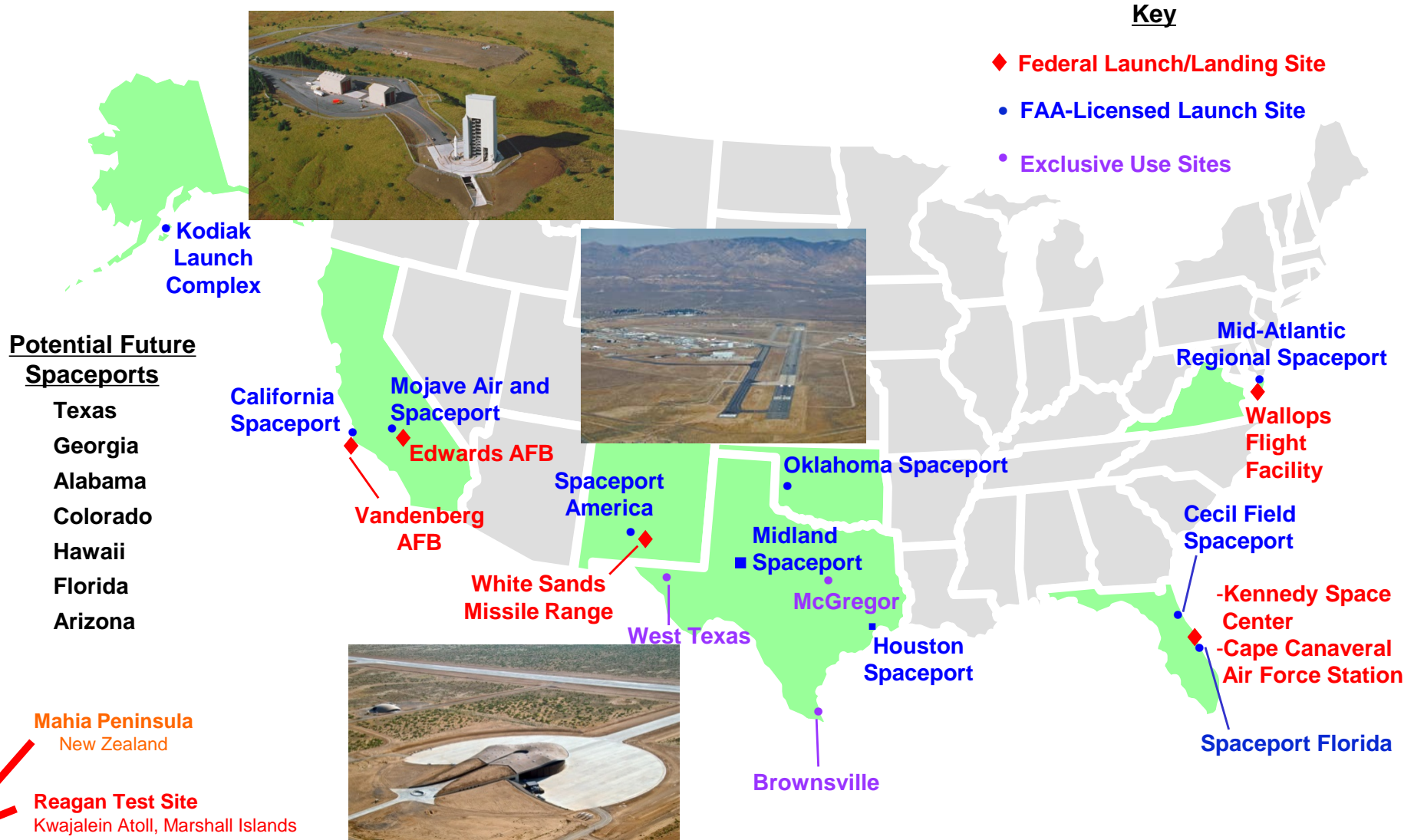
Suborbital Space Flight Business



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The Industry

US Launch Sites – Significant Investments by States, Local Authorities & Industry



Commercial Space R&D Development

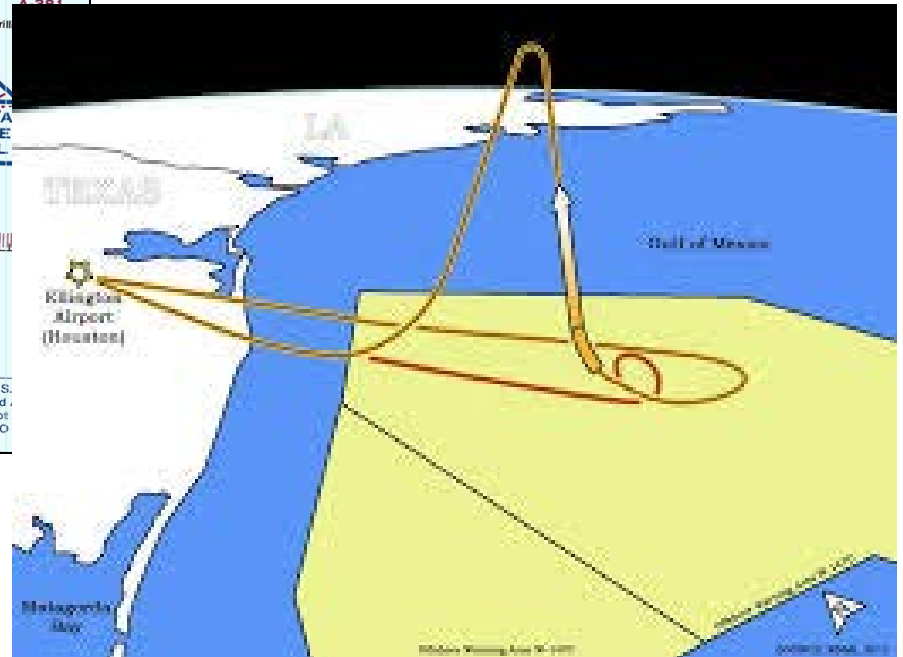
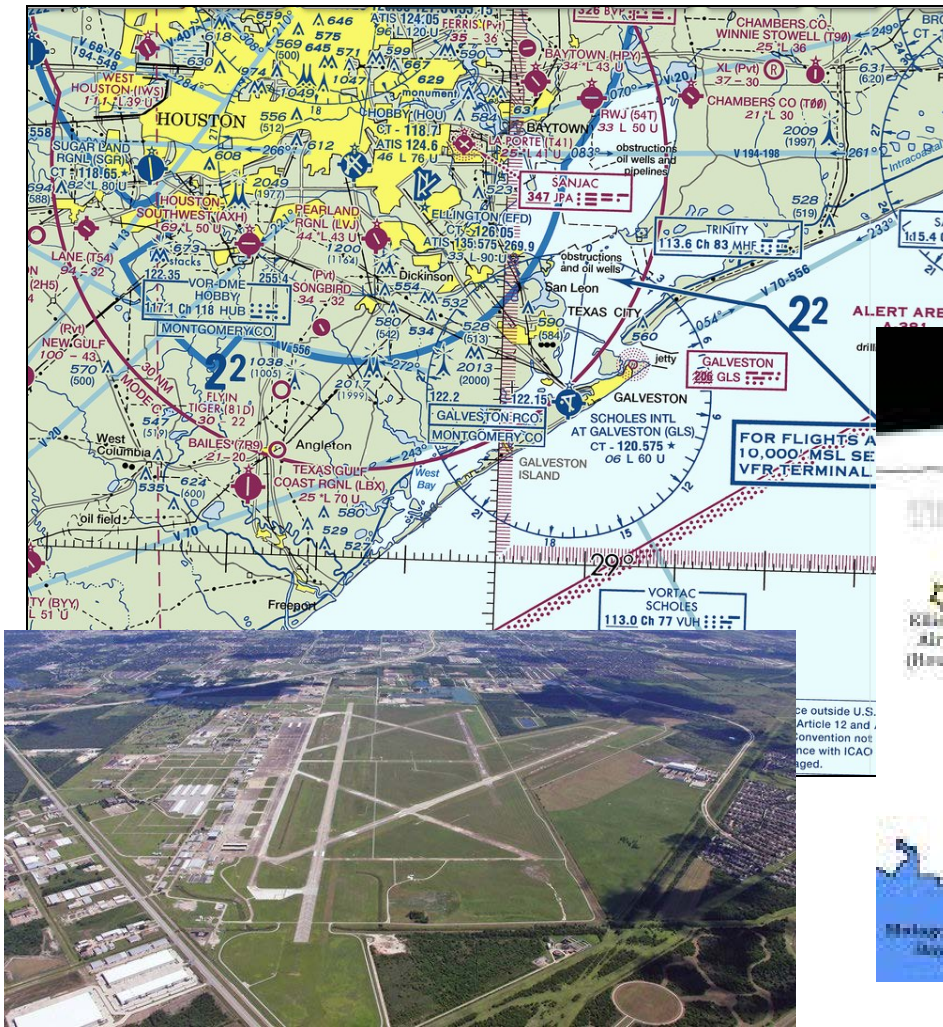
- Research projects within *Safe and Efficient Integration* may include:
 - **Improving integration of launch sites (i.e., spaceports) into the NAS and its system of airports**, including sites in the vicinity of major airports or complex airspace.
 - **Exploring the development of separation standards** for improved airspace management of launch/reentry vehicles during non-explosive phases of flight.
 - **Improving airspace integration planning** for return to land-based sites to decrease the amount of airspace closed to air traffic operations by using higher fidelity input data and models.
 - **Improving real-time monitoring of launch/reentry vehicle operations for airspace integration**, to decrease the amount of airspace closed to regular air traffic operations and expedite response to off-nominal scenarios.
 - **Developing and validating improved noise models for commercial space launch operations at inland launch sites**, including spaceports co-located with airports.
 - **Improving methods for launch and reentry collision avoidance analysis** to produce more efficient launch and reentry planning and NAS integration.



Spaceport Integration

- Spaceports are a critical driver of AST R&D needs
 - Aspects embody a broad spectrum of research questions
- Location and concept of operations of proposed sites have potential implications on:
 - Public safety
 - Air traffic
 - Airports
 - Environment
- Types of operations to be hosted, frequency of operations, timing of operations, etc. all need to be analyzed and addressed

Example: Houston Spaceport



R&D to Assist Spaceport Siting & Integration

Enable applicants to explore trade-space considerations – identifying and quantifying key factors for integrating spaceports in proposed locations

Criteria	Wt.	Click in the perspective box to chose the most appropriate response			
Geographic Location	5.0	In-land			
Proximity of other Airports	3.0	<25 Miles			
What classification is the airport nearby?	3.0	Small Hub			
Are there any vulnerable facilities within __miles?	5.0	>= 21			
What is the latitudinal coordinate for the planned launch point?	N/A	38.941N			
What is the longitudinal coordinate for the planned launch point?	N/A	-76.77			
What is the planned launch orientation?	N/A	Horizontal			
What is the population in the flight corridor?	5.0	2000			
What is the Availability of surrounding airspace?	3.0	Limited Impact to NAS			
Ship traffic	2.0	N/A			
Is there a designated hazardous operations area?	4.0	In Proximity of Runway			
What is the class of Airspace surrounding the location?	4.0	Class G&E			
Will there be an Unmitigated Environmental Impact	3.0	None			
Aircraft operations: avg/day	3.0	121-206		N/A	N/A
Is there a redundant runway available?	5.0	No		N/A	N/A
Are there a Crosswind/Tailwind runways available?	3.0	No		N/A	N/A
Type of Runway Material?	2.0	Concrete		N/A	N/A
Weighted Scores		63.0	0.0	0.0	0.0

Question	Further Explanation
Geographic Location	Chose the best answer for where the launch site is geographically located.
Proximity of other Airports	The proximity to other airports is measurement of the straight line distance from the proposed launch location to the nearest airport
What classification is the airport nearby?	Using the definitions found here , please choose the classification of the nearest airport.
Are there any vulnerable facilities within __miles?	Vulnerable facilities are facilities that provide essential services to the local or national population. Some examples may include: petroleum refineries, nuclear plants, power components, gas pipelines etc.
What is the latitudinal coordinate for the planned launch point?	Please enter the coordinates in decimal form. For horizontal launches, please use the departure end of the runway as the launch point.
What is the longitudinal coordinate for the planned launch point?	Please enter the coordinates in decimal form. For horizontal launches, please use the departure end of the runway as the launch point.
What is the planned launch orientation?	Flight corridors are calculated based on the planned launch orientation to more accurately ascertain population at risk during a launch.
What is the population in the flight corridor?	Using the coordinates that were generated and displayed on the main matrix, please enter the population inside the defined area.
What is the Availability of surrounding airspace?	A qualitative assessment of the impact launch activities have on the National Airspace System around the launch site.
Ship traffic	The amount marine traffic that may be traversing the waters near the launch site.
Is there a designated hazardous operations area?	A designated hazardous operations area is a designated area in which hazardous operations, such as the loading of propellants, can be performed without the interference to other modes of transportation.
What is the class of Airspace surrounding the location?	What is the highest classification of airspace within a 20 mile radius of the launch site as depicted on an aeronautical sectional chart.
Will there be an Unmitigated Environmental Impact	
Aircraft operations: avg/day	What are the average takeoffs and landings (operations) that occur at the proposed launch site that is co-located at an airport.
Is there a redundant runway available?	Does the facility contain alternate runway for non-nominal operations
Are there a Crosswind/Tailwind runways available?	Does the facility offer runways in which takeoffs and landings can be conducted with the aid of the prevailing wind.
Type of Runway Material?	What material is the runway constructed with.
Note on calculation The formula for weighted scores uses a Sumproduct formula and has conditional formatting applied. Please check that the formula and conditional formatting includes the correct cell ranges if you add or remove any rows or columns.	

- Exploratory tool proved viability of concept; further work needed to mature
- Factors include:
 - Inland/coastal
 - Proximity to airports/co-location
 - Proximity to critical infrastructure
 - Horizontal/vertical launch
 - Local airspace
 - Neighboring air & ship traffic
 - Local population density
 - Planned launch services



Example Output – Highlights Areas of Program Risk

Spaceport Categorization Main Matrix

Clear All

Start

Run Model

Date last saved: May-18 2015

Decision Factors		Part 139 Commercial Service Airports	General Service Airports	Exclusive Use Sites	Multiple Launch Operators Site
Criteria	Wt.	Values below represent the collective score from selected answers in the factor categories.			
Launch site suitability	1.0	63	0	0	0
Services Provided	0.9	11	0	0	0
Weighted Scores		47.27	100.00	100.00	100.00

Model Result

Air and Spaceport: Class 2

Criteria

Characteristics

Launch site suitability

General attributes of available infrastructure support and the impact launch operations would have other mode of transportation.

Services Provided

A list of services that could be offered to enhance the location's ability to host launch activities. To receive credit for the providing a service, it must be able to pass the safety approval process.

Note on calculation

The formula for weighted scores uses a Sumproduct formula and has conditional formatting applied. Please check that the formula and conditional formatting includes the correct cell ranges if you add or remove any rows or columns.

Result Details

License Name

Air and Spaceport: Class 2

Public Safety Risk

Typical characteristics may include; Located in a more populated area. The trajectory may traverses populated areas and require limitations.

Complexity of operations

Location is co-located at a federally obligated airport. Facility capable of launching less risky vehicles. Operations from this location have some impact on other modes of transportation.

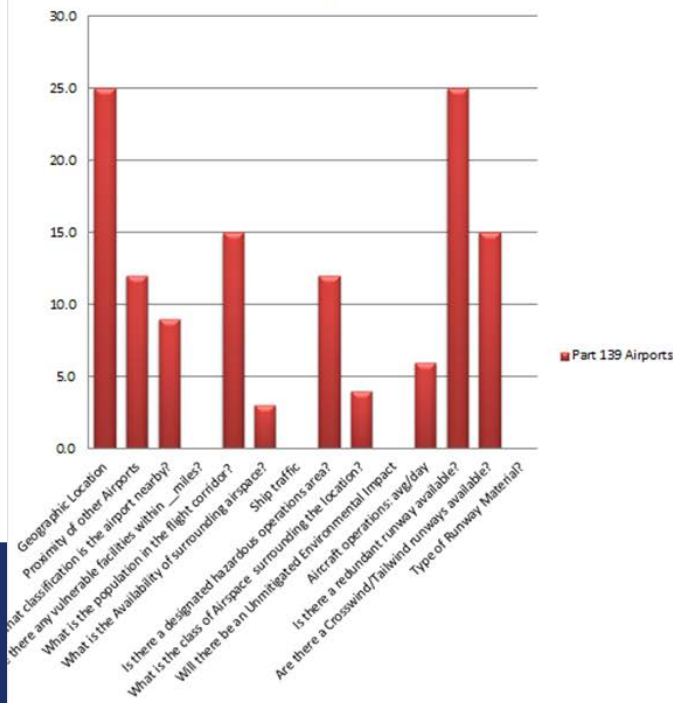
Services Provided

Safety services shall be provided nominal launch operations. Additional services may be need to qualify for this category. Some examples may include: FOD removal, runway inspection, fuel handling and storage, ect

Current Location Examples

Midland

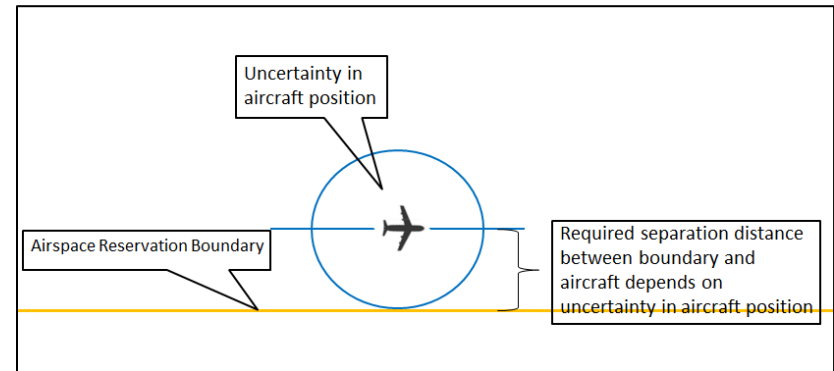
Risk Drivers



Leveraging Research: Separation Standards

- Research to define separation standards specific to launch/reentry operations:

- Separation of aircraft from airspace (aircraft hazard areas)

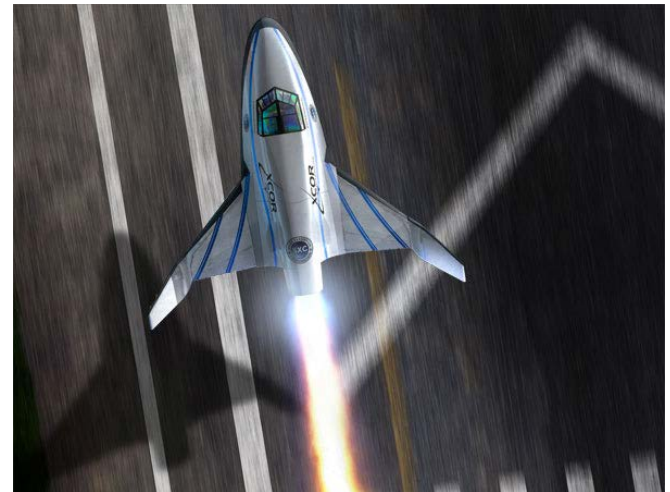


- Separation of aircraft from launch/reentry vehicles
 - non-explosive flight phases like captive carry and gliding return



Leveraging Research: Noise

- Modelling & understanding of space vehicle noise, sonic boom, and other effects on environmentally sensitive areas and communities needs further work
 - Gather noise measurements, validate and modify models for rocket noise and sonic boom



Discussion

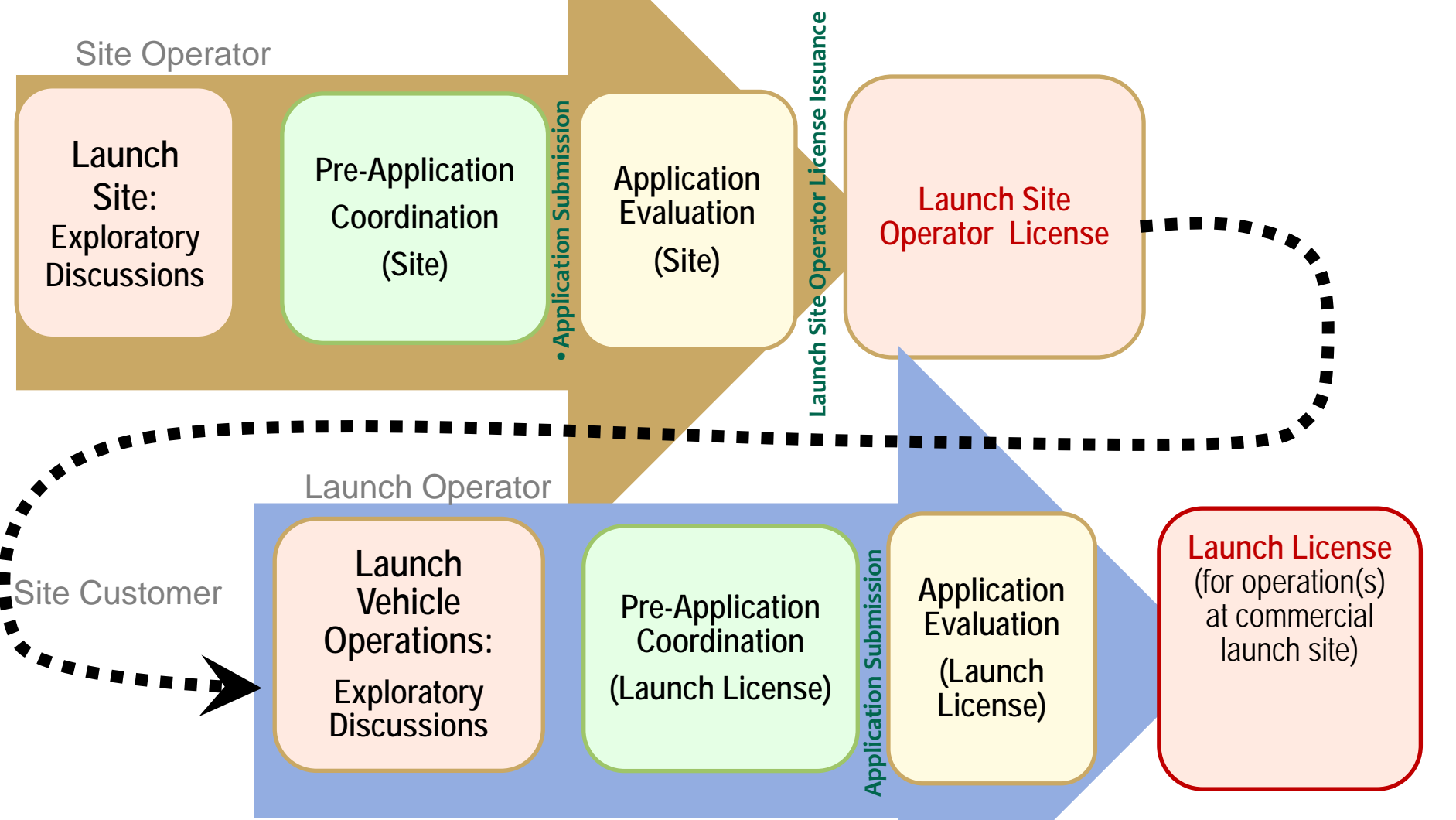


PPT Portfolio Overview

- **The Commercial Space Transportation RE&D portfolio will enable advances in critical areas such as:**
 - Safe and efficient integration of increased commercial space launch and reentry activity in to the national airspace
 - Advanced safety assessment methods
 - Advanced vehicle safety technologies and methodologies, and
 - Human space flight safety and physiology factors
- **Funding enables maturation of concepts for follow-on use in methods, systems, operations and the regulatory framework**
- **Funding also sustains cooperative, innovative R&D within the FAA's Commercial Space COE**



Licensing Process Overview for Commercial Launch Site



Licensing & Permitting – *Generic Process Flow*

