S2S WHITE PAPER

Spaceport to Spaceport
Suborbital Flight
Airspace Guiding Principles

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Table of Contents

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Lists of Figures

Foreword

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In the last few years, the commercial spaceflight industry has come of age. Suborbital and orbital launch vehicles frequently and safely launch humans and payloads to earth's sub orbits and orbits. Many vehicles also return to earth also carrying humans and payloads. Some launch vehicles are also aimed towards other planets aiming to place research equipment and send humans to set foot on other worlds. These are exciting times for humanity, not seen since the heady days of the Apollo program.

This White Paper focuses on the airspace needed for a special breed of spacecraft which are designed to fly suborbital trajectories with the intent of linking distant Spaceports on earth. These Suborbital spacecrafts will be using atmospheric and space volumes and trajectories that are new to the existing air and space transportation regulatory and standards stakeholders.

This paper addresses such trajectories and defines them as Spaceport to Spaceport (S2S) flight profiles or simply termed, "corridors". As of today, S2S corridors lack clear definition, characterization and protocols to enable them for practical spaceflight operations that are scalable and ideally, profitable for their operators.

This White Paper intends to provide the spaceflight industry with the basic guiding principles necessary for the design, implementation and use of airspace corridors suitable for suborbital spaceflight operations connecting spaceports and related ranges licensed to perform launch and reentry spaceflight operations.

This White paper is informed by members of the Global Spaceport Alliance (GSA) and the High-Speed flight (HSF) Point to Point (P2P) Working Group. The insights and knowledge of this selected group of aviation, aerospace and space industry stakeholders, Subject Matter Experts, operators and academicians who believe in the possible near-term feasibility of suborbital spaceflight operations connecting spaceports across the United States and in time, the world.

This White Paper provides the initial guiding principles necessary to enable safe, reliable and scalable suborbital spaceflight operations that are intended to connect airspace volumes or "corridors" linking licensed Spaceports to Spaceports (S2S) across the United States, and in the future, Globally.

About the Authors

InterFlight Global Corporation

InterFlight Global (IFG) is a world leading Commercial Air and Space Transportation Industries advisory, consulting, brokerage and finance firm. Based in the United States, it was founded in 1992. IFG provides tailored consulting and advisory work product exactly designed to fit small, medium and large clients on time and on budget. IFG is also a proven partner and affiliate to some of the world's largest consultancy and advisory firms, seamlessly sharing methodologies and best practices. IFG principals are well known thought leaders, industry captains and regular contributors to influential media, think-tanks, government and academic institutions worldwide. IFG clients include private and public investors, corporate shareholders, senior executives, government and non-government institutions, civic foundations in the Americas and worldwide through a selected network of regional affiliated consultancies in Europe.

Hight Speed flight and FastForward Project

The High-Speed Flight (HSF) and the Fastforward Project (FF) are an industry leader in information, resources, networks and any and all assets that facilitate, promote and lead the High-Speed Flight aerospace transportation industry. HSF-FF develop and harness extensive expertise and resources to facilitate the emergence and growth of the High-Speed Flight industry with an intense focus on safety, efficiency, sustainability, scalability and global inter-operability.HSF-FF provide their viewers, participants, collaborators, sponsors and donors with information and intelligence required to design, develop, fund, build and successfully grow HSF related enterprises, businesses and related entities. Since their formation in 2008, HSF-FF leaders have interacted with its stakeholders through its yearly High Speed Aerospace Transportation (HSAT) Workshops, quarterly conference calls and collaboration with industry groups such as IFG, FAA COE CST, GSA, CSF, F4F, AIAA, ASTM, and others

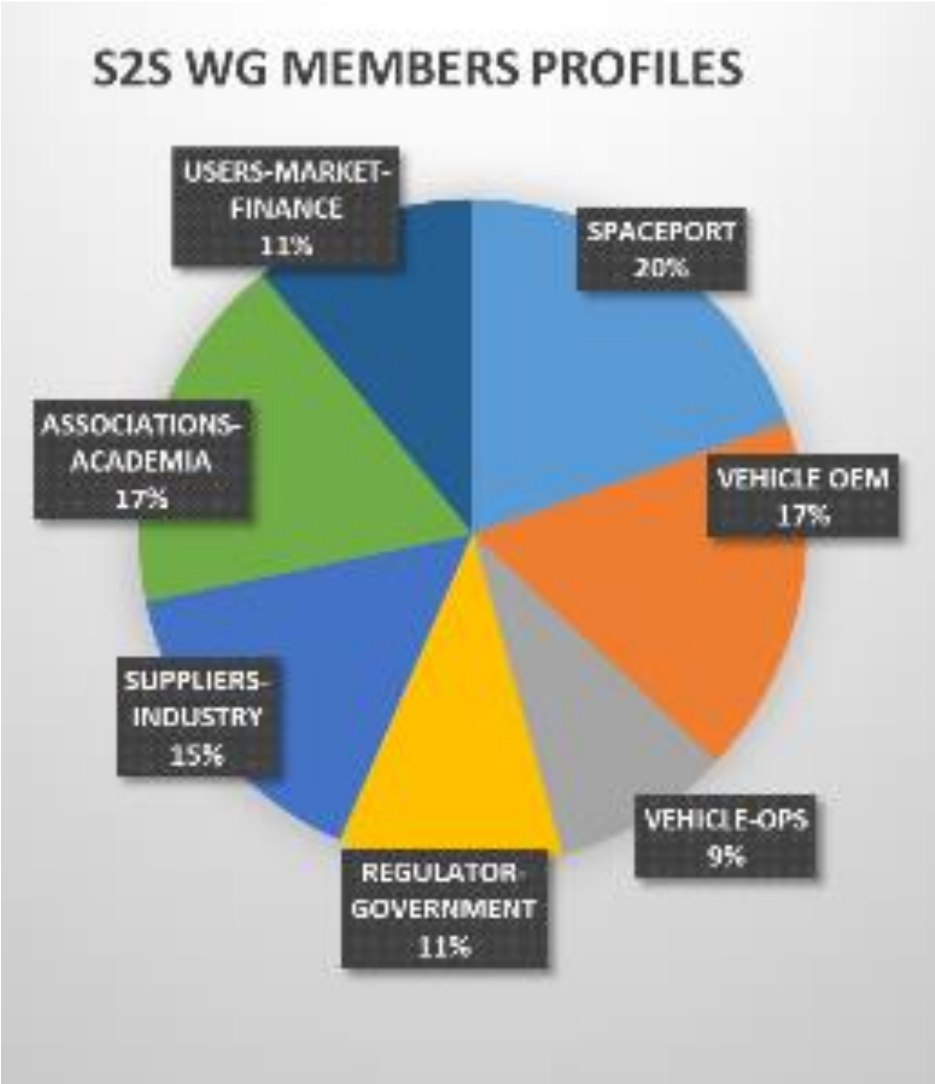
Global Spaceport Alliance

The Global Spaceport Alliance (GSA) is the voice of the emerging global spaceport community. As the recognized and official organization for spaceports and the spaceport eco-systems worldwide, we provide members with the information, data, research and networking needed for the successful planning, funding, and operation of spaceports around the world.

To accomplish this vision, we will provide members with the information, data, research and networking needed for the successful planning, funding, and operation of spaceports around the world.

Point to Point Working Group (WG)

This group includes almost forty aerospace, aviation and space industry stakeholders. The WG ability to conduct high-speed, long-distance transportation, specifically point-to-point transportation through space, will be a major game-changer for the global space economy. The working group is fully focused on enabling the ability to fly from one side of the Earth to the other in less than 90 minutes safely, reliably, sustainably and economically. Thus, to radically change not only how we travel, but how we communicate and how we do business. This working group will address the issues relating to spaceport readiness for this exciting eventuality. Point to Point and Spaceport to Spaceport (S2S) are synonyms for the purposes of this White Paper.



Abstract

This white paper is a foundational document to inform and guide the commercial suborbital spaceflight industry about the characteristics of the airspace required to accommodate commercial space vehicles' flight and ground operations conducted between spaceports[1]

The missions characterized by this document are Spaceport to Spaceport ("S2S") spaceflights. The airspace volumes and trajectories required to perform these missions are referred to as "S2S corridors" "S2S airspace ways" or simply "corridors".

An S2S spaceflight profile consists of three distinct phases; launch, cruise[2], and reentry.

The proposed guiding principles intend to bring clarity and standardize the definitions, designs and characteristics of the airspace required by space vehicles to perform S2S missions safely, reliably and in compliance with best industry practices and Federal Aviation Administration (FAA) regulations.

> The proposed guiding principles intend to bring clarity and standardize the definitions, designs and characteristics of the airspace required by suborbital space vehicles to perform S2S missions safely, reliably and in compliance with best industry practices and Federal Aviation Administration (FAA) regulations.

The paper includes analysis of the technical, legal, operational, commercial, and regulatory feasibility of the corridors for S2S flight and ground operations applicable to a variety of vehicles. The paper also explores the best practices and methodologies for the design, implementation, and efficient integration of the S2S corridors with the existing airspace used by other aviation and space flight stakeholders.

This White Paper places a special emphasis on providing fundamental definitions and characterizations of the S2S cruise flight phase. The cruise phase occurs between launch and reentry and is currently unaddressed by regulations and thus, poses a fundamental problem for the development of the S2S spaceflight industry.

The paper is intended to be useful to airspace designers as initial airspace design guidance. It is ultimately intended to act as a framework for future flight and ground operations best practices, guidance and standards to be used by the stakeholders involved in the commercial S2S transportation space industry.

Keywords: Airport, Spaceport, Take-Off, Launch, Cruise, Coast, Orbit, Re-Entry, Landing, Airspace, Air way, Space way, Atmosphere, Vacuum, Suborbital, Orbital, Certification, Licensing, Permit, Supersonic, Hypersonic, FAR 450.

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[1] The document is focused on airspace connecting spaceports located in the United States. Future revisions will include airspace connecting spaceports internationally.

[2] Cruise, coast or orbit are synonyms in this document

1. Introduction

We predict and expect that this decade will bring to bear an inflection point in the world of suborbital spaceflight immediately after the first safe Spaceport to Spaceport, or "S2S" flight demonstration takes place. Afterwards, the efficiency, reliability, profitability and sustainability of the S2S flight operations will increase very quickly.

The guiding principles proposed by this White Paper such as corridors dimensions and operations focus on suborbital S2S flight operations in the US NAS and are meant to blend seamlessly with the existing set of CFR 14 FAR 450 launch and reentry regulations and suborbital flight and ground operations industry consensus standards development.

We can confidently expect that a multibillion-dollar industry transporting ten of millions of passengers and millions of metric-tons across the world. This will be a generational change in the way people fly and the world of commerce connects. Truly, we hope, the S2S industry will make the world smaller in size and larger in harmony and well-being for all.

Moreover, with the advent of this HSAT modality, Spaceports will be able to network and connect in an unprecedented manner that empowers and multiply their economic, financial and social value to their users, operators and stakeholders. The addressable market is estimated to reach $.8trillion[3] by 2040 with a resulting multiple of that figure in terms of direct, indirect and induced economic impact to the world economy.

There is a present need for industry to develop an initial set of guiding principles as precursors to future voluntary consensus standards, recommended and best practices that will inform and help future regulations to enable the required airspace for suborbital vehicles launching from a Spaceport with the specific intent to reenter the atmosphere and touchdown at a different spaceport.

These guiding principles will be useful for spaceflight stakeholders, particularly vehicle designers and operators in their initial Research &Development, Test & Evaluation and subsequent licensing and permitting by the FAA.

The guiding principles' usefulness will be augmented when the suborbital S2S flight operations maturity and frequency increases.

[3] UBS Report-Who Will Win The Billionaire's Space Race -EnterLink-/ Morgan Stanley Report-Virgin Galactic High Speed Markets

2. Background

For the purposes of this White Paper, S2S flight operations phases are Spaceport departure, launch, suborbital transit or cruise, reentry and arrival. The focus is on the suborbital transit or cruise stage of an S2S Mission. Due to the lack of actual suborbital spaceflight missions that intend S2S flight, there are no relevant or existing regulations, standards, best practices that address this mission profile. Since the Spring of 2020, the GSA-HSF-FF Working Group has met virtually and in person and focused on gathering and organizing insights and knowledge using past suborbital flight data, experience and knowledge as a foundational baseline for the airspace design guiding principles in this White Paper.

Suborbital spaceflight flight operations dates back to the Department of Defense (DOD) flights in the 50's and 60's. All flights were intended to depart and land at the same location, even though some landed on dry lakes or similar runways near the points of departure and launch. (enter history of suborbital military spaceflight 1/2 page, list those flights that departed and arrived at different location, provide some photos)

Commercial Suborbital Spaceflight operations in recent times, originate and end at the same location, or in the case of Blue Origin's New Sheppard, close to the launch site. (enter recent history of suborbital commercial spaceflight) (enter history of suborbital military spaceflight 1/2 page, list those flights that departed and arrived at different location, provide some photos).

3. Objectives

The group's cardinal rule guiding this White Paper is first and foremost the safety if human spaceflight. The Global Spaceport Alliance and the HSAT-FastForward Groups believe that commercial spaceflight will evolve from single point of departure-destination tourism flights into a modality of aerospace transportation connecting Spaceports. The initial demonstrations will proliferate and scale up as flight operations proceed with ever improving safety as its guiding principle. In turn, a robust tempo of innovation and technology advancement will enable extraordinary experimentation and testing, achieving technology and maturity readiness levels that the involved and uninvolved public will enjoy for decades to come.

This White Paper intends to solve this suboptimal context by providing guidance inputs to improve the existing regulatory, compliance, oversight, standards, protocols and safety frameworks for suborbital launch and re-entry spaceflight activities.

- The WG has found circa 196 possible S2S airspace corridors with up to 2,000NM separation between spaceports and their launch and reentry sites which are suitable for R&D and T&E suborbital missions
- The WG has identified circa 72 possible S2S commercial transportation corridors with more than 2,000NM separation between spaceports and their launch and reentry points, which are suitable for commercial S2S flights carrying cargo and people onboard

The recommended guiding principles in this paper focus on the safe, reliable, efficient and equitable integration of suborbital spaceflight with the existing aviation ecosystems of users and stakeholders. This paper is meant to be a live document incorporating the most current developments in aviation and space flight activities.

The main objective of this paper is to inform airspace designers, industry operators, regulators and standards developers about initial Guiding Principles to define and characterize the airspace volumes needed to accommodate all S2S flight operations and phases (departure, launch, orbital transit, reentry and arrival).

Timelines and milestones to design and enable S2S airspace volumes for suborbital and orbital S2S spaceflight demonstrations first, frequent flight operations second and lastly routine flights.

- Timelines for S2S Development, Entry Into Service and Growth
  - Short term-Demos, Proof of Concept, R&D 2022-2025
  - Mid-term- Demos and frequent flights 2025-2035
  - Long term-routine commercial operation 2035-Onwards

4. Analysis

This White Paper's guiding principles are meant to be insightful precursors to definitions and characterizations for the airspace volumes needed for future suborbital S2S corridors.

Initially, the reference framework for integration of S2S mission is the United States' National Airspace (NAS). Thus, the primary reference regulatory rules set are CFR 14 FAR 450[4] Streamlined Launch and Reentry Regulations and CFR 14 FAR 420 License to Operate a Launch Site[5].

For the purposes of this White Paper, S2S flight operations phases are Spaceport departure, launch, suborbital transit or cruise, reentry and arrival. The focus is on the suborbital transit or cruise stage of an S2S Mission.

This White Paper references include:

- Existing regulations, standards and best practices including the current CFR 14 FAR 450 launch and reentry regulations applicable to the licensing and permitting of suborbital spacecraft intended to depart, launch, reenter and fly back to the same spaceport.
- S2S Working Group inputs for the period 2019-2022
- Methodologies and best practices for airspace volumes and corridors including; analysis of performance data, air traffic monitoring and measurement, aerospace operational systems and advanced technologies research and development, environmental design, air traffic flows simulations, airport-spaceport-airspace integrated design and systemwide safety analysis and reviews

The Following is a list of foundational observations and findings that drive the resulting recommended guiding principles. The list is broken down by Spaceports, Airspace and Vehicles

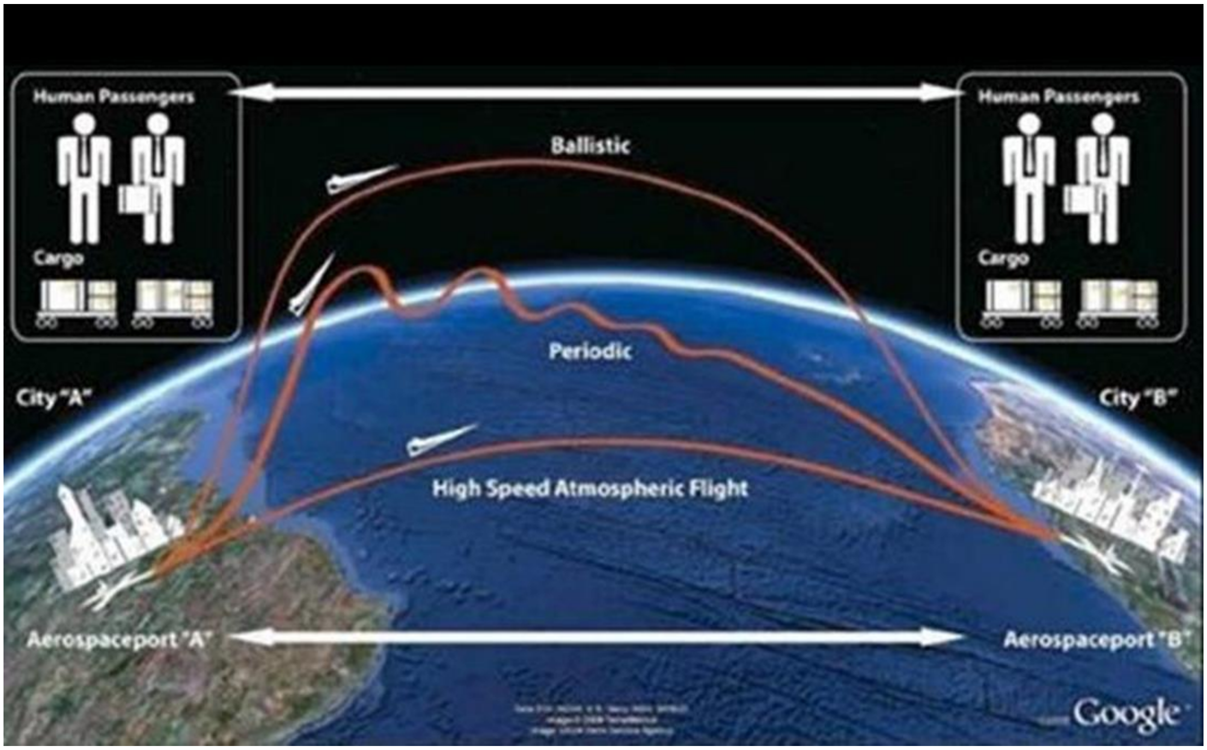
[4] CFR 14 FAR 450 Streamlined Launch and Reentry regulations link https://www.ecfr.gov/current/title-14/chapter-III/subchapter-C/part-450

[5] CFR 14 FAR 420 License to Operate a Launch Site https://www.ecfr.gov/current/title-14/chapter-III/subchapter-C/part-420

High Speed Aerospace Transportation (HSAT) using suborbital spacecraft between Spaceports will be a major game-changer both for economic, technologic competitiveness as well as for national security and defense.

Such operations are characterized as Spaceport to Spaceport (S2S) spaceflight operations.

To scale up S2S operations across the globe, the suborbital spaceflight industry will require airspace around and between spaceports that is accurately designed and enabled to permit safe, efficient and frequent (routine) flight operations of a variety of suborbital vehicles flying to and from Spaceports,



4.1 Spaceports

For the purposes of Suborbital S2S flight, a Spaceport is defined[6] as an area authorized by an appropriate authority to support launch and, or reentry activities. Launch and reentry activities sites are defined as the location on Earth from which a launch or a reentry takes place. This White Paper focuses on FAA licensed Spaceports in the USA according to CFR 14 FAR 420[7].

Thus, the Spaceports' lands footprints and their associated building and equipment installed facilities are considering the departure and arrival points for S2S suborbital flight missions considered on this white paper.

For our purposes, there are thirteen (13) licensed spaceports in the USA and eleven (11) proposed spaceports, from which S2S Suborbital flight missions could launch and reenter. Collaboration and Competition "Coopetition" amongst Spaceports is essential for the development of S2S airspace corridors initially for R&D, T&E efforts and in time to provide capabilities for the safe, reliable and frequent S2S transportation of people and goods.

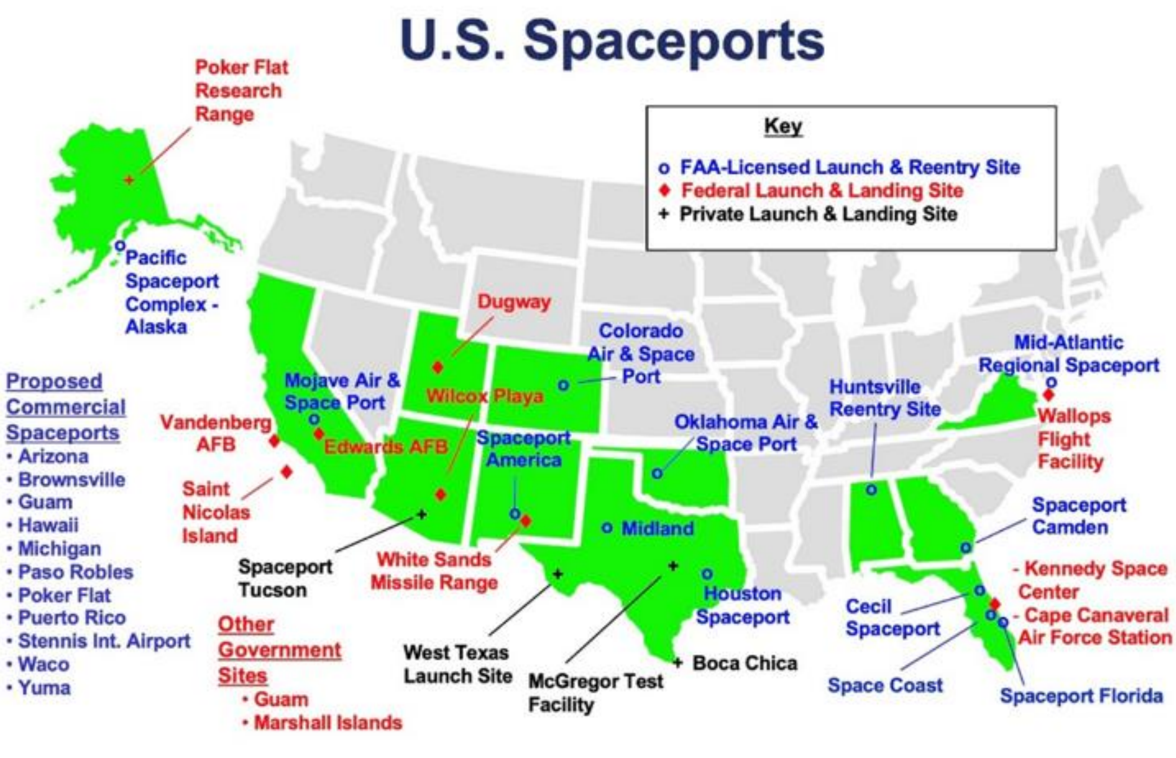


Figure 1 US Licensed Spaceport- Active and Proposed (source FAA AST)

[6] ASTM F47 Commercial Spaceflight Committee F3377-20 Standard Terminology Relating to Commercial Spaceflight
[7] https://www.ecfr.gov/current/title-14/chapter-III/subchapter-C/part-420

This section identifies several areas that need attention, review, development or additions to enable the set of airspace corridors needed to support suborbital S2S operations.

The following figures exhibit first the flight profiles of active suborbital commercial vehicles such as the Virgin Galactic Spaceship 2 and Blue Origin New Sheppard, and second, the possible S2S airspace corridors networks that will emerge connecting the launch and reentry points of suborbital vehicles.

Existing CFR 14 FAR 420 launch site licensing and regulations are mainly focused on launch and reentry activities for suborbital flights intending to reenter and land at the place of launch, or nearby.

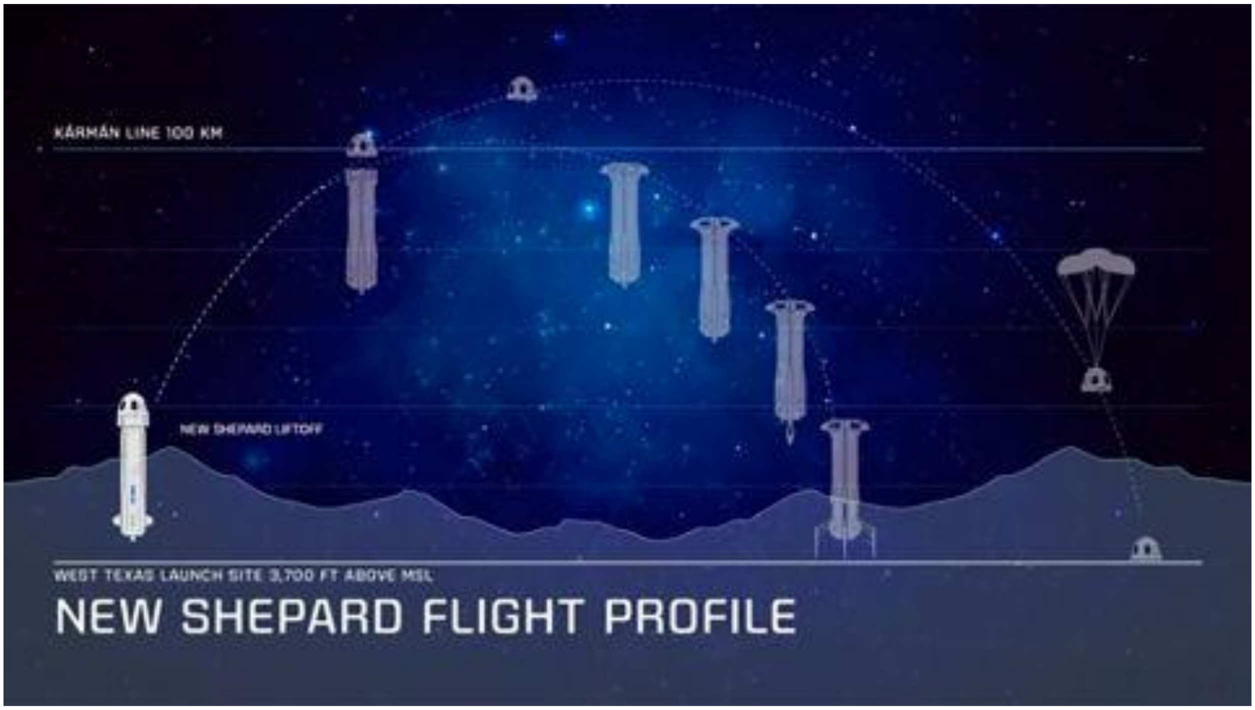


Figure 2 Blue Origin-Launch Site One-Van Horn, West Texas (Source: Blue Origin)

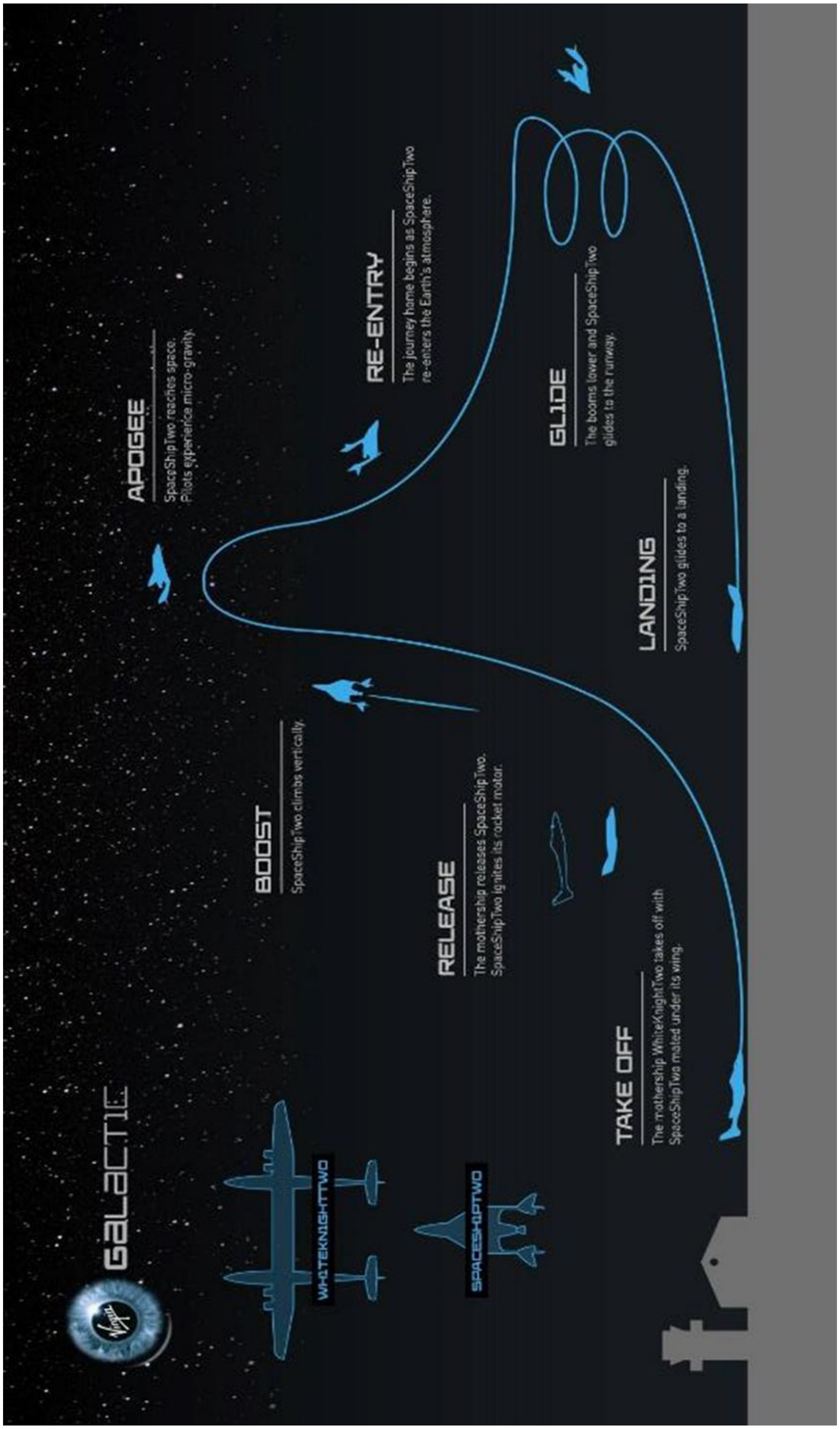


Figure 3 Virigin Galactic- Spaceport America, Las Cruces, New Mexico Source: Virgin Galactic

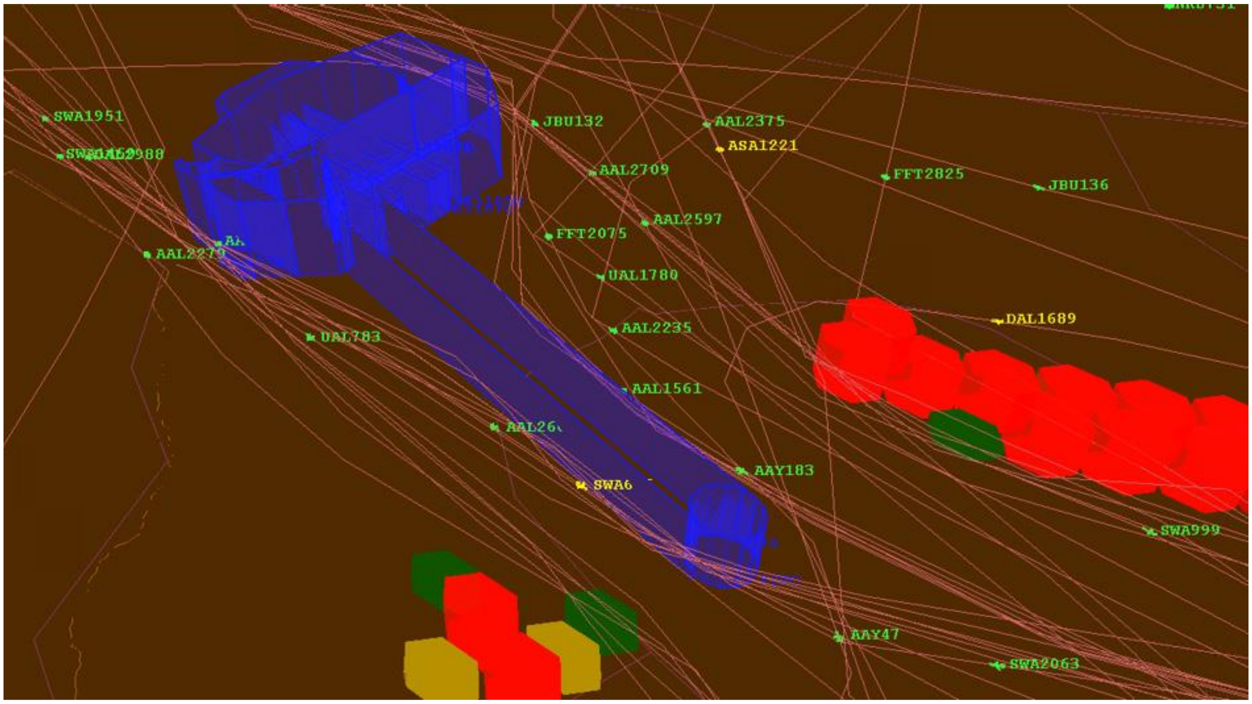


Figure 4 Notional Suborbital Spaceport to Spaceport (S2S) Corridor – Midland to/from Spaceport America- Source: Midland Development Corporation

The airspace distances required for S2S Suborbital commercial operations were studied by the authors and the GSA-FF P2P Working Group. The group and relevant aviation, aerospace and space industry participants completed a thorough airspace definition survey[8]. The initial conclusions are as follows:

S2S Corridors Purposes and Lengths

- S2S Corridors with up to 2,000NM separation between spaceports-launch and reentry sites are suitable for R&D and T&E suborbital missions
  - The WG has found circa 196 possible S2S R&D Corridors
- S2S Corridors with more than 2,000NM separation between spaceports-launch and reentry points are suitable for commercial flights carrying cargo and people onboard
  - The WG has identified circa 72 possible S2S commercial -transportation corridors
- S2S Corridors Dimensions Corridors Dimensions, as per industry surveys -GSA-HSF-FF S2S Input as of 12/2022

S2S CORRIDOR PURPOSE	LENGTH	WIDTH	HEIGHT
R&D, T&E	0NM-ANTIPODAL MAXIMUM ~12,500 NM	40-130 NM	GROUND-UNLIMITED
COMMERCIAL OPS	2,000NM- ANTIPODAL MAXIMUM 12,500 NM	20-130 NM	FL 600-UNLIMITED

[8] HSF-FF-GSA Working Group Airspace Corridors Survey https://surveys.benchmarkemail.com/Survey/Start?id=1395206&s=696900

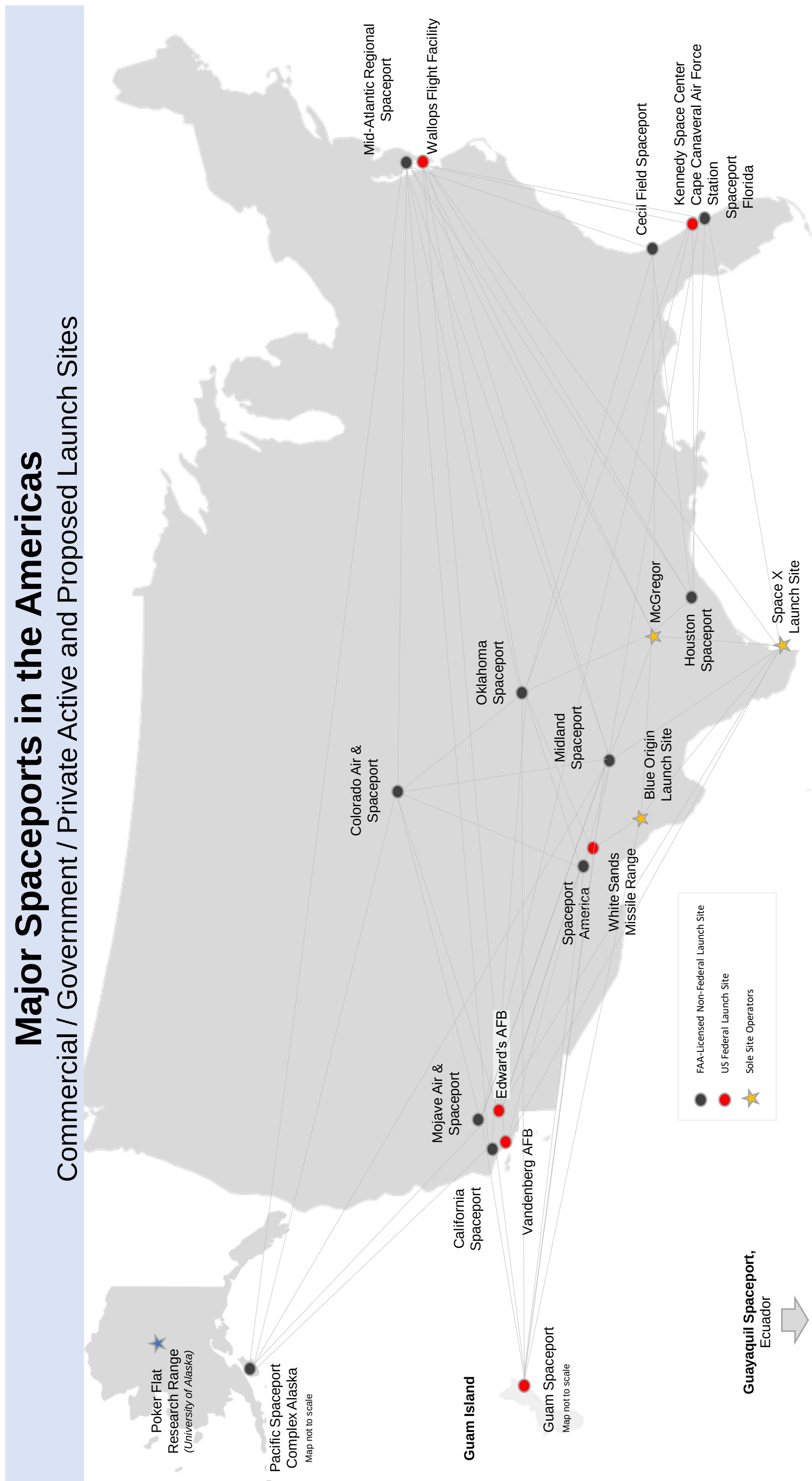


Figure 5 US Suborbital Spaceport to Spaceport (S2S) Potential Airspace Corridors Network

	Airport code	Airport Name	KVQQ Cecil Field	KTTS Kenned Space Center	KTIX Spaceport Florida	KVBG California Spaceport	PADQ eport Co	SEGU raquil Spac	UAM dersen Ai
1	KMHV	Mojave Air and Spaceport	1,850	1,941	1938	122	1,934	3,095	5,276
2	9NM9	Spaceport America	1,293	1,379	1376	688	2,362	2,603	5,844
3	MAF	Midland Air and Spaceport	1051	1133	1129	938	2558	2,403	6,092
4	KCFO	Colorado Air and Spaceport	1,250	1,356	1355	824	2,126	2,852	5,796
5	KCSM	Oklahoma spaceport	927	1,025	1022	1,052	2,494	2,491	6,140
6	KEFD	Houston Spaceport	693	762	757	1,327	2,890	2,091	6480
7	KWAL	Mid Atlantic Regional	562	617	625	2,174	3,135	2,410	6978
8	KVQQ	Cecil field	0	114	117	1,971	3,287	1,938	7044
9	KTTS	Kenned Space Center	114	0	8	2,061	3,400	1,839	7152
10	KTIX	Spaceport Florida	117	8	0	2,058	3,402	1,833	7151
11	KVBG	California Spaceport	1971	2061	2058	0	1,883	3,181	5,165
12	KADQ	Pacific Spaceport Complex Alaska	3287	3400	3402	1,883	0	4,960	3,847
13	SEGU	Guayaquil Spaceport	1,938	1,839	1,833	3,181	4,960	0	8,069
14	UAM	Andersen Airforce Base Guam	7044	7152	7151	5,165	3,847	8,069	0

	Airport code	Airport Name	KMHV Mojave Air and Spaceport	9NM9 Spaceport america	MAF dland Air and Spacep	KCFO rado Air and Spacep	KCSM Oklahoma spaceport	KEFD Houston Spaceport	KWAL Mid Atlantic Regional
1	KMHV	Mojave Air and Spaceport	0	571	821	709	931	1210	2,054
2	9NM9	Spaceport America	571	0	250	424	411	640	1,564
3	MAF	Midland Air and Spaceport	821	250	0	483	253	390	1362
4	KCFO	Colorado Air and Spaceport	709	424	483	0	368	765	1,361
5	KCSM	Oklahoma spaceport	931	411	253	368	0	400	1,153
6	KEFD	Houston Spaceport	1,210	640	390	765	400	0	1,101
7	KWAL	Mid Atlantic Regional	2,054	1,564	1,362	1,361	1,153	1,101	0
8	KVQQ	Cecil field	1,850	1,293	1,051	1,250	927	693	562
9	KTTS	Kenned Space Center	1,941	1,379	1,133	1,356	1,025	762	617
10	KTIX	Spaceport Florida	1,938	1,376	1,129	1,355	1,022	757	625
11	KVBG	California Spaceport	122	688	938	824	1,052	1327	2174
12	KADQ	Pacific Spaceport Complex Alaska	1,934	2,362	2,558	2,126	2,494	2890	3135
13	SEGU	Guayaquil Spaceport	3,095	2,603	2,403	2,852	2,491	2,091	2,410
14	UAM	Andersen Airforce Base Guam	5,276	5,844	6,092	5,796	6,140	6480	6978

Figure 6 US S2S Distance Charts All Spaceports-Launch and Reentry Sites (S2S > 2,000NM in Green Shade)

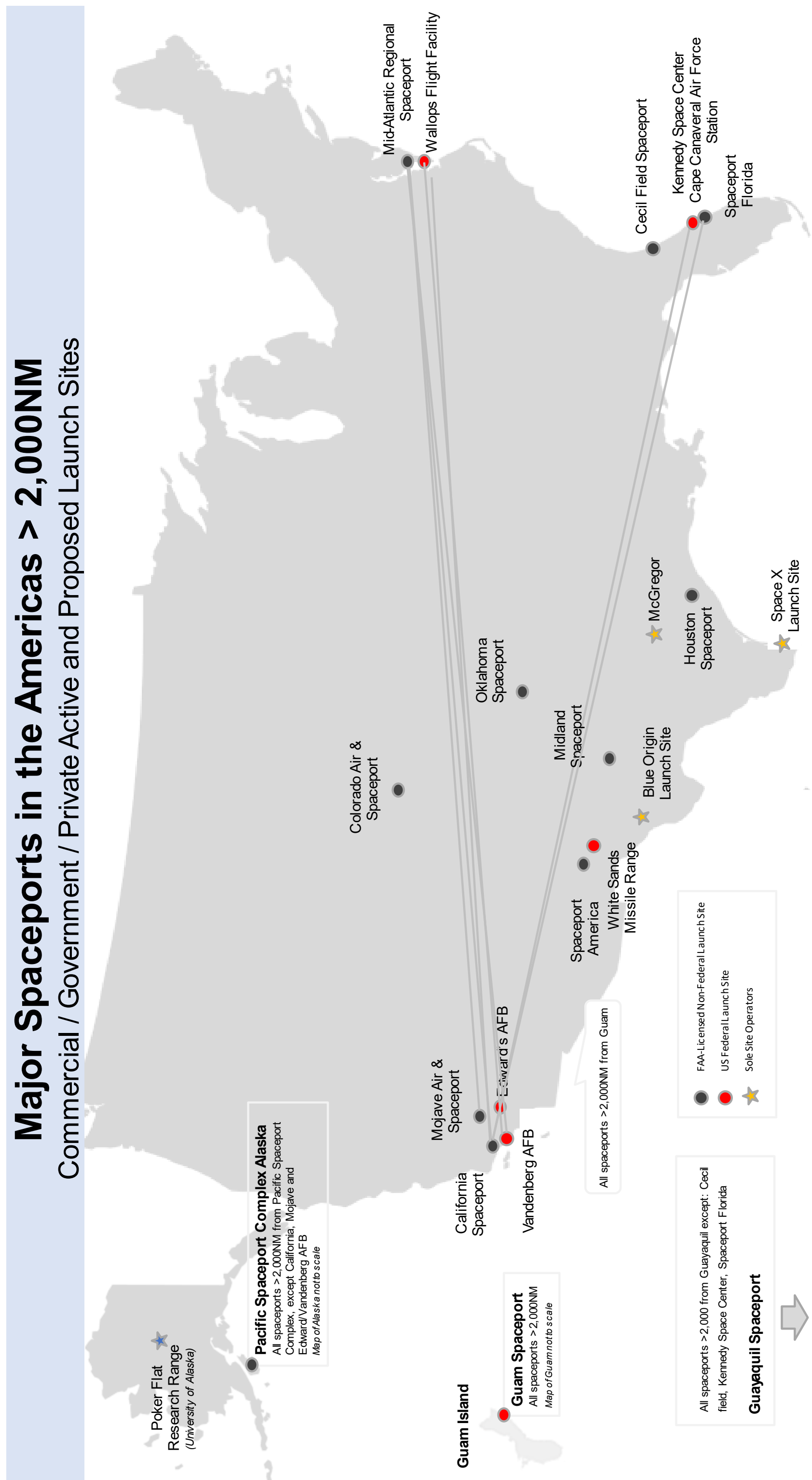


Figure 7 US Suborbital Spaceport to Spaceport (S2S) Potential Airspace Corridors Network >2,000NM

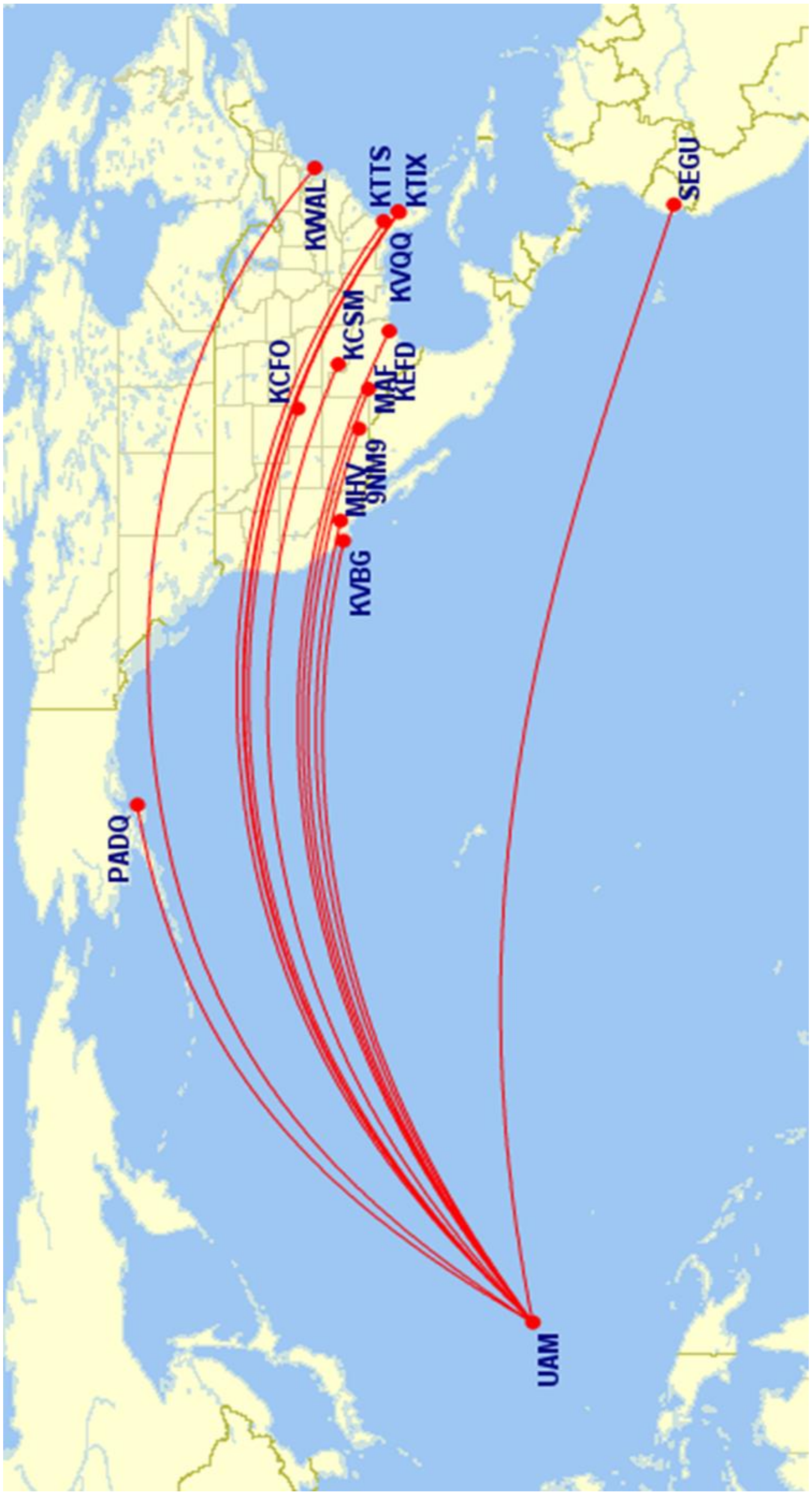


Figure 8 US Suborbital Spaceport to Spaceport (S2S) Potential Airspace Corridors Network >2,000NM Guam Detail

Spaceport Regulatory S2S Considerations

This section focuses in FAR 420-regulations through a lens intended to highlight findings and recommendations to support S2S suborbital commercial spaceflight.

The existing regulations in CFR 14 FAR 420 License to operate a launch site address possible S2S missions to a limited extent. Thus, the following are possible areas of interest for launch site operator to anticipate and prepare their spaceports to accommodate future S2S suborbital flight operations.

- **Definitions:** FAR 420.5 needs to include definitions of airspace volumes or "corridors" required to perform S2S missions connecting launch and reentry sites for suborbital space vehicles.
    - Definitions of interest:
        - "Downrange area" means a portion of a flight corridor beginning where a launch area ends and ending 5,000 nautical miles from the launch point, or where the IIP leaves the surface of the Earth, whichever is shorter, for an orbital launch vehicle; and ending with an impact dispersion area for a guided sub-orbital launch vehicle.
        - "Flight corridor" means an area on the Earth's surface estimated to contain the hazardous debris from nominal flight of a launch vehicle, and non-nominal flight of a launch vehicle assuming a perfectly functioning flight termination system or other flight safety system.
        - "Launch Area" means, for a flight corridor defined in accordance with appendix A of this part, the portion of a flight corridor from the launch point to a point 100 nautical miles in the direction of the flight azimuth. For a flight corridor defined in accordance with appendix B of this part, a launch area is the portion of a flight corridor from the launch point to the enveloping line enclosing the outer boundary of the last debris dispersion circle.
        - "Overflight Exclusion Zone" means a portion of a flight corridor which must remain clear of the public during the flight of a launch vehicle
- FAR 420.31 Agreements, it is intended for launch and reenter with no intent for an S2S mission profile. The regulation needs to also refer to the ATC offices at the reentry site or destination in S2S flight profiles.
    - Except as provided by paragraph © of this section, an applicant shall complete an agreement with the FAA Air Traffic Control (ATC) office having jurisdiction over the airspace through which launches will take place, to establish procedures for the issuance of a Notice to Airmen prior to a launch and for closing of air routes during the launch window and other such measures as the FAA ATC office deems necessary to protect public health and safety.
- Appendix A to Part 420-Method for Defining a Flight Corridor
    - The definition of a flight corridor in this section is not optimal for an S2S suborbital mission. It is intended for a suborbital vehicle that returns to the launch site, or that releases an intermediate or final stage.

  - A flight corridor includes an overflight exclusion zone in a launch area and, for a guided suborbital launch vehicle, an impact dispersion area in a downrange area. A flight corridor for a guided suborbital launch vehicle ends with the impact dispersion area, and, for the four classes of guided orbital launch vehicles, 5000 nautical miles (nm) from the launch point.
    - Impact dispersion area means an area representing an estimated three standard deviation dispersion about a nominal impact point of an intermediate or final stage of a suborbital launch vehicle.
- The airspace corridor volume to accommodate a planned "cruise" or orbital phase of an S2S Suborbital flight corridor might need to consider the reentry point at the destination spaceport, rather than the more vague "downrange term" in the present definition.

The figures below depict current suborbital flight corridor geometry as per FAR 420 Appendix A, and a possible- preliminary S2S suitable corridor. There is an evident gap as the current regulations address the downrange boundary, and not the reentry at the destination spaceport.

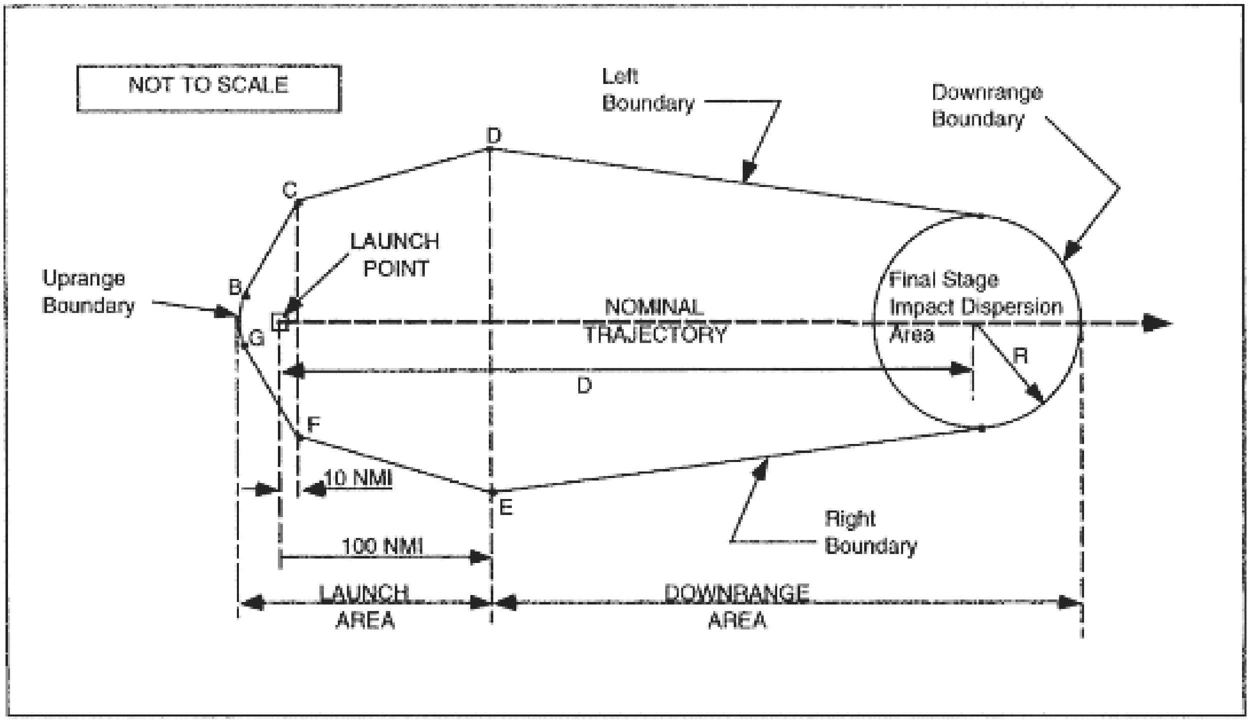


Figure 9 Flight Corridor[9] For Guided Sub-Orbital Launch Vehicles Source: FAA FAR420

[9] https://www.ecfr.gov/current/title-14/chapter-III/subchapter-C/part-420

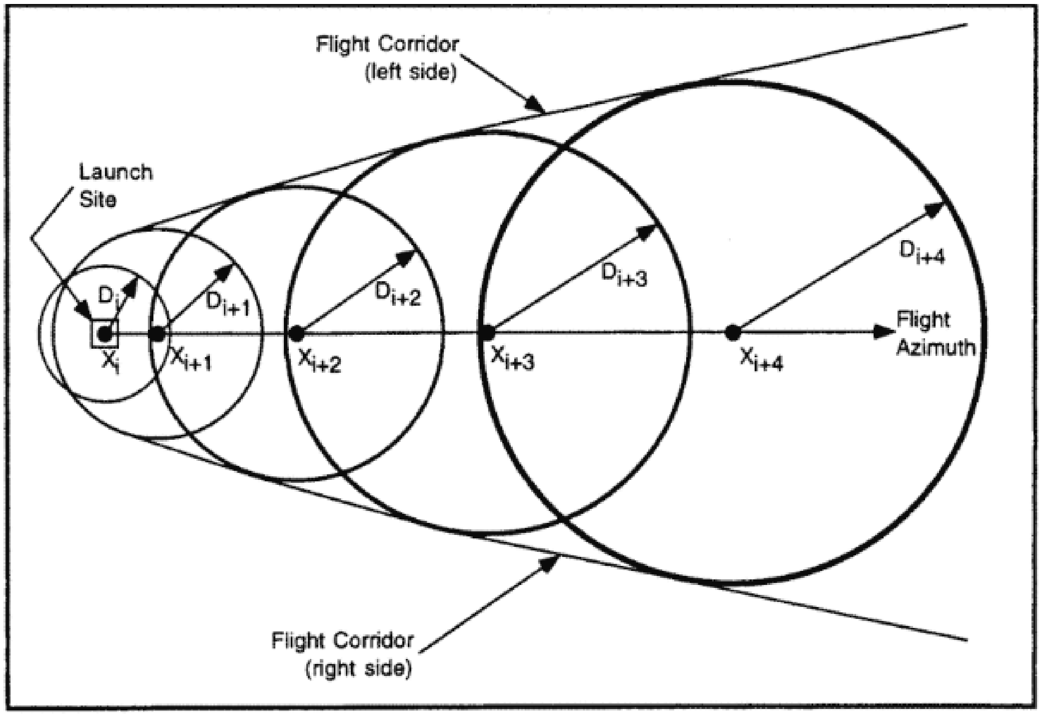


Figure 9 Flight Corridor[10] *For Guided Sub-Orbital Launch Vehicles Source FAA FAR 420*

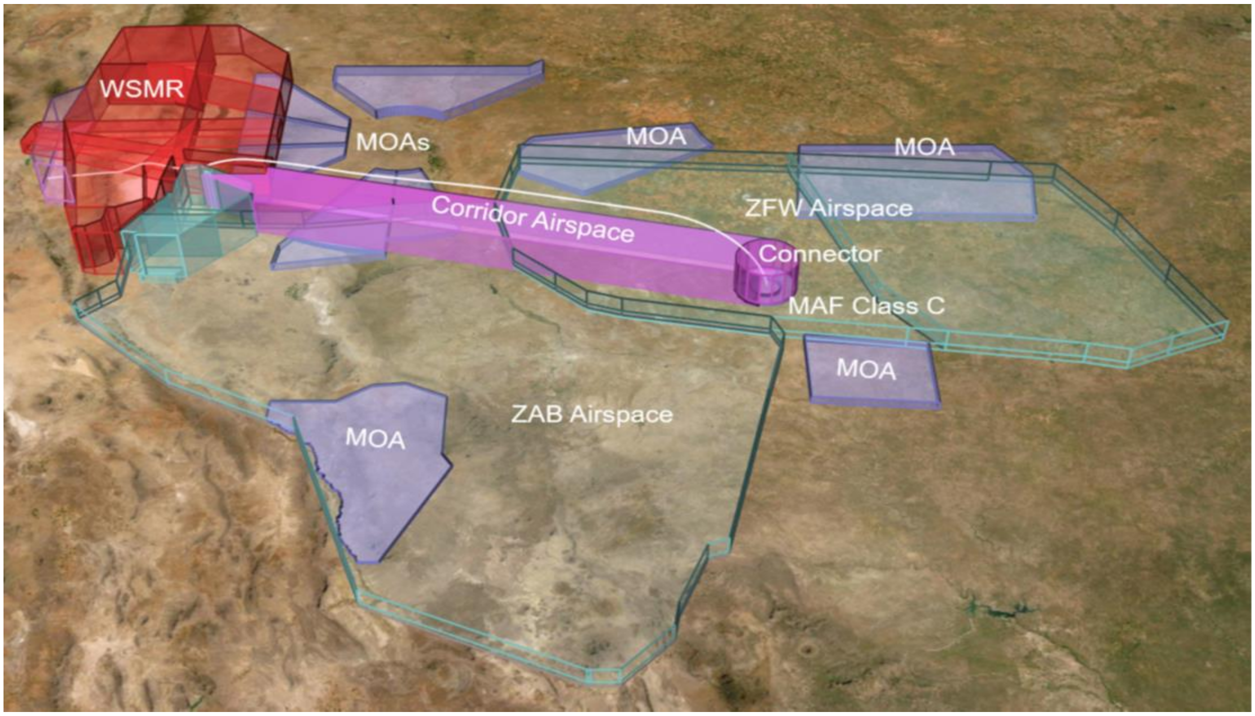


Figure 10 Notional Suborbital Spaceport to Spaceport S2S Flight Corridor (Spaceport America-Spaceport Midland Scenario-Source Midland Development Corporation-Midland International Air and Spaceport)

[10] https://www.ecfr.gov/current/title-14/chapter-III/subchapter-C/part-420

- Appendix B to Part 420-Method for Defining a Flight Corridor
    - This Appendix provides methodology for suborbital vehicles from launch to downrange and does not address downrange as a destination spaceport.
        - **Introduction** (1) This appendix provides a method to construct a flight corridor from a launch point for a guided suborbital launch vehicle or any one of the four weight classes of guided orbital launch vehicles from table 1, § 420.19, using local meteorological data and a launch vehicle trajectory. Sections of interest:
            - (2) A flight corridor is constructed in two sections - one sections comprising a launch area and one section comprising a downrange area. The launch area of a flight corridor reflects the extent of launch vehicle debris impacts in the event of a launch vehicle failure and applying local meteorological conditions. The downrange area reflects the extent of launch vehicle debris impacts in the event of a launch vehicle failure and applying vehicle imparted velocity, malfunctions turns, and vehicle guidance and performance dispersions.
            - (3) A flight corridor includes an overflight exclusion zone in the launch area and, for a guided suborbital launch vehicle, an impact dispersion area in the downrange area. A flight corridor for a guided suborbital launch vehicle ends with an impact dispersion area
        - **Data requirements:** for suborbital flight refer to launch and downrange yet should address data at the destination spaceport. Sections of interest:
            - **(b) (3) Table C-1** Overflight Analysis Data Requirements
                - **Vehicle Data**-Overflight Dwell Time-Determined by range from the launch point or trajectory used by applicant. For S2S missions, the term overflight "dwell time" should evolve into "cruise" or orbital transit phase

4.2 Airspace

General Considerations

The airspace volumes required for S2S Suborbital operations were studied by the authors and the GSA-FF P2P Working Group. The group and relevant aviation, aerospace and space industry participants completed a thorough airspace definition survey. The resulting airspace dimensions are described below.

- S2S Research and Development Airspace
    - No Minimum S2S Distance
        - Height — Ground to Unlimited
        - Width — 40-130NM
        - Length — ~100-500+NM

- S2S Commercial Operations Airspace
  - Minimum S2S Distance- 2,000 NM
    - Height — Ground to Unlimited
    - Width — ~20-130NM
    - Length for Commercial Ops — ~2,000+NM

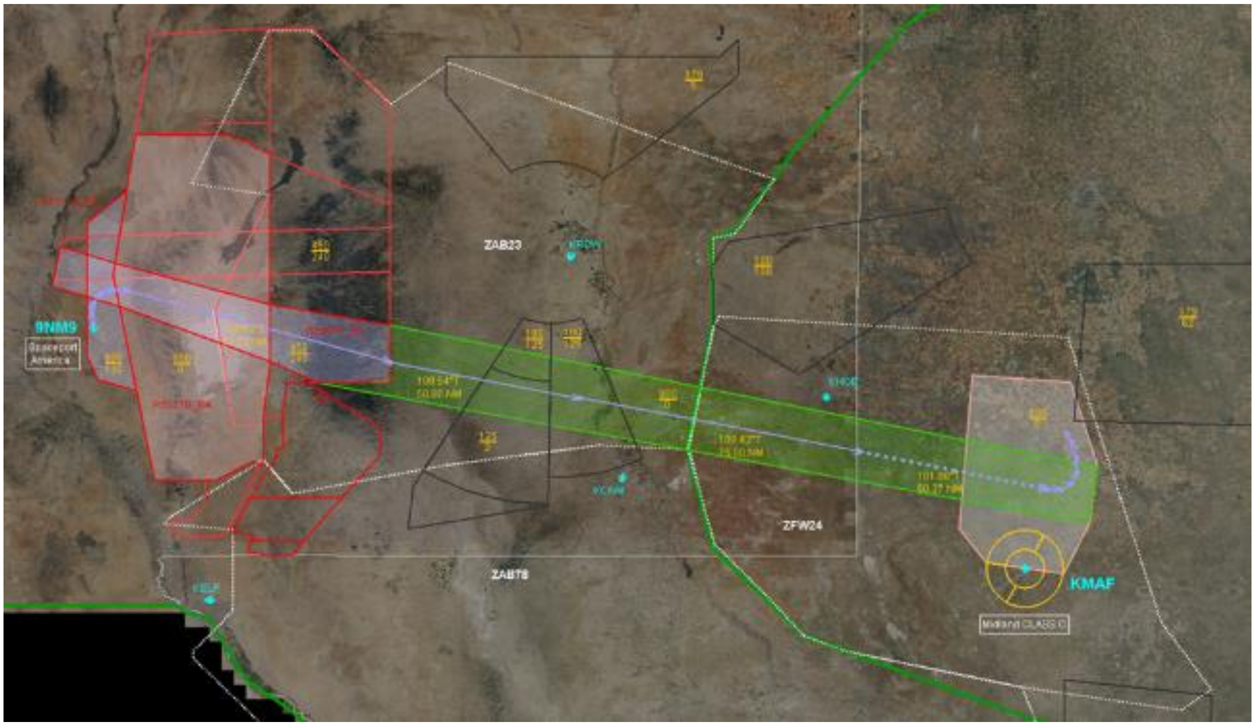


Figure 11 Example: Spaceport Midland to/from Spaceport America

Upper Class E Airspace Considerations

All S2S Suborbital flight profiles will fly across Upper Class E airspace[11] in which operations refer to those that take place over 60,000 feet above mean sea level (MSL) in the National Airspace System (NAS). Upper Class E extends to an unlimited altitude and will become an important factor for future frequent commercial S2S missions.

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[11] https://nari.arc.nasa.gov/sites/default/files/attachments/ETM_ConOps_V1.0.pdf

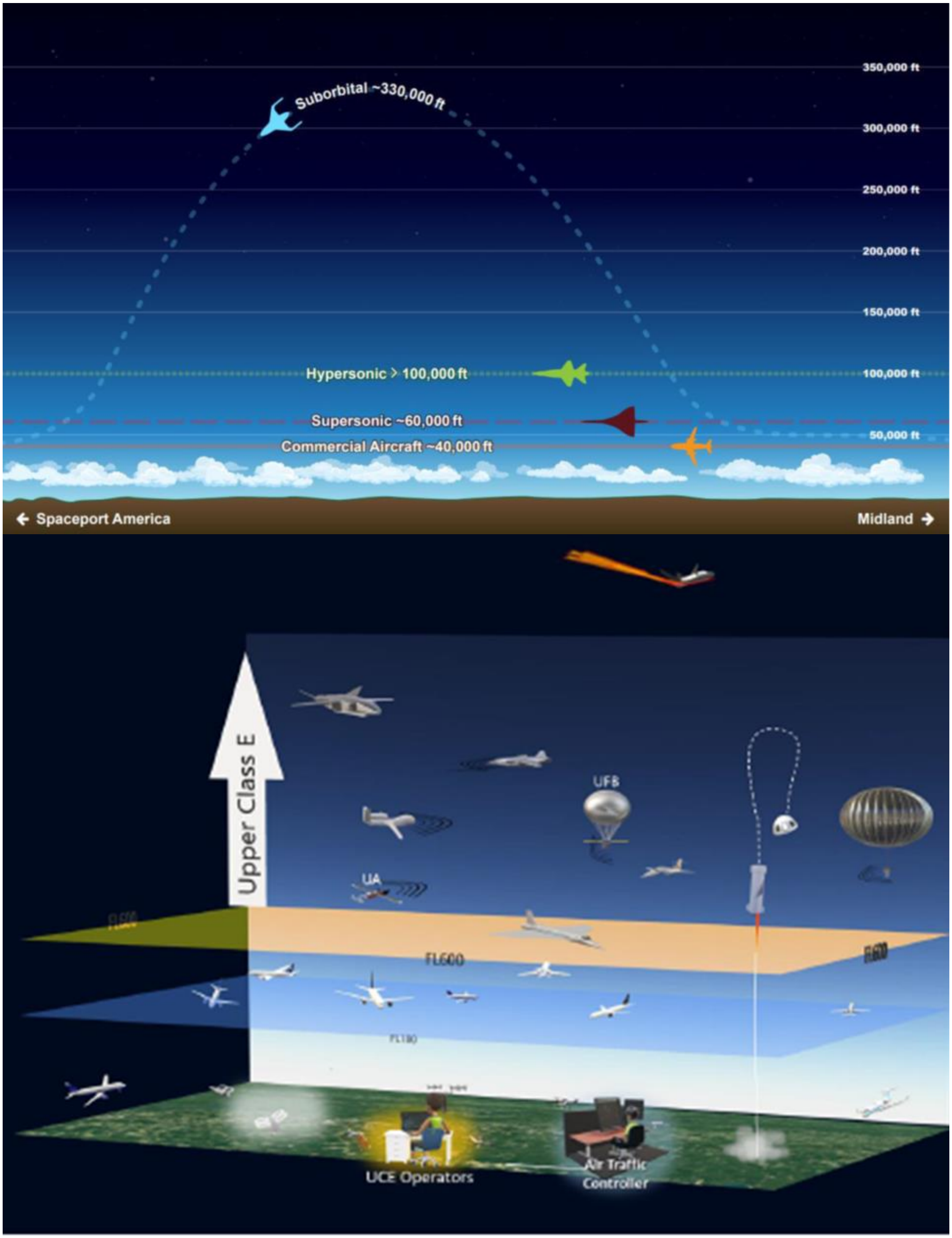

Figure 12 Future Upper Class E Environment-Source Mitre Corporation

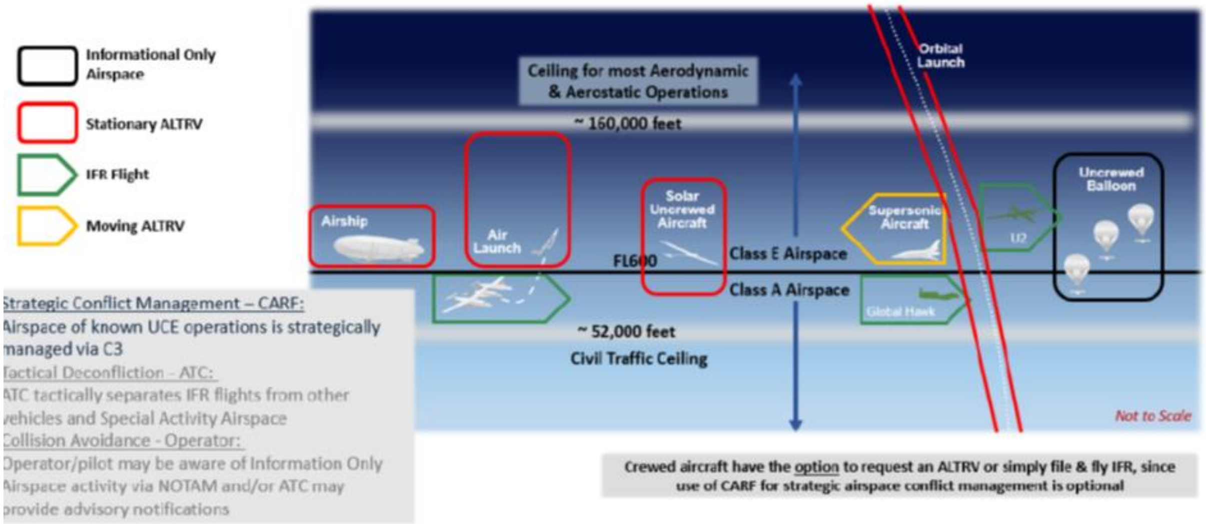

Figure 12 Future Upper Class E Environment-Source Mitre Corporation

S2S Airspace Regulatory Considerations:

The cruise portion of an S2S FAR 450 licensed missions lacks clear jurisdictional authority as per current rules. The US DOC Office of Space Commerce has such on-orbit jurisdiction[12]. As the S2S cruise phase is a (sub) orbital transit, the US DOC Office of Space Commerce (OSC) has such jurisdiction. However, an S2S suborbital mission would be licensed by the FAA AST FAR 450 rules. Thus, there is an important regulatory gap for licensed launch vehicle operators intending to perform S2S missions.

The following items could address the gap as building blocks for suborbital S2S licensing protocols:

- This White Paper defines and characterizes the airspace volumes necessary to enable the cruise portion of the S2S flight missions as follows:
  - S2S Cruise Phase: The portion of airspace between the launch and reentry phases of an FAR 450 licensed suborbital flight operation.
- The integration of the cruise phase of an S2S mission into the existing FAR 450 licensing process will enable launch vehicle operators to safely, and confidently, perform S2S missions
- Launch and Reentry S2S Corridors Considerations, FAR 450 focus areas for development are listed below:
  - FAR 450.3 Scope of Vehicle Operator License addresses launch and reentry yet does not address the suborbital transit or cruise element of an S2S mission.
- The FAA's definition of a Suborbital Trajectory as the intentional flight path of a launch vehicle, reentry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave

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[12] https://www.space.commerce.gov/department-of-commerce-and-department-of-defense-sign-memorandum-of-agreement-to-advance-coordination-in-space/

the surface of the Earth. 49 U.S.C. § 70102(20) is valid and applicable to an S2S mission profile.

- The definitions of Cross-Range, Downrange and Uprange on FAR 401.5 are valid, yet insufficient as a precursor to defining the suborbital or cruise stage of an S2S mission.
    - Cross range is defined as distance measure along a line whose direction is either 90 degrees clockwise (right cross range) or counterclockwise (left cross range) to the projection of a vehicle's planned azimuth onto a horizontal plane tangent to the ellipsoidal Earth model at the vehicle's sub-vehicle point. The terms right cross range and left cross range may also be used to indicate direction.
    - Downrange is defined as the distance measured along a line whose direction is parallel to the projection of a vehicle's planned nominal velocity vector azimuth into a horizontal plane tangent to the ellipsoidal Earth model at the vehicle sub-vehicle point. The term downrange may also be used to indicate direction.
    - Uprange is defined as the distance measured along a line that is 180 degrees to the downrange direction.

- The definitions of reentry and reentry window from a Suborbital S2S mission are defined in terms of reentry time. It should be defined point-of-reentry based on the planned S2S trajectory.
    - Reenter: reentry means to return purposefully a reentry vehicle and its payload from earth orbit
    - Reentry window means a period of time during which the reentry of a reentry vehicle is initiated

- The following FAR 450 sections do not include provisions for the suborbital transit or cruise phase between the launch and reentry phase of suborbital S2S missions:
    - **FAR 450.3 Launch and reentry safety regulations Scope of a Vehicle Operator License** and FAR 450.43 Payload Review and Determination
        - FAR 450.3 (3) (iii)For a suborbital launch that includes a reentry launch ends after reaching apogee
        - FAR 450.3 (c) A vehicle operator's license authorizes reentry which includes activities conducted in Earth orbit or outer space and that are critical to ensuring public health and safety and the safety of property during reentry flight. Reentry also includes activities necessary to return the reentry vehicle to a safe condition on the ground after landing
    - **FAR 450.43 Launch and reentry safety regulations Payload Review and Determination**
        - The payload determination for a mission including a suborbital transit or cruise phase of a S2S mission belongs to the US DOC and its Office of Space Commerce.
    - **Subpart C-Safety Requirements**
        - **FAR 450.101 Public Safety Criteria** provides risk criteria for launch section (a) and reentry (b) and the suborbital transit phase as follows on section (e)
            - ***Protection of people and property on orbit.***
            - (1) A launch or reentry operator must prevent the collision between a launch or reentry vehicle stage or component and people or property on

orbit, in accordance with the requirements in § 450.169(a).

- **FAR 450.169 Launch and Reentry collision avoidance analysis requirements**
  - Suborbital S2S vehicles on missions achieving a maximum altitude below 150 Km (~500,000 ft) are exempted from performing a collision avoidance analysis. Thus, S2S corridor dimensions and separation distances need a novel definition and specifications.
    - For instance, in the form of industry voluntary consensus standards
- FAR 450.181 Coordination with a site Operator
  - Launch or reentry Operations are coordinated with other launch and reentry operators and other affected parties to prevent unsafe interference
    - This FAR is unclear on which entity the S2S flight operator shall coordinate for the "cruise" orbital transit
    - Suborbital S2S Operations should coordinate the "cruise" orbital transit phase with the US DOC (new regulation, standards or practices required) and the Launch and Reentry Spaceports as required by FAR 450.181
- FAR 450 Appendix A-Collision Analysis Worksheet
  - Section (4) Segment Number. A segment is defined as a launch vehicle stage after the thrusting portion of its flight has ended
  - An S2S mission "cruise" trajectory would be considered a segment and the operator must determine its orbital parameters. In the case of an S2S flight, these parameters are the "cruise" trajectory between launch and reentry.

Airspace Modeling, Design and Validation Analysis and Methodology

The existing tools and methodologies for high-speed (supersonic) and launch and reentry airspace are not optimal for the analysis and modeling required to design and implement S2S corridors, and in particular the launch to reentry segment, or suborbital "cruise" phase. There has been no need to date for such airspace.

The following technical areas were reviewed and required for S2S airspace corridors design and implementation:

A. Airspace
   1. Airspace Impact Analysis including Special Use Airspace (SUA) and Temporary Flight Restrictions (TFR) FAA Order JO 7400 10A
   2. Sonic Boom and Noise Analysis (CFR 14 FAR 91.817 Civil Aircraft Sonic Boom FAR 91.817 AMDT No 91-362 [13] Authorizations to Exceed Mach 1))

[13] https://www.faa.gov/news/media/attachments/SFA_Supersonic_Final_Rule.pdf

3. Environmental assessment (EA); reviews (NEPA CFR 40 1500-1508) applicable to the FAA Order 1050 1F Para 4-1 including air quality, hazardous materials, visual effects, socioeconomics, land use, DOT Act Section (4F) et al.
4. Surface and Airborne support for S2S missions including; telemetry infrastructure, radar, chase aircraft, special fuel containment, cooling and lighting protection equipment, sound-noise compliance measuring devices, et al
5. Letters of agreement with SUA airspace and ground facilities affected by cross-range S2S trajectories (i.e., DOD, Private Airports, etc)
6. Air Traffic-National Airspace System (NAS) Simulation Models (i.e., Terminal Area Route Generation Evaluation and Traffic Simulation (TARGETS)) and Dynamic ATMC research Technology (DARTS) and with current air traffic routes, including airspace and weather considerations for the launch, "cruise" and reentry phases of a S2S suborbital mission. Key performance indicators to include, delays, rerouting and other traffic flow considerations for Enroute and Terminal Departure/Arrival ATC centers.

B. Vehicles
   1. Technical data for each operator of a Suborbital Vehicle, and related Experimental Permits (CFR 14 FAR 43) and Launch Operators Licensing documentation, to include Flight Path Data (FPD).
   2. Flight Safety Analyses including Expected Casualty (Ec) and Individual Risk Analysis (IRA)

C. Spaceports
   1. Explosive Siting Reviews, including explosive site plans vehicles propellant parameters, engine/s performance, flight cadence and timings.

4.3 Vehicles

This section references crewed suborbital spaceflight vehicles that have flown in the past or are flying now in order to inform the design and development of S2S airspace corridors.

For the purposes of S2S suborbital spaceflight missions, a Suborbital Vehicle is defined[14] as a vehicle that is designed to achieve trajectories not completing a full orbit of the earth.

Future editions of this document will consider data from vehicles in the conceptual stage that are expected to fly in the future.

As of 2022, we are not aware of any suborbital vehicle has been flown on a commercial, planned and licensed S2S mission.

[14] ASTM F47 Commercial Spaceflight Committee F3377-20 Standard Terminology Relating to Commercial Spaceflight

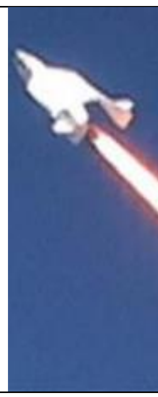
Suborbital spaceflight vehicles operational performance should comply with CFR 14 FAR's aviation and space flight regulations for the following flight phases:

- departure and arrival to/from spaceports
- launch and reentry to/from launch and reentry sites, and
- suborbital transit or cruise phase between the launch and reentry points

Suborbital spaceflight vehicles on S2S missions should complete sonic boom and flight safety analysis as per applicable CFR 14's.

Suborbital spaceflight vehicles' performance should be compatible with other airspace users in Upper Class E airspace (FL 600 and above) and with CFR14 FAR 91 Instrument and Visual Flight Rules (IFR/VFR) below Flight Level 600, and particularly in the terminal Spaceport area. This consideration will affect the reduction and eventual elimination of "segregated" airspace for S2S suborbital flight missions.

List and general performance of the crewed suborbital vehicles referenced for S2S airspace corridors development:

VEHICLE	Lockheed NF-104	North American X-15	Scaled Composites Spaceship 1	The Spaceship Company-Virgin Galactic Spaceship 2	Blue Origin New Sheppard
					
TIMELINE	1959-1972	1959-1968	2004	2018-Present	2021-Present
NUMBER OF FLIGHTS	302	199	4	4	6
CREW	1	1	2	2-6	4-6
MAX APOGEE (Approx.)	120,000ft	355,000ft	370,000ft	300,000ft	390,000ft
MAX SPEED	Mach 2.4	Mach 6.7	Mach 3.0	Mach 3.0	Mach 3.8

The Spaceship 2 (FAA Type Z Vehicle) suborbital spacecraft and the Lockheed NF-104 FAA Space Support Vehicle (SSV) are both ready to fly and suitable for S2S suborbital flight demonstrations.

The feasibility of such demonstrations have been evaluated in principle for a circa 280 NM S2S feasible corridor between Spaceport America and Spaceport Midland.

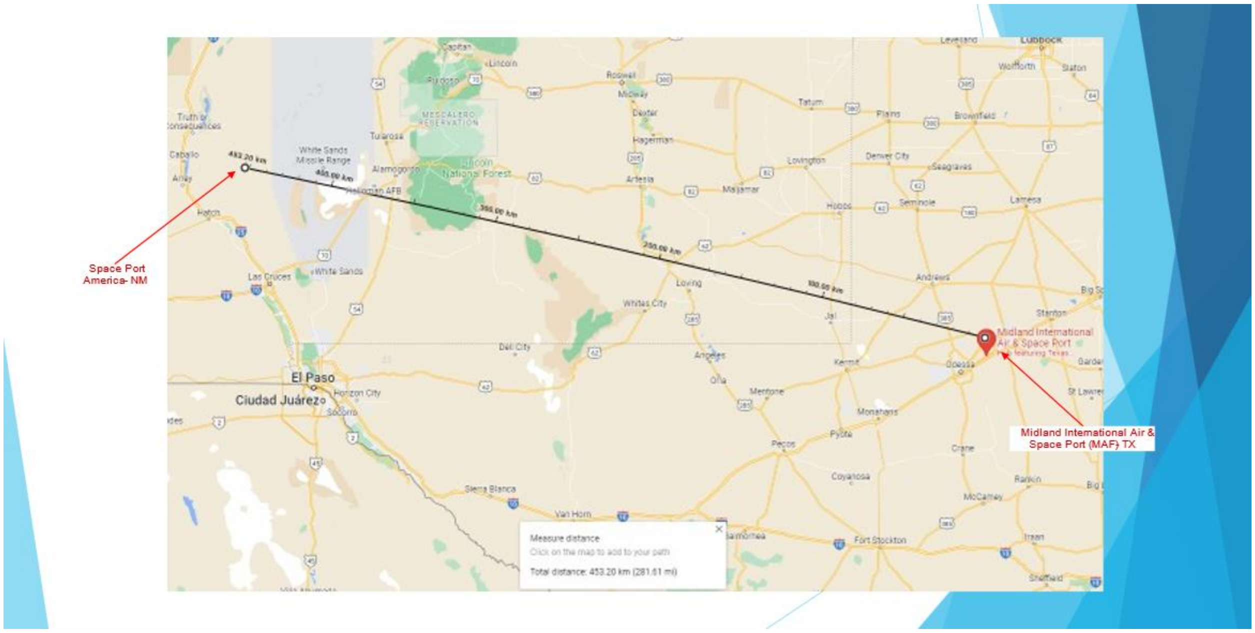


Figure 13 Notional S2S Trajectory Spaceport America to/from Spaceport Midland

Virgin Galactic Spaceship 2 S2S To/From Spaceports Midland-/America Cas (Photo Source: Virgin Galactic)

The figures below showcase the possible S2S flight profiles and Rough Order of Magnitude performance figures for a notional flight profile in S2S airspace corridors:

This profile presents a notional trajectory with a Westerly departure from Midland and Mid-Course release of the Spaceship 2 Vehicle with a reentry and glide to Spaceport America

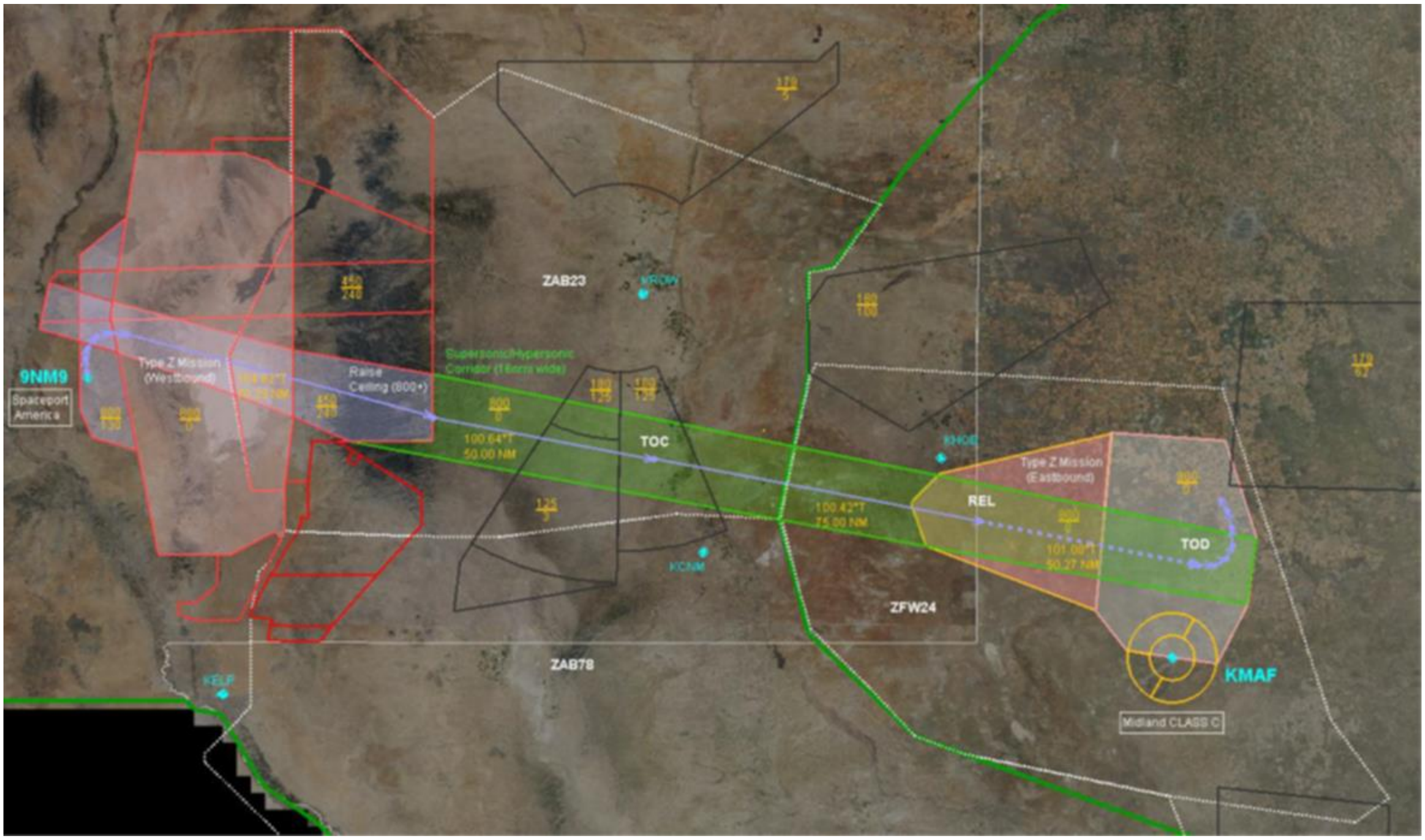
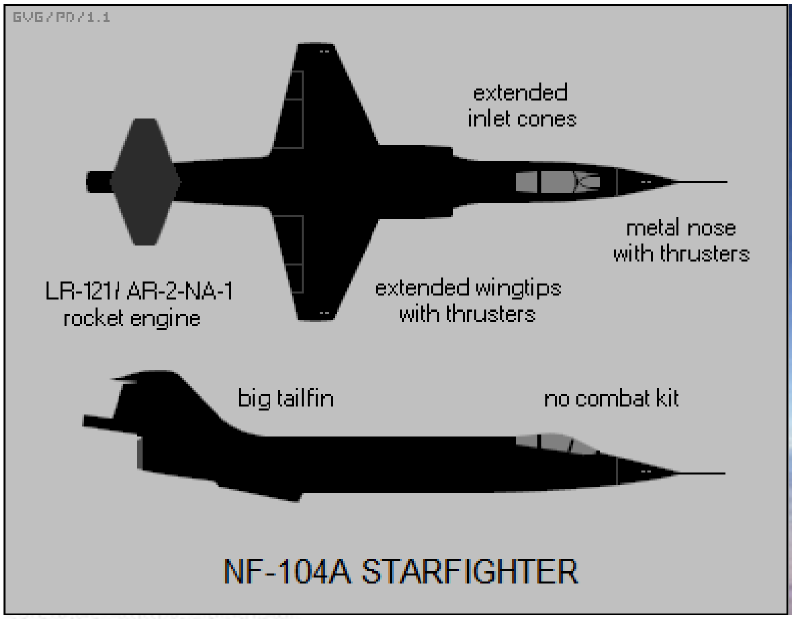
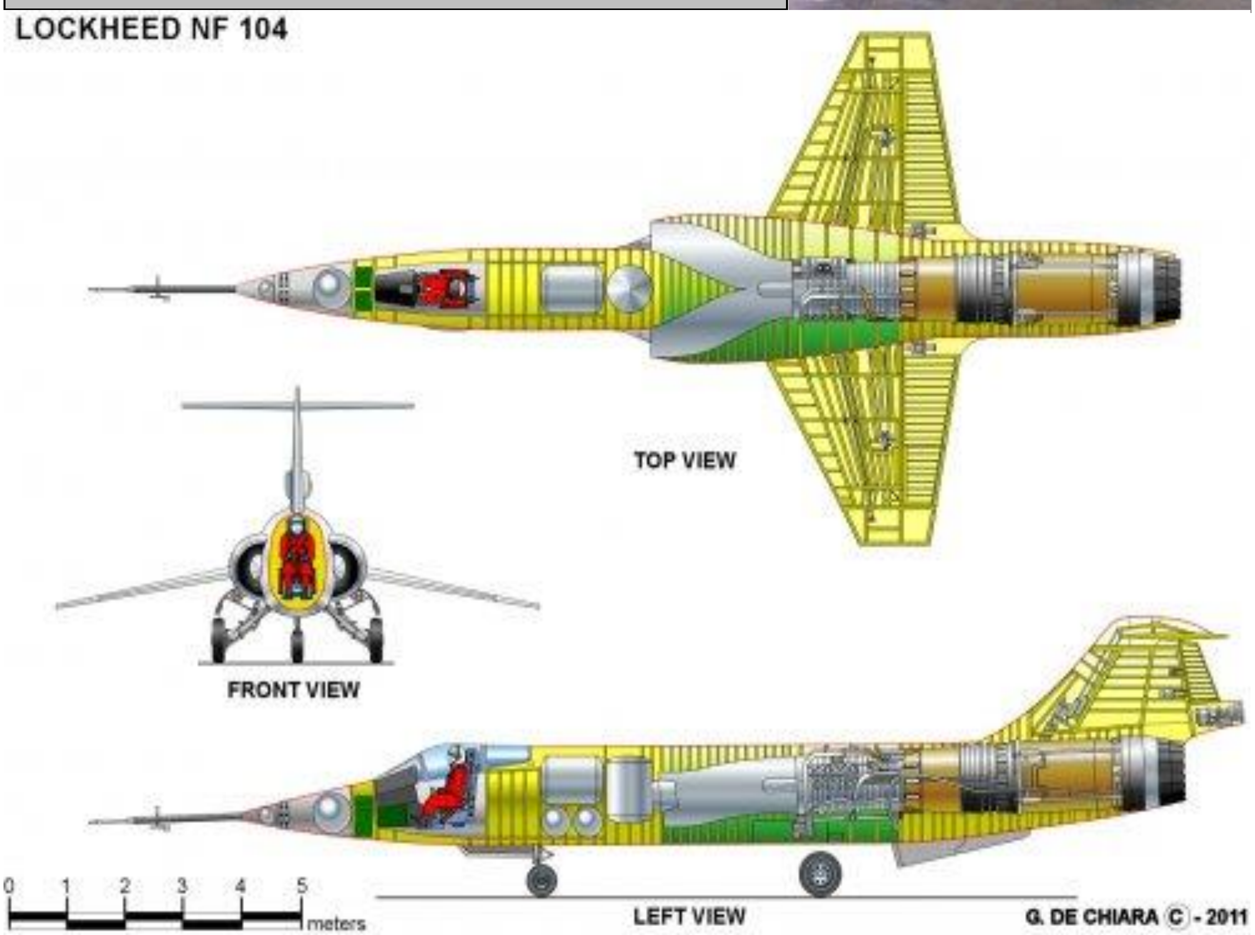


Figure 14 Virgin Galactic Spaceship 2 S2S Profile-Midland to/from Spaceport America

Lockheed NF-104 Case S2S To/From Spaceports Midland-/America (Photo Source Secret Project):





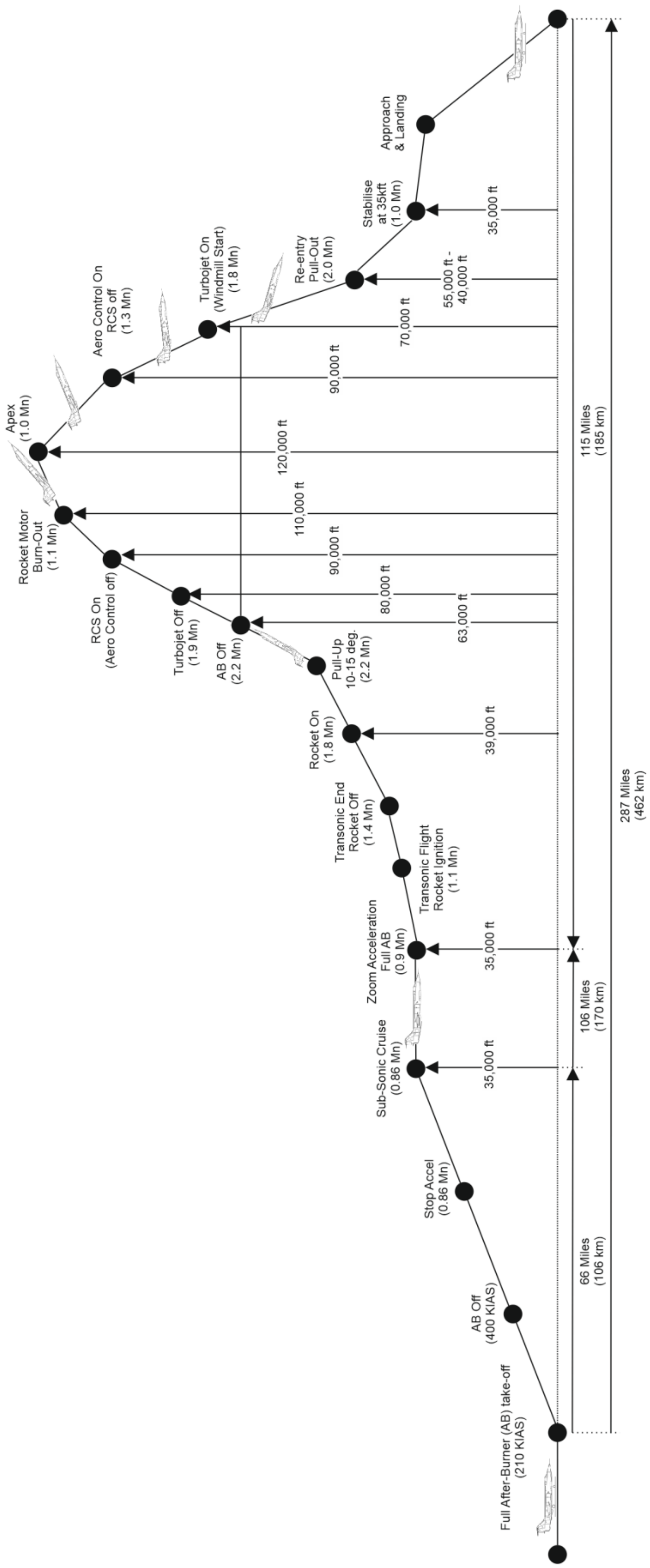


Figure 15 Starfighters Aerospace NF-104 S2S Profile Midland to/from Spaceport America

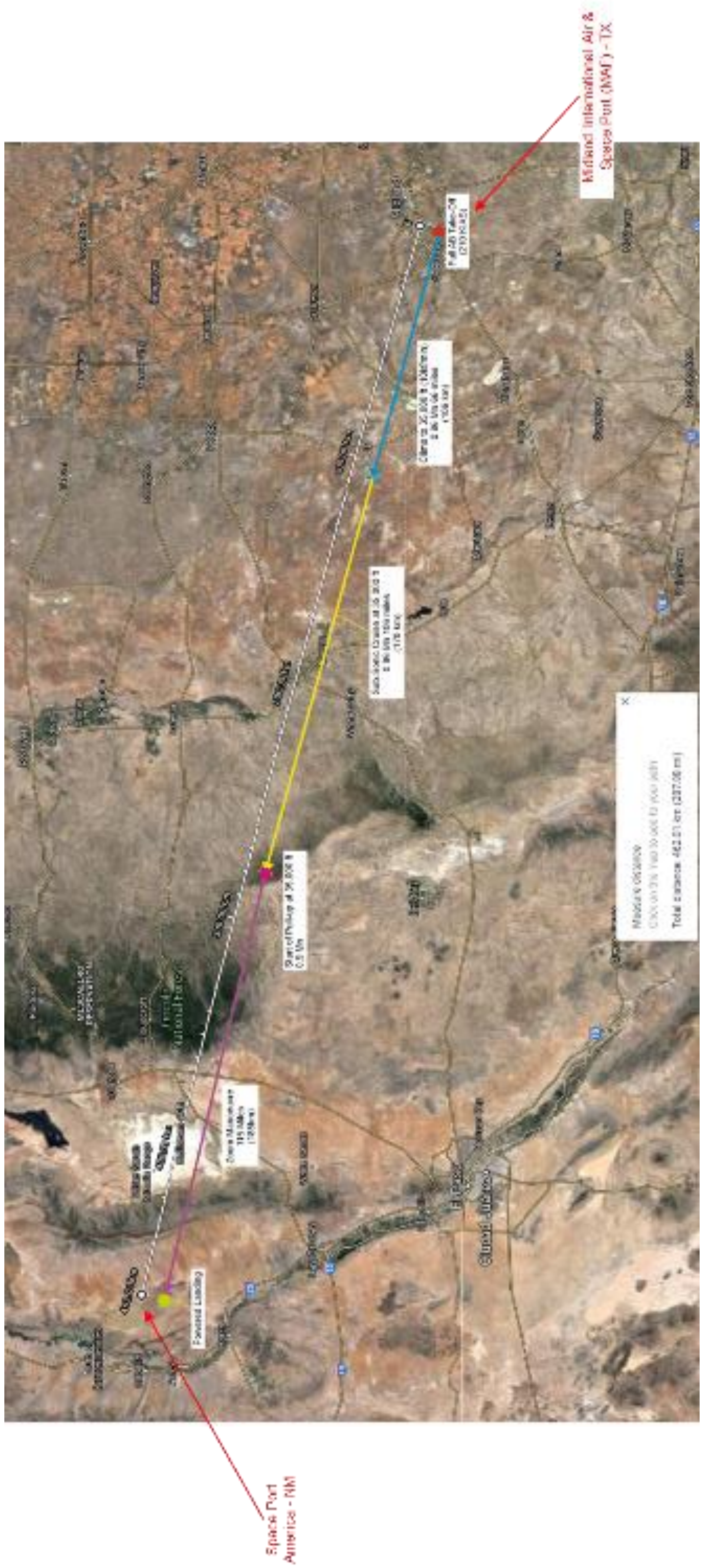


Figure 15 Starfighters Aerospace NF-104 S2S Profile Midland to/from Spaceport America

5. S2S Airspace Corridors -Guiding Principles

1. SPACEPORTS

- Licensed Launch Sites and Spaceports in the USA supporting S2S flight operations should compete and collaborate at the same time. Such activity is known as "Coopetition" and enables a network of S2S airspace routes or corridors supporting the safe, efficient and scalable transportation of goods and people on suborbital spaceflight vehicles.
  - Suborbital S2S missions will require both origin and destination spaceport co-preparation of the required flight corridor to accommodate the flight profile as per FAR 450
- Spaceports and Launch Site Operators supporting suborbital flights should ensure CFR 14 FAR 420 License to Operate a Launch Site regulations are relevant and support S2S commercial flights for the transportation of payloads and people. Particularly as related to Appendix A- and Appendix B Methods for Defining a Flight Corridor
- S2S Flight corridors will include portions of Upper-Class E airspace. Upper Class E airspace is becoming more congested with time. Spaceports must preempt and manage the portions of S2S airspace crossing Upper Class E Airspace in close collaboration with the relevant air traffic managers and operators
- Spaceports and related launch and reentry sites should plan for adequate S2Scorridors dimensions
  - S2S Corridors with lengths up to and exceeding 2,000NM separation between spaceports-launch and reentry sites are suitable for R&D and T&E suborbital missions
  - S2S Corridors with lengths' more than 2,000NM separation between spaceports-launch and reentry points are suitable for commercial flights carrying cargo and people onboard

2. AIRSPACE

- S2S airspace needs to integrate seamlessly and with minimal changes into the National Airspace System rules and regulations (i.e., Visual flight Rules (VFR) and Instrument Flight rules (IFR)
- S2S airspace volumes to emerge as "one-off" segregated airspace for R&D, T&E and demonstrations and evolve into on-demand standardized corridors and eventually into charted or "published" airspace
- The S2S Suborbital Transit or "cruise" phase of flight must be defined by CFR 14 FAR 450.1 and included in Subpart C-Safety Requirements and CFR 14Suborbital Mission Analysis
- S2S Airspace Corridors development technical approach include Air Traffic-National Airspace System (NAS) Simulation Models (i.e., Terminal Area Route Generation Evaluation and Traffic Simulation (TARGETS)) and Dynamic ATMC research Technology (DARTS) and with current air traffic routes, including airspace and weather considerations for the launch, "cruise" and reentry phases of a S2S suborbital mission. Key performance indicators to include, delays, rerouting and other traffic flow considerations for Enroute and Terminal Departure/Arrival ATC centers.

- Corridors Dimensions (GSA-HSF-FF Surveys[15] as of 12/2022 ~75 responses)

S2S CORRIDOR PURPOSE	LENGTH	WIDTH	HEIGHT
R&D, T&E	0-ANTIPODAL MAXIMUM ~12,500 NM	40-130 NM	GROUND-UNLIMITED
COMMERCIAL OPS	2,000-MAXIMUM ANTIPODAL 12,500 NM	20-130 NM	FL 600-UNLIMITED

- S2S Suborbital Airspace Corridors Design Is Most Effective Based on Real Flight Experience and Data
  - Data collection, analysis and databasing of all “flown” Suborbital flight trajectories regardless of their flown cross range is key to enable future S2S flight operations with expanding cruise segments
  - Dimensions and Characteristics of S2S corridors informed by stakeholders involved in suborbital spaceflight activities (ground and air ops) via surveys and data analytics
- S2S Suborbital Airspace Corridors Seamlessly Integrated with existing endo-atmospheric (i.e., Aviation) CFR 14 FAR 91, 135, 121, et al airspace Rules, Standards, Practices and Regulations
  - S2S corridors users to seek equitable access with other users of airspace, atmospheric and space
- S2S Suborbital Airspace Corridors to Seamlessly Integrate with existing CFR 14 FAR 450 Launch and Reentry Rules, FAR 420 Launch and Reentry Site Operators, and related Standards, Practices and Regulations
  - S2S corridors development ideally always aligned with FAA AVS-AST, SDO’s and other government agencies DOD, DOC (for Suborbital transit or cruise stage), NASA, et al
- S2S Suborbital Airspace Corridors Safety Focus on “cruise” phase collision avoidance to meet or exceed orbital separation and probability of collision standards
  - If the maximum altitude of a S2S flight is 150Km or higher, a collision avoidance analysis must be performed according to FAR 450.169
  - If below 150Km, novel definitions and dimensioning of S2S corridors is necessary
    - Most US S2S missions linking licenses Spaceports are forecast to be flown at altitudes below 150Km.
  - S2S Corridors are to meet and exceed separation and probabilities of collision requirements for suborbital flights above 150Km.
- Launch and Launch window, Reentry a Reentry window should be time and position “gates” in the planned trajectory of a suborbital S2S flight mission
  - Definitions should be included in both the FAA 450 and US DOC Office of Space Commerce (OSC) definitions
- Suborbital S2S Vehicles exceeding an apogee of 150Km are subject to Collision analysis and separation criteria as per FAR 450.169

[15] https://surveys.benchmarkemail.com/Survey/Start?id=1395206&s=696900

- For S2S flights with apogees less than 150Km, separation criteria needs to be defined for instance, as industry voluntary consensus standards

✈ **Suborbital S2S Operations should coordinate the "cruise" orbital transit phase with:**

- The US DOC (new regulation, standards or practices required) and the Launch and Reentry Spaceports as required by FAR 450.181
- The FAA as the Suborbital S2S "cruise" phase is defined as the orbital parameters for Collision Analysis (FAR 450 Appendix A)

3. VEHICLES

✈ For the purposes of S2S suborbital spaceflight missions, a Suborbital Vehicle is defined[16] as a licensed launch vehicle or Space Support Vehicle[17] (SSV) that is designed to achieve trajectories not completing a full orbit of the earth.

✈ Spaceflight vehicles operational performance should comply with CFR 14 FAR's aviation and space flight regulations for the following flight phases:

- Departure and arrival to/from spaceports
- Launch and reentry to/from launch and reentry sites, and
- Suborbital transit or cruise phase between the launch and reentry points

✈ Suborbital spaceflight vehicles on S2S missions should complete sonic boom, environmental reviews and flight safety analysis as per applicable CFR 14's.

✈ Suborbital spaceflight vehicles' performance should be compatible with other airspace users in Upper Class E airspace (FL 600 and above) and with CFR14 FAR 91 Instrument and Visual Flight Rules (IFR/VFR) below Flight Level 600, and particularly in the terminal Spaceport area. This consideration would enable the reduction and eventual elimination of "segregated" airspace for S2S suborbital flight missions.

[16] ASTM F47 Commercial Spaceflight Committee F3377-20 Standard Terminology Relating to Commercial Spaceflight

[17] CFR 51 USC 50902(22) space support vehicle (22) "space support vehicle" means a vehicle that is— (A) a launch vehicle; (B) a reentry vehicle; or (C) a component of a launch or reentry vehicle.

6. Key Issues for Further Research

The next phase for development of this White Paper will include, an increased number of S2S Airspace Corridors survey responses, working sessions of the GSA-IFG-FF Working Group, per reviews and comments to include Standards Development Organizations (SDO's), Aerospace Trade Associations, FACA-FAA AST Committees, et al.

The main focus for next step will be to ingest Mission-specific design, modeling and simulation on a case-by-case basis for launch vehicle and space support vehicle operators. The next phase will focus on vehicles flying S2S missions and their specific performance, and impacts, such as sonic boom flight safety, air quality, explosive analysis-siting and (terminal, Class A and Upper-Class E) airspace scheduling and integrations.

With vehicle specific elements at play, the S2S corridors modeling could include; variable dimensions-floor-ceilings, expanded time-data for VFR and IFR traffic and forecast Traffic Management Initiatives (TMI).

The key issues for further research and revisions to this White Paper are derived from all sections above, and summarized as follows to include but not limited to:

- Air and space traffic management
- Environmental
- Technology
- Safety and security
- Economic, market and business
- International S2S airspace development with FAA-Foreign Civil Aviation Authorities (CAA) bilateral agreements and in the future multi-lateral and eventually global agreements, standards and recommended best practices (see below-addressable future s2s points of departure and arrival)

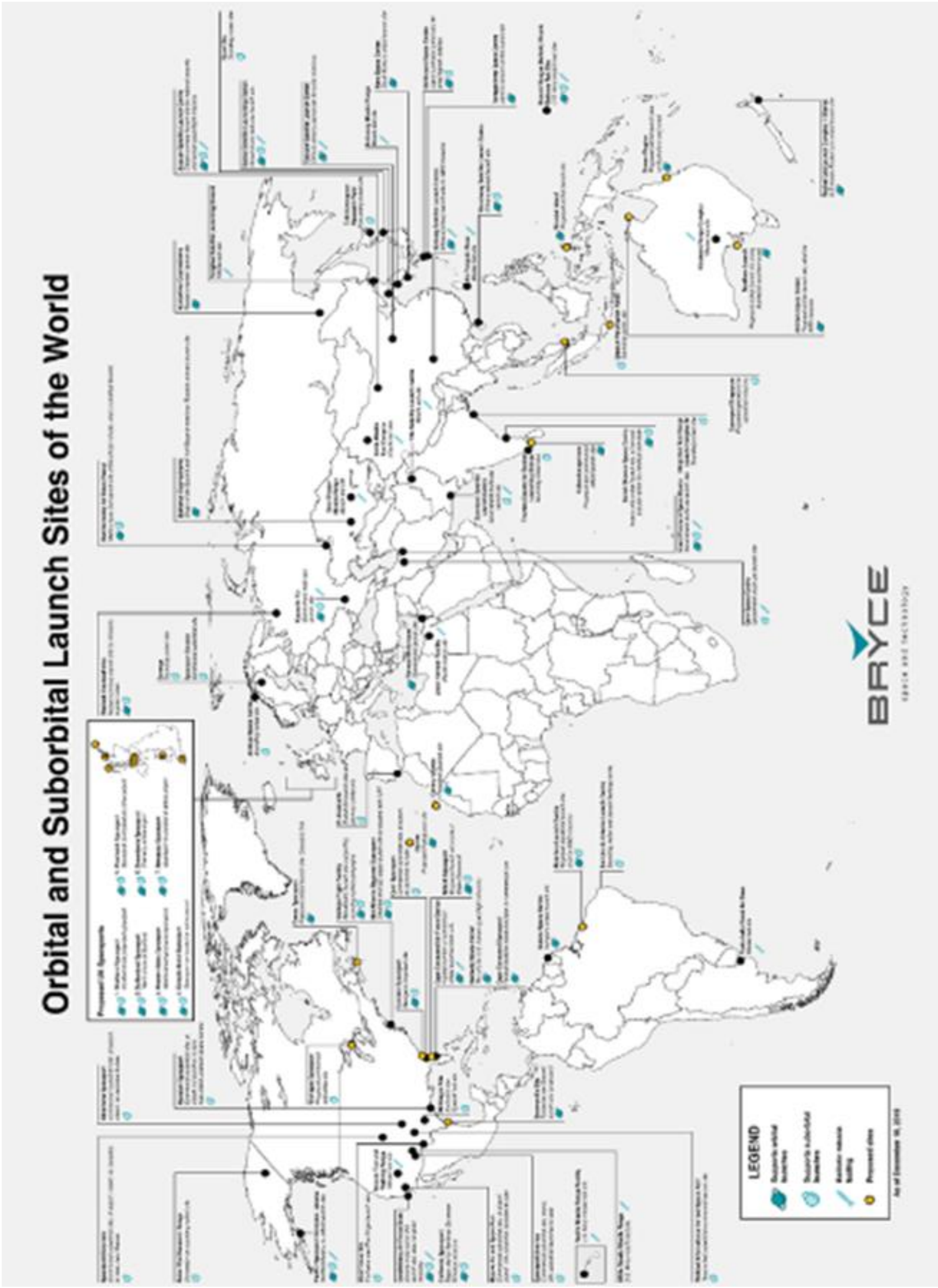


Figure 16 US Global Suborbital and Orbital Spaceport to Spaceport (S2S) Potential Departure-Arrival Sites

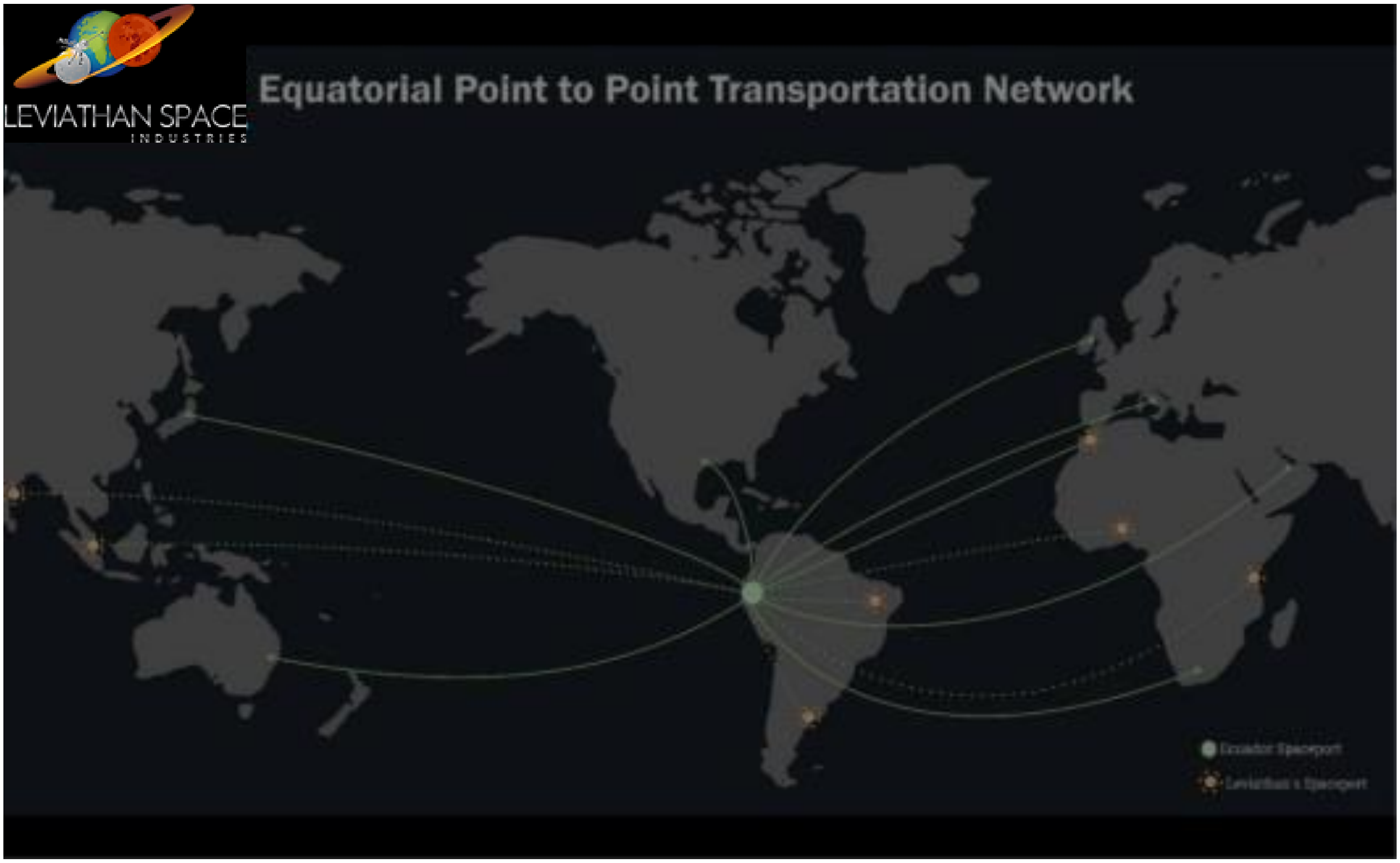


Figure 17 Example: Equatorial Suborbital and Orbital Spaceport to Spaceport (S2S) Potential Sites Source: Leviathan Space Industries

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3	Francisco	Partida	**City of Brownsville**
4	TBD	TBD	**Colorado Air and Spaceport**
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6	Jeroen	Wink	**Dawn Aerospace**
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22	Pat	Hynes	**New Mexico State University**
23	Adam	Dissel	**Reaction Engines**
24	Steven	Wolf	**SpaceCom-Deputy Exec Director**
25	James	Causey	**SpaceCom-Deputy Exec Director**
26	Scott	McLaughlin	**Spaceport America**
27	Chas	Miller	**Spaceport America**
28	Joachim	Lohn_Jaramillo	**Spaceport America**
29	Jorge	Armendariz	**Spaceport America**
30	Robert	Aillon	**Spaceport Ecuador**
31	Craig	Smith	**Spaceport Oklahoma**
32	Sean	Sherry	**Spacework Enterprises**
33	Kevin	Daugherty	**Titusville Regional Airport**
34	Anna	Bennett	**Stratolaunch**
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Acronyms

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Acronyms

ACAS	Airborne Collision Avoidance System
ACM	Airport Certification Manual
ADS-B	Automatic Dependent Surveillance - Broadcast
AEP	Airport Emergency Plan
AHA	Aircraft Hazard Area
ALP	Airport Layout Plan
ALTRV	Altitude Reservation
AMP	Airspace Management Plan
ANSP	Air Navigation Service Provider
ANG	Office of NextGen
AOC	Airport Operating Certificate
APL	FAA's Office of Policy, International Affairs and Environment
APREQ	Approval Request
APT	Advanced Planning Team
ARE	Adaptive Risk Envelope
ARFF	Airport Rescue and Firefighting
ARP	FAA Office of Airports
ARTCC	Air Route Traffic Control Center
ASH	FAA's Office of Security and Hazardous Materials Safety
AST	FAA’s Office of Commercial Space Transportation
ATC	Air Traffic Control
ATCAA	Air Traffic Control Assigned Airspace
ATCSCC	Air Traffic Control System Command Center

ATCT	Air Traffic Control Tower
ATM	Air Traffic Management
ATO	FAA's Air Traffic Organization
AVS	FAA Office of Aviation Safety
CARF	Central Altitude Reservation Function
CCDev	NASA's Commercial Crew Development
CDM	Collaborative Decision Making
CFR	Code of Federal Regulations
CNS	Communication Navigation & Surveillance
ConOps	Concept of Operations
CSINAS	Commercial Space Integration into the NAS
CSLAA	Commercial Space Launch Amendments Act
DHS	Department of Homeland Security
DoC	Department of Commerce
DoD	Department of Defense
DST	Decision Support Tool
EA	Environmental Assessment
EIS	Environmental Impact Statement

Glossary

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Term	Definition
Air Navigation Service Provider (ANSP)	A public or a private legal entity providing Air Navigation Services.
Airport Certification Manual (ACM)	The requirements of what goes in an Airport Certification Manual (ACM) are found in 14 CFR 139.203.
Airport Emergency Plan (AEP)	A concise planning document developed by the airport operator that establishes airport operational procedures and responsibilities during various contingencies. (AC 150/5200-31C, Airport Emergency Plan, 6/19/09)
Air Traffic Control Clearance	Air traffic clearance means an authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace. (FAA Federal Aviation Regulations (14 CFR Part 1)
Aircraft Hazard Area (AHA)	Used by ATC to segregate air traffic from a launch vehicle, reentry vehicle, amateur rocket, jettisoned stages, hardware, or falling debris generated by failures associated with any of these activities. An AHA is designated via NOTAM as either a TFR or stationary ALTRV. Unless otherwise specified, the vertical limits of an AHA are from the surface to unlimited.
Airport Layout Plan	Airport Layout Plan (ALP): The ALP is a set of drawings that depicts both existing facilities and planned (future) development for an airport. The ALP is a key output of the typical airport planning process.
Altitude Reservation (ALTRV)	Airspace utilization under prescribed conditions normally employed for the mass movement of aircraft or other special requirements which cannot otherwise be accomplished.
ATC Assigned Airspace	Airspace of defined vertical/lateral limits, assigned by ATC, for the purpose of providing air traffic segregation between the specified activities being conducted within the assigned airspace and other IFR air traffic

ATCSCC Space Operations Group (SOG)	Co-leads the JSpOG, and through its role as the commercial space point of contact defined in FAA Order JO7400.2L, serves as the single point of contact within the ATO for space and rocket activities. In this role, ATCSCC Space Operations manages the process by which notification of a space launch or reentry is distributed throughout the ATO, by working directly with AST to gather and distribute data and information to ATC facilities, FAA Headquarters ATO, and representatives of other NAS stakeholders.
Air Traffic Control System Command Center (ATCSCC)	An Air Traffic Tactical Operations facility responsible for monitoring and managing the flow of air traffic throughout the NAS, producing a safe, orderly, and expeditious flow of traffic while minimizing delays.
Central Altitude Reservation Function (CARF)	Responsible for coordinating, planning, and approving special user requirements under the Altitude Reservation (ALTRV) concept. CARF is located at the ATCSCC.
Contingency Hazard Area (CHA)	Used by ATC. Areas of airspace that are defined and distributed in advance of a launch or reentry operation and are activated in response to a failure.
Debris	The parts of a launch vehicle, satellite, missile, or reentry vehicle that are either jettisoned, broken off, or a result of flight termination.
Dual-use airport	A launch or reentry site whose boundaries include an area that is also included within the boundaries of a public-use airport that is (a) included in the National Plan of Integrated Airport Systems, (b) certificated under 14 CFR Part 139, or (c) Federally obligated.
Electronic System Impact Report (eSIR)	A process where AT facilities coordinate with their Traffic Management Unit (TMU) or overlying TMU for all planned outages/projects/events that could cause a significant system impact, reduction in service, or reduction in capacity (for example, air shows, major sporting events, business conventions, runway closures, and procedural changes affecting terminals and/or ARTCC facilities).
Federal Ranges	Provide range safety and operational services to space vehicle operators operating from Federal ranges. Through agreements and the acceptance of common standards, range safety services provided by a Federal range meet the 14 CFR Parts 400-460 regulations for public safety. For operations occurring within a federal range, federal ranges compute the Flight Hazard Areas

	FHAs needed to ensure safe separation from aircraft and coordinate the results with ATC facilities and the JSpOG.
Flight Vehicles	Can be manned or unmanned and they rely on secondary launch systems to help them reach their operational altitude or orbit. They have limited propulsive capability.
Flow Control Area	The defined region of airspace, flight filters, and time interval used to identify flights subject to a constraint.
Flow Evaluation Area	The defined region of airspace, flight filters, and time interval used to identify flights.
Haul Routes	Ground routes for propellant/equipment, etc. those transit routes on the airfield that will be traversed either by a loaded vehicle or propellant fueling vehicles.
Instrument Flight Rules (IFR)	As defined from by the FAA Instrument Flying Handbook: Rules and regulations established by the FAA to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signs. It is also a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying, such as an IFR or VFR flight plan (Aeronautical Information Manual).
Integration	Incorporation of space vehicle operations as NAS Users, utilizing available airspace management techniques to ensure safe and equitable access with other users in order to maximize the efficiency and capacity of the NAS.
Joint Space Operations Group (JSpOG)	A team of FAA specialists from Air Traffic Organization (ATO) System Operations (AJR) and AST which works collaboratively with launch and reentry vehicle operators on a mission-by-mission basis. The JSpOG team was established in 2014 as a result of the FAA Administrator’s Strategic Initiatives, to collaborate to safely integrating increased launch and reentry operations into the NAS, including developing the methods and processes needed for launches and reentries.
Launch Site	The location on Earth from which a launch takes place (as defined in a license the Secretary issues or transfers under this chapter) and necessary facilities at that location. (14 CFR §401.5 definition)
Launch Vehicle	Means a vehicle built to operate in, or place a payload in, outer space or a suborbital rocket. (14 CFR §401.5 definition)

National Airspace System (NAS)	The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.
NAS User	Civil, commercial organization, government agency, military organization that makes use of NAS services and/or facilities.
Negotiation	A process for back-and-forth communication and information exchange between space vehicle operators and the air navigation service provider to establish a mutually acceptable schedule, timing, and location for a particular space vehicle operation. Note that the simplest negotiation, where the proposed changed is accepted, does not require back and forth communication.
Notice to Airmen (NOTAM)	A notice filed with an aviation authority to alert aircraft pilots of potential hazards along a flight route or at a location that could affect the safety of the flight.
Off Nominal Event	An event that is unplanned or abnormal that the system must detect and react to when it occurs, or the situation exists.
Reentry Site	The location on Earth where a reentry vehicle is intended to return. It includes the area within three standard deviations of the intended landing point (the predicted three-sigma footprint). (14 CFR §401.5 Definitions)
Refined Hazard Area (RHA)	Used by ATC. Airspace that is defined and distributed after a failure of a launch or reentry operation to provide a more concise depiction of the hazard location than a Contingency Hazard Area.
Reusable Launch Vehicle	(RLV) means a launch vehicle that is designed to return to Earth substantially intact and therefore may be launched more than one time or that contains vehicle stages that may be recovered by a launch operator for future use in the operation of a substantially similar launch vehicle. (14 CFR §401.5 Definitions)
Special Activity Airspace (SAA)	Any airspace with defined dimensions within the National Airspace System wherein limitations may be imposed upon aircraft operations. This airspace may be restricted areas, prohibited areas, military operations areas, air ATC assigned airspace, and any other designated airspace areas.
Space Operations Specialist (SOS)	Designated FAA personnel performing launch and reentry operations duties (e.g., AJR-1100, MOS, Facility POC, etc.)

Strategic Planning Team (SPT)	A focal point for the development of collaborative Strategic Plans of Operation. Their goal is to provide advanced planning information for system users and air traffic facilities in order to maximize the utilization of the NAS in an organized and equitable manner.
Telemetry	The process by which a measurement of a quantity is transmitted from a remote location to be recorded, displayed, or processed.
Temporary Flight Restriction (TFR)	An area temporarily restricted to air travel due to a hazardous condition, a special event, or a general warning for the entire FAA airspace.
The FAA Office of Commercial Space Transportation (AST)	AST ensures the safety of the public, property, and the foreign policy and national security interest of the United States during commercial space launch and reentry operations. AST also encourages, facilitates, and promotes the commercial space transportation industry. Through its regulatory role, AST facilitates the development of letters of agreement (LOAs) between launch and reentry operators, launch and reentry site operators, and ATC facilities, as described in FAA Order JO7400.2L. AST evaluates these agreements to ensure that they meet the requirements of 14 CFR Parts 400-460 regulations.
Traffic Management Initiative (TMI)	Techniques used by air traffic control to balance demand with capacity when conditions are not ideal, either at an airport, or in a section of airspace.
U.S. Notice to Airmen (NOTAM) Office	Responsible for collecting, maintaining, and distributing NOTAMs for the U.S. civilian and military, as well as international aviation communities. U.S. NOTAM Office is located at the ATCSCC.
Virtual Private Network (VPN)	An extension of a private network across a public network that enables users to send and receive data across shared or public networks as if their computing devices were directly connected a private network.
Visual Flight Rules (VFR)	Rules that govern the procedures for conducting flight under visual conditions. The term "VFR" is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate a type of flight plan.