



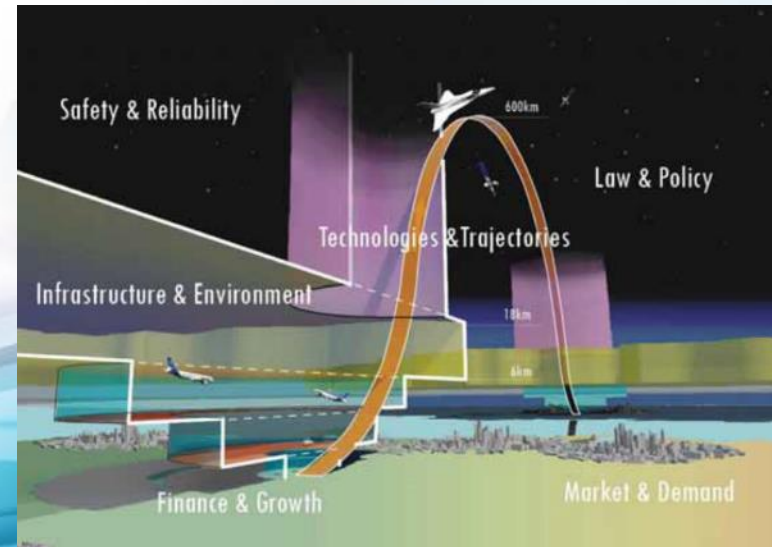
# High Speed Air and Space Transportation State of The Industry 2023

Transonic, Supersonic, Hypersonic & Sub-Orbital

Presented by:  
Oscar S. Garcia, Chairman & CEO  
InterFlight Global Corporation

High-Speed Flight Fast Forward Project  
Q1 2023 Conference Call  
March 10<sup>th</sup>, 2023

References: 2016-2023 IFG Presentations to TRB,FAA-COE/CST  
Speednews/Aviation Week, ICAO, UNOOSA, ERAU,  
FAA/AST,NBAA, HSAT, GSA , US TRANSCOM,





# Working Group Style- Call Protocols

- HSAT “Crew” will capture discussion inputs for action
  - Yvette Garcia
  - Matteo Middei
  - Doug Swiggart
  - Jeff Krukin
  - HR Zucker
  
- **ITAR DISCLAIMER**
  - **In the event this meeting includes participants identified as both “US Persons” and “Foreign Persons” in accordance with U.S. Export Control Law. Communications and discussions should avoid disclosure of ITAR or export controlled technical data**

# Working Group Style- Call Protocols

- Questions and comments are welcome along the presentation
  - Verbally
  - Chat line
- Detailed discussions and insights will be noted
  - Follow up off-line and at FF, Calls and Workshops
- Presentation will be published on the FF Website
- Call recording will be available on request
- Chatham House Rules

When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed

**Solving the Puzzle  
Enabling High-Speed Flight  
Supersonic-Hypersonic and Orbital Transportation  
By the End of Decade (2030)  
“Not Because it is Easy, But Because It is Hard”**

Photo Sierra Space



# State of the HSAT Industry 2023

**Very promising....We will, for the first time, work on involving and galvanizing the “mainstream” flying public to “clamor” for access to safe, cost-effective high-speed flight across the world!...**



# IFG Agenda

- 2023 Global-Geo and Aerospace Transport Industry Context
  - Post-COVID global air transportation new “normal”
  - **Sustained** Geo-Political Distress (Russia-Ukraine, China, Iran, et al)
  - European push to **“reduce” air transportation use**, no matter how environmentally sound, and contrary to popular “mainstream” demand
- Industry Review:
  - Transonic
  - Supersonic
  - Hypersonic
  - Suborbital/Orbital
- HSAT-FF December 2022 Review
- 2023 Go- Forward Action Plan and Insights

## **Glossary:**

**HSAT - High Speed Aerospace Transportation**

**HSF - High Speed Flight**

**P2P - Point to Point**

**A2A - Airport to Airport**

**S2S - Spaceport to Spaceport**

# High Speed Commercial Flight

## Industry Segments-CONOPS-Airspace Integration

MODE	SPEED	ALTITUDE	GANP* /TRL	TIME
➤ Transonic	Mach .90-1.0	<50,000 ft.	Existing/10	<u>NOW</u>
➤ Supersonic	Mach 1.0-3.0	<65,000	Existing/9	<u>NOW</u>
➤ Hypersonic	Mach 3.0-5.0	<150,000 ft.	Emerging/7	2030
➤ Sub Orbital-Orbital				
– Long Range	Mach 5.0-10.0	<500,000 ft.	Emerging/6	<u>2035</u>
– Ultra Long-Range	Mach 10.0+	>500,000 ft.	Emerging/5	<u>2035</u>

\*GANP=Global Air Navigation Programs (UN-ICAO), TRL=Technology Readiness Levels (1-10)



# High Speed Flight Chairman's Opening Remarks





# High Speed Commercial Aerospace Transportation

Supersonic, Hypersonic and Suborbital/Orbital **transport vehicles point-to-point flight demonstrations** are planned for 2023 (SpaceX-Starship, F-104 SSV's, perhaps VG, Dawn Aerospace and others).

The **global geo-political safety and security environments and defense imperatives accelerates the tempo of demonstrations.** Thus, I expect that the **entry into various forms of commercial services,** will be almost a decade faster, and is forecast to take place by the **late 2020's- early 2030's.**

**Safe and sustainable integration** into the existing airspace, airport and spaceport infrastructure, legislative and regulatory frameworks are essential. Need for **adequate infrastructure funding and capitalization within and around the air transportation industry** to ensure long-term industry viability.

As the vehicles exceed Mach 5; long and ultra long-haul flight times could be reduced by a factor of ten. Enabling a **“one-business-day-out-and-back”** anywhere in the world. **This capability will catalyze economies and improve geo-socio-political relationships.** It will also contribute to provide “airplane” like safe, reliable and routine **access to space.**

**Who Wants, Needs and Asks to Fly Fast Across the World?...EVERYONE!**

Oscar S. Garcia, Chairman & CEO  
InterFlight Global Corporation, March 2023

# 2022 Global-Geo and Aerospace Transport Industry Context

# Fundamental Thesis

**The HSAT Industry is “closely” coupled to the Commercial Subsonic Air Transportation, Space Transportation and the Hypersonic Military-Defense Industries.**

**HSAT is moderately coupled to the Space Exploration and Orbital industries**

# HIGH-SPEED FLIGHT (HSF) INDUSTRY R/EVOLUTION

**HSF EVOLUTION + TECHNOLOGICAL\* DISRUPTION  
= HSF R/EVOLUTION**

**\*In 2023:**

**The defense, security and global geo instability tilt the balance towards the “R”(evolution).**

**The Environmental push to reduce flying (EU driven) tilt the balance towards slow “E” (volution)**

# Air Transportation Global New Normal:

## ➤ Variables and frameworks (FAA-EASA-IATA-ICAO, et al):

- Mid-term growth set back 3 years
- Long term growth
- Security enhancements
  
- Sustainability imperatives

On track to 7 Billion Pax/Yr by 2030

On track to 10 Billion Pax/Yr by 2040

MUST prevent Biological, Chemical and Radiological (BCR) threats

MUST prevent Cyber-Attacks, Hacking, etc for both aircraft and ATM

Sustainable Aviation Fuels (SAF)

Sustainable Space Fuels (SSF)



# Air Transportation Global New Normal:

- Variables and frameworks (FAA-EASA-IATA-ICAO, et al):
  - Drive P2P smaller airports and aircraft Door to door time matters-New balance between virtual and in person travel-Less trips per person, but more people in the world travel by air
  - Surprising growth of private-business aviation Very Robust backlog of very fast long range jets
- New Normal variables FAVOR HSAT industry... except.....



# IFG Environmental Challenges-Flight Shame:

**Activists spray-paint parked Air France 777 to protest climate bill**



**Greta Thunberg Is Making People Rethink Air Travel: The Flight Shaming Movement**



**French scientists call for ban on private jets, a symbol of 'climate inequality'**





# Environmental Challenges-Space Flight Shame:



Rocket launches more polluting than all other sources

A recent research paper by Dr Eloise Marais showed that the climate effect of soot from rocket launches is 400-500 times more damaging than earthbound sources.

**Elon Musk's SpaceX launch site threatens wildlife, Texas environmental groups say**



**Upsurge in rocket launches could impact the ozone layer**

*Date:*

February 14, 2023

*Source:*

Taylor & Francis Group

*Summary:*

Researchers have summarized the threats that future rocket launches would pose to Earth's protective ozone layer





## New Normal 2023

# Air Transportation Industry Context (back to 2019 levels in 2023, 2 years ahead of forecast! Good News)

- Scheduled Domestic-Regional (i.e., EU, LATAM, USA)
  - 10/10
- Scheduled International
  - Passengers 8/10 (improving)
  - Cargo 9/10 (robust)
- General-Private Aviation 10/10 (surprise!...)

# Space Transportation New Normal:

- Variables and Frameworks (UNOOSA-COPUOS, FAA AST, NASA, ESA, et al):

- **2022 was a mixed year for suborbital and orbital human space flight**  
 Axiom AX-1, Inspiration 4, VG, Blue, SpaceX plus NASA, et al (50 total crew/participants)
- Increased number of HSF  
 Includes LEO-ISS Visits and Spacewalks
- Sustainability imperatives  
 Sustainable Orbital Environment (debris and space traffic management)
- First Demos Suborbital/Orbital P2P  
**SpaceX Starship leads (ready to go)**
- Spaceport to Spaceport Airspace  
 In development S2S-White Paper
- Capital available, SPACS and others  
 Tech developed can derive to HSAT

➤ **2023 New Normal variables HIGHLY FAVOR HSAT industry...But Public Perception (Billionaires only?), Environment?**



## New Normal 2023



Photo: Virgin Galactic

## Space Transportation Industry Context

- Human SpaceFlight 8/10 (VG-Blue next flights?)
- Orbital P2P airspace development 9/10 (S2S White Paper)
- Orbital traffic, debris and compliance 5/10 (critical!)
- Geo-Political Environment (March 2023) 3/10 (problem!)



# Commercial High-Speed Flight 2023

## “Game-Changers”- Hypersonics

### Defense and National Security

Defense Production Act Title III  
Presidential Determination for  
Airbreathing Engines, Advanced  
Avionics Position Navigation and  
Guidance Systems, and Constituent  
Materials for Hypersonic Systems  
March 3, 2023

<file:///C:/Users/inter/OneDrive/2022/HSAT/HYPersonics/R45811%20Congress%20HYpersonics%20Feb%202023.pdf>



**Hypersonic Weapons:  
Background and Issues for Congress**

Updated February 13, 2023

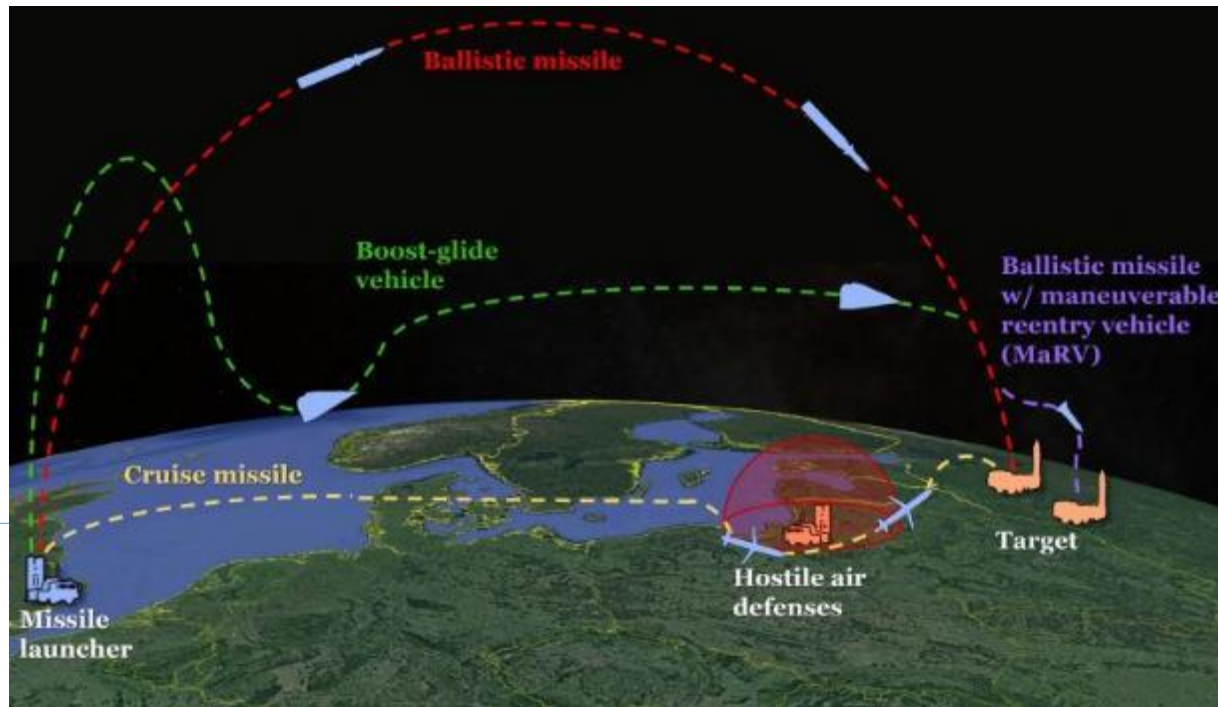




Photo: National Defense Magazine

## ➤ Defense and Security New Normal:

### – Reset Variables (US DOD, EU, AUS, Japan, NATO, et al led):

- Budgets for hypersonic weapons
- Budgets for Orbital transport
- Budgets for space weapons
- New Threat realms
  - Chemical, Biological and Radiological
  - Cyber and Communications
- March 2022-3 war events (Russia)

New US Admin, New Trans-Atlantic, ASEAN  
Hypersonic Defense Strategies Increase

USTRANSCOM-CRADA's SpaceX, Blue, Xarc,  
Rocketlab

New US Admin, EU-Germany-France, AUS and UK  
Non-Kinetic-Non-Flight Related

ISS, Soyuz, et al as war-bargaining chips

Russian ASAT Strike, UNCOPUOS/UNOOSA tensions

## ➤ Post Covid-Post March 2022 Geo-Conflicts HIGHLY FAVOR the HSF development



# **New Normal 2023 High Speed Flight (HSF) Point to Point (P2P)**



Photo: National Defense Magazine

## **Defense and Security Industry Context**

- **Humanitarian Medical/Disaster relief and War-Events March 2022-3** **Favor HSF P2P (9/10)**  
**ROCKET CARGO!**
- **Orbital Situational Civil-Defense** **Favor HSF (8/10)**
- **Geo Defense Volatility** **Blocks HSF (5/10)**
  - **Increased ITAR/EAR**
  - **Decreased Tech Transfer/Supply Chains**

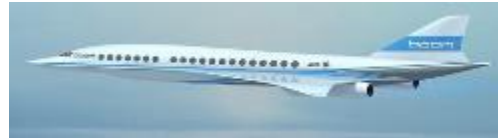


# New Normal 2023 Favor HSAT Industry

- **Chemical Bacteriological and Radiological (CBR) Security in Airport and Aircraft environments**
  - Smaller commercial aircraft-larger business aircraft
  - Smaller airports- Direct-Hub Bypass-Suitable for future high-speed vehicles
  - Business and First class move to separate aircraft-then high-speed vehicles
- **Increased used of private aviation**
  - Assured access and itineraries- Door to Door Speed-Connectivity (i.e., Advanced Air Mobility feeding high-speed vehicles)
- **More virtual and remote based middle-management**
  - More high speed travel for leadership, top-management and geo-political decision making
- **Shift to Sustainable Av and Space Fuels (SAF-SSF's)** from the get-go, including low volume demand
- **Diplomatic and Collaborative Defense** requires “face to face” travel for Defense leaders
  - Intel-Data Diplomacy vs. Kinetic strategies favors transportation vs. weapon delivery
  - Defense budgets could grow aligned with the private sector R&D for HSAT



# HSF Flight 2023-2030 Decade



# High Speed Transonic



Photo Credit: Gulfstream

# High Speed Transonic M.94



Photo Credit: Bombardier



# Private Aviation Ultra-Long-Range Mission BOEING BBJ 777-X 12,500 NM/M.85/22 HRS “Anywhere to Anywhere on Earth NON-STOP





# Transonic

## Existing Certified Vehicles

Range and Comfort are NOT the Issues, Speed is!

### 777-200LR RANGE CAPABILITY



347.45 tons maximum take off weight  
301 passengers  
Airways and traffic allowances included

----- Distance 11,000 miles approx  
----- Maximum range

Source: Boeing



# Fast Transonics

## Existing Certified Vehicles

Integrated in airspace Mach .90-1.0 <50,000 ft.

**MAX RANGE 8,000 Nm**



Photo Credit: Bombardier

### The world's longest non-stop flights



Perth – London  
17h 20m



Houston – Sydney  
17h 30m



Auckland – Doha  
17h 40m



Singapore – New York  
18h 45m

# Fast Transonics

## Existing Certified Vehicles

Integrated in airspace Mach .90-1.0 <50,000 ft.

**MAX RANGE 8,000 Nm**



The world's longest non-stop flights



Perth – London  
17h 20m



Houston – Sydney  
17h 30m



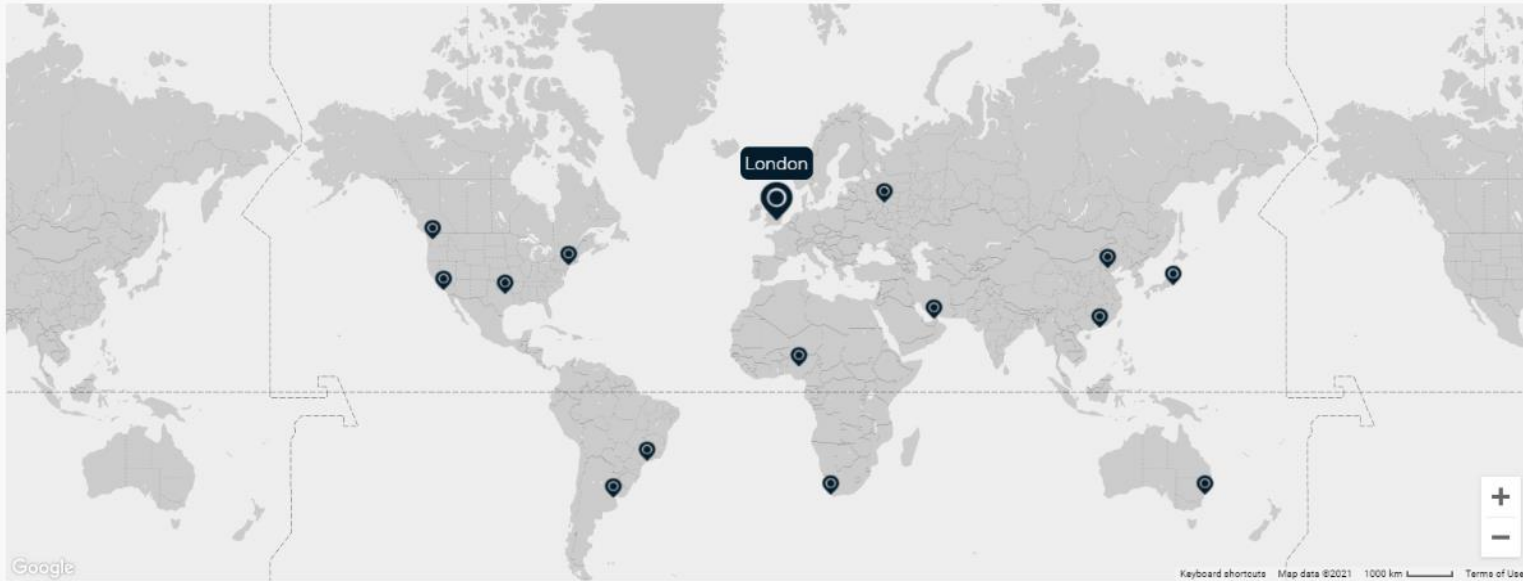
Auckland – Doha  
17h 40m



Singapore – New York  
18h 45m



# Private Aviation Ultra-Long-Range Mission G-800 8,000 NM/M.85/17 HRS The World in 4 Business Days



# Fast Transonics

## Existing Certified Vehicles

Integrated in airspace Mach .90-1.0 <50,000 ft.

**MAX RANGE 8,000 Nm**



Photo Credit: Bombardier

### The world's longest non-stop flights



# TRANSONICS STATE-OF-THE-ART CHALLENGES FOR PUSH INTO SUPERSONIC

- **Technical**                      **Max Range to 12,500 sm /20 hours endurance at Max Speed >M.90**
- **Propulsion**                    **Adapting supersonic engines de-rated**
- **Environmental**
  - **Human factors, fatigue, radiation on long flights**
  - **Enviro Sustainability**
    - **Fuels –Future Electric/Hydrogen/Hybrids**
  - **Noise**
    - **Achieve Mach Cut-Off @ M1.1-1.2 for flight overland**
  
- **Economic**                      **Difficult to scale aircraft size and maintain efficiencies**
- **ATC/ATM/STM**                **Door to Door speed gains reduced by terminal airspace and airports congestion – ATC efficiencies are a KEY Emissions “Reducer”**

# Supersonic



Conceptual render

# SUPERSONIC – Towards a 3-Day World



Quieting the Sonic Boom

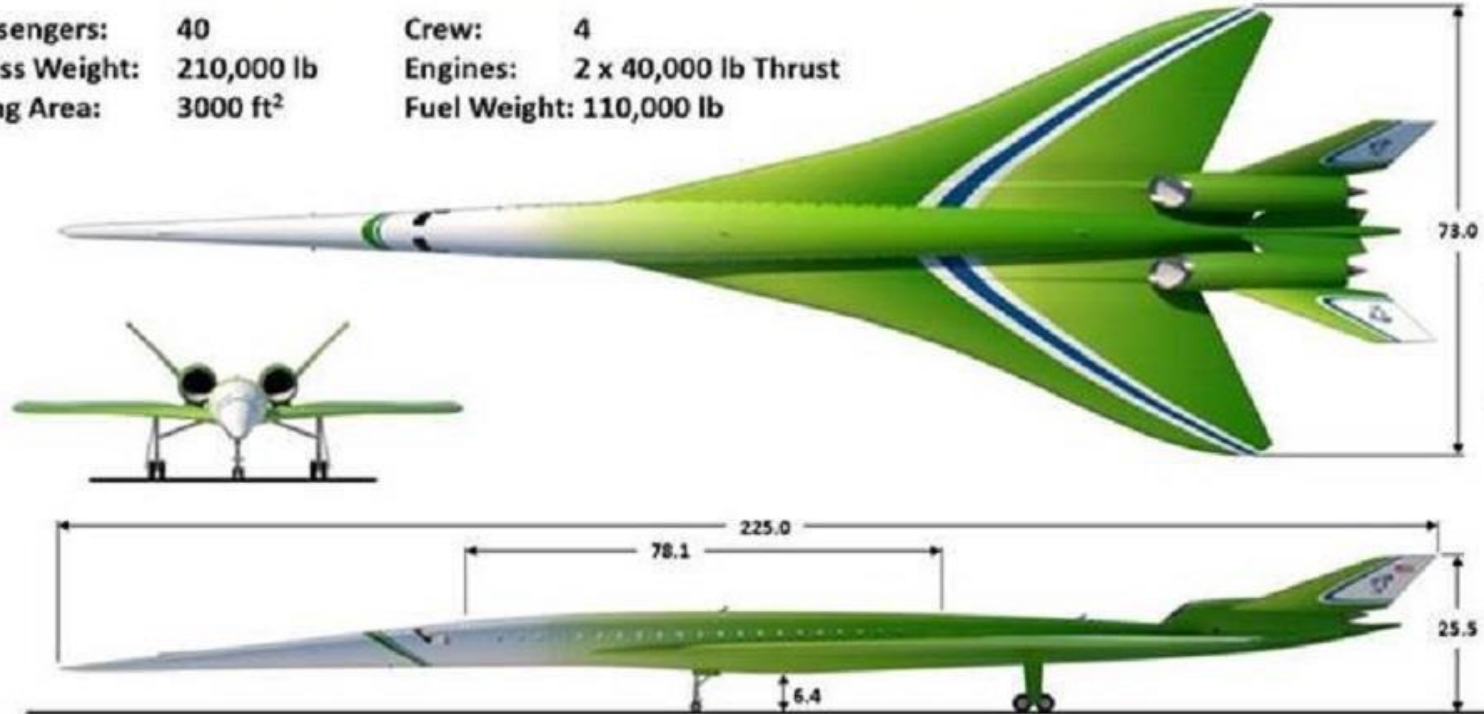


PHOTO: NASA

# SUPERSONICS – Towards a 3-Day World

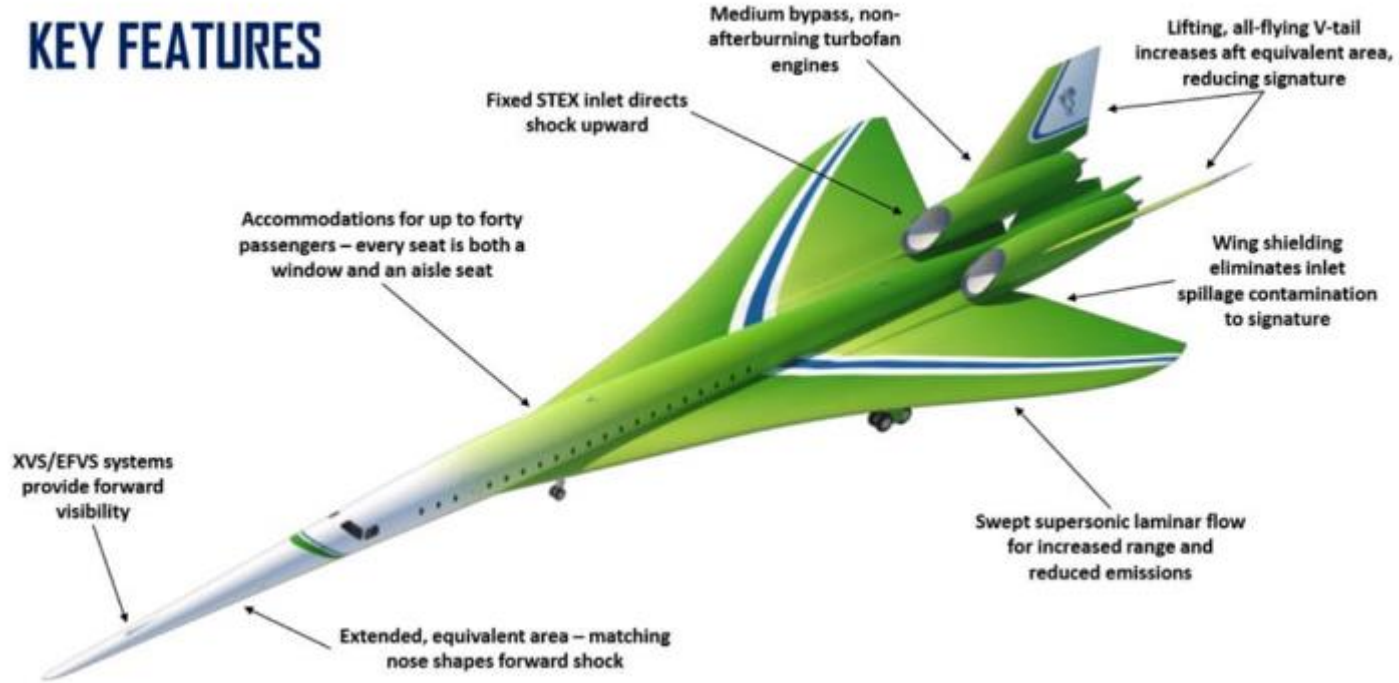
## QUIET SUPERSONIC AIRLINER CONFIGURATION OVERVIEW

Passengers:	40	Crew:	4
Gross Weight:	210,000 lb	Engines:	2 x 40,000 lb Thrust
Wing Area:	3000 ft <sup>2</sup>	Fuel Weight:	110,000 lb



# SUPERSONICS – Towards a 3-Day World

## KEY FEATURES



# Supersonic

## Certified Vehicles - Airspace Integrated



Mach 1.0-3.5  
 <65,000 ft.  
 4,000 Nm

Concorde Experience = CONOPS Feasible

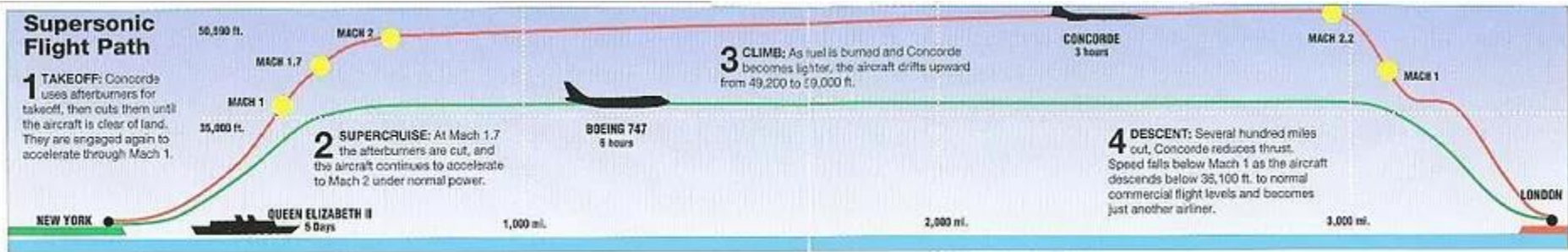


Image © International Masters Publishers Inc. "Miracle of the World" produced under license to IFG, Inc.

Source: Concorde-Heritage.com



# Supersonic

## Certifiable Vehicles - Airspace Integrated Concorde Experience = CONOPS Feasible



Source: Concorde-Heritage.com

# Commercial High-Speed Flight 2023 “Game-Changers”- Supersonic



Spike Aerospace, Tech Mahindra sign MoU for Supersonic flight

17 Feb 2021 by Business Traveller India



### Sustained super cruise

Optimized for prolong high speed use. Durable hot and harsh combustors and advanced coatings for turbine section. Slim high-altitude design.



### Operability redefined

Performance throughout the flight envelope with a high-altitude service ceiling of 60,000 feet.



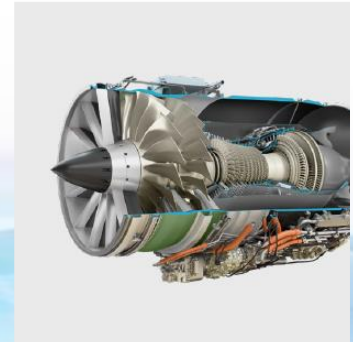
### Noise compliant

Acoustically treated throughout, the Affinity is designed to meet or exceed regulatory requirements.



## GE's Affinity™

Supersonic turbofan



Bids for Aerion Assets Now Due on September 7

by [Kerry Lynch](#)

- August 8, 2022, 12:25 PM

- **PROJECT FAILED TO RAISE INVESTMENT TRANCHE, JUNE 2021**
- AERION PROGRAM IS IN FINANCIAL-ASSIGNMENT FOR THE BENEFIT OF CREDITORS (ABC) **Assets SOLD September 7<sup>th</sup>, 2022**
  - Restart...With an even Faster ~M3.0-4.0 Aircraft



# Commercial High-Speed Flight 2023 “Game-Changers”- Supersonic

**Aerion Assets SOLD!**  
**Assigned to Boeing Ace**  
**Welcome Back AS-2?**



# A Promising New Entrant



## Spike Aerospace S512

- M 1.6, 18 PAX, 6,200 NM, 50,000ft

**\$100million supersonic private jet gets ready for take-off in 2022**

The Spike S-512 Supersonic Business Jet, by Boston-based Spike Aerospace, is slated for test flights in 2022

The plane will incorporate 'windowless Multiplex Digital tech' – high-definition screens instead of windows

It's claimed that the 1,100mph jet will produce a quiet sonic boom - something like a soft clap at ground level

By TED THORNHILL, MAILONLINE TRAVEL EDITOR

Daily Mail  
.com

PUBLISHED: 14:27 EST, 4 March 2021 |





# A Promising New Entrant



## Spike Aerospace S512

- M 1.6, 18 PAX, 6,200 NM, 50,000ft





# A Surprise Japanese New Entrant

Quiet, 50 Seat ~ M 2.0,  
5,000 NM, 50,000ft

Press release

The Japan Aerospace Exploration Agency (JAXA) announced today that, together with Mitsubishi Heavy Industries, Kawasaki Heavy Industries, and Subaru, they plan to develop supersonic planes by 2030. Forming what it calls the Japan Supersonic Research Council



Japan Expects To Develop Supersonic  
Planes By 2030

BY MARK FINLAY  
PUBLISHED JUN 16, 2021



# Commercial High-Speed Flight 2023

## “Game-Changers”- Mach 3 Supersonic



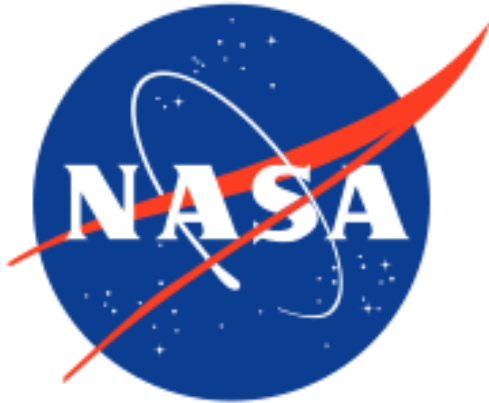
**Virgin Galactic unveils Mach 3 design for supersonic passenger flights**

By [Chelsea Gohd](#) August 03, 2020





# Commercial High - Speed Flight “Game-Changers”- Mach 3 Supersonic



Virgin Galactic is partnering with NASA to develop supersonic point-to-point air travel

[Darrell Etherington@etherington](mailto:Darrell Etherington@etherington) / 2:05 PM MDT • May 5, 2020

**Newsweek**

## TECH & SCIENCE

### NASA and Virgin Galactic Are Developing Supersonic Air Travel

BY [JASON MURDOCK](#) ON 5/6/20 AT 10:37 AM EDT

MAY 6, 2020

The work will be conducted via a Space Act Agreement.

# Supersonics - Market Demand Airlines



# Supersonics - Market Demand Airlines

**Overture**

Area-ruled carbon fiber composite fuselage

55 premium seats

Large personal windows

Quiet, efficient turbofan engines

Capacity	55 seats	Altitude	60,000 ft.
Length	46 meters	Round-trip transatlantic fare	Similar to today's business class (~\$5,000)
Maximum speed	Mach 2.2 (1,451 mph)	Demand	1,000 - 2,000 airliners serving 500+ global routes* <small>Based on Boom's research</small>
Flight range	4,500 nautical miles nonstop (9,000 with refueling stop)	Timeline	First flight: Mid-2020s



Boom Supersonic and Rolls-Royce Agree on New Collaboration for Supersonic Overture Engine Program Design Engine Studies Advance Program Development and Focus on Sustainability

(PRNewfoto/Boom Supersonic)  
NEWS PROVIDED BY

Boom Supersonic  
Jul 30, 2020, 10:02 ET

# Supersonics - Market Demand Airlines



Collins Aerospace and Boom Supersonic announce strategic collaboration

Supersonic jet company adds former Boeing CEO Phil Condit as advisor

**Boom Supersonic Achieves Unicorn Status With \$50M in New Funding**

BY ASHLEY BOWDEN  
DECEMBER 15, 2020

PUBLISHED FRI, FEB 19 2021 9:00 AM EST  
UPDATED FRI, FEB 19 2021 9:03 AM EST



BOOM! AEROSPACE

# Supersonics - Market Demand Airlines

Supersonic Steps: <https://www.youtube.com/watch?v=hGbcnhzOWWU>

- Japan Airlines (JAL) signs for 20 supersonic airliner options
- Boom Supersonic has 76 options, 20 of which are for JAL, 10 for Virgin Atlantic
- Three more operators that placed options have yet to be announced
- Boom design seats 55 and will cruise at Mach 1.7, cutting flight times 50%
- Projected in service LATE-2020's



# SUPERSONIC STATE-OF-THE-ART CHALLENGES

- **Legislative**
  - Over Land,- FAA HR 4 provides for research and review mandate
- **Technical**
  - Propulsion and Materials
- **Environmental**
  - Noise sonic boom, over-land flight emissions-pollution above 50,000 ft
- **Economic**
  - Costs and Current Markets
- **ATC/ATM/STM**
  - Safety and Efficiency
  - SWIM, NEXTGEN, SESAR, etc
  - Airports-Spaceports, SID's, STAR's
  - High Speed-Altitude Gateways
  - Air or Space?- New Realm
- **Human Factors**
  - Exposure to radiation >50,000ft,
  - Jet-Lag, depressurization survival
- **Supersonic**

# Supersonic - State of Affairs

## Main Challenge - Overland Flight Rules and Certification Standards



- **FAA Authorization- for Testing Mach 1+ Over Land**
  - CFR 91.818 Flight Test > M1 Authorization Rule Published 2021
  - US Rule and Standards for over land reviewed every 2 years could be ready 2023-2025
  
- **EASA RUMBLE Project (Regulation and norm for low sonic Boom Levels) 2025-2026**
- **NASA X-59 Program-Leads World**
  - Community overland acceptance flights 2022-2025
  
- **ICAO Supersonic aircraft certification for overland flights based on Committee on Aviation Environmental Protection (CAEP)**
  - Receives data from NASA X-59, trails FAA, data set due 2024-2025
- **Takes 3-5 Years after ICAO from CAEP data set to Standards 2028-2030**
- **Uncertainty for OEM's – Designing for an unknown international standard**

# Supersonic - State of Affairs

## Second Challenge Remains Integration into the NAS

- **State of the Art for Studies is 2017-2018**  
<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20180000699.pdf>
- **NASA ConOps 2025-2035**
- **Flight Deck and ATC design**
- **Integration in NextGen, SWIM, etc**
- **Assumes cruise 50-60,000 ft**
- **Assumes Subsonic transitions at M.95**
- **Assumes Subsonic traffic mix and flow for departures (SID) and arrival procedures**
- **Need for new “Corridors Clear of Traffic”, using ATC 4-D trajectories to optimize supersonic cruise time**
  - **Civilian versions of High-Altitude Supersonic Corridors**
- **Introduces the use of Autonomous Flight Rules (AFR) –Vehicle separates itself from others**
- **Introduces Real Time Sonic Boom Mapping cockpit instruments and flight management systems**

NASA/TP-2017-219796



Concept of Operations for Integrating  
Commercial Supersonic Transport Aircraft into  
the National Airspace System

*Matthew C. Underwood  
Langley Research Center, Hampton, Virginia*

December 2017



# Supersonic Challenges

## ATC/ATM/STM -Airspace Integration



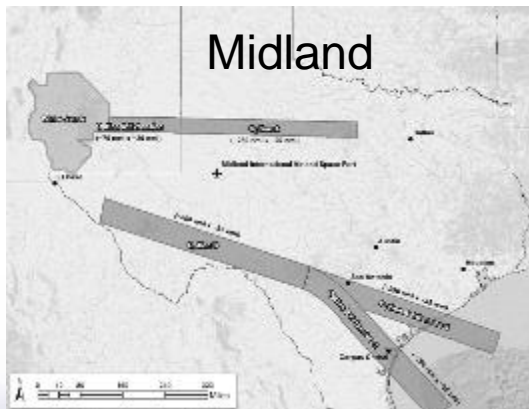
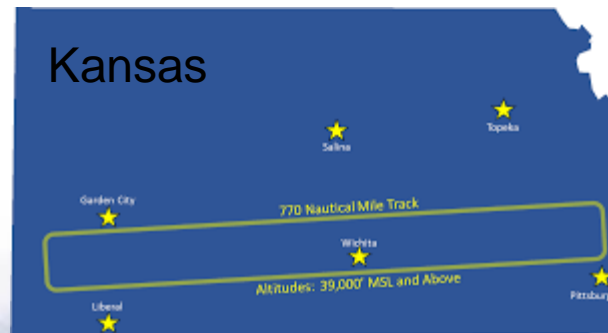
Source: Contrail Science



# Supersonic - State of Affairs

## Second Challenge Remains Integration into the NAS

- In addition to existing Military Supersonic Corridors i.e. Mojave-China Lake
- Three Civilian Corridors under development in:
  - Seattle, WA
  - Kansas City, KS
  - Midland, TX



# Supersonic - Noise Mitigation Tech Enablers

- Aerodynamics - Different approaches
- Avionics - Variable speed with terrain contours
- Ongoing NASA research X-59 Lockheed Martin
- Takeoff and Landing Variable Noise Reduction Systems (VNRS) , Limit 150,000 Lb and M 1.8



- GE Affinity- First New Commercial Supersonic Engine in 55 years since the Rolls Royce Olympus (Concorde RR)

<https://bikeshop.geaviation.com/community/ges-affinity-launches-new-era-of-efficient-supersonic-flight/>



Supersonic-  
Propulsion  
Tech Enablers

# Supersonics – ALL ABOUT ENGINES!

**Overture** **Bloomberg**

Area-ruled carbon fiber composite fuselage

55 premium seats

## Supersonic Jet Deal Blow When Rolls-Royce Quits Boom

Large personal windows

Quiet, efficient turbofan engines

Length 46 meters

Round-trip transatlantic fare

Similar to today's business class (~\$5,000)

1,000 - 2,000 airliners serving 500 global routes\*

First flight: Mid-2020s

# Technology

sep 8th, 2022



Boom Supersonic and Rolls-Royce Agree on New Collaboration for Supersonic Overture Engine Program Design Engine Studies Advance Program Development and Focus on Sustainability

(PRNewsfoto/Boom Supersonic)  
NEWS PROVIDED BY

Boom Supersonic  
Jul 30, 2020, 10:02 ET

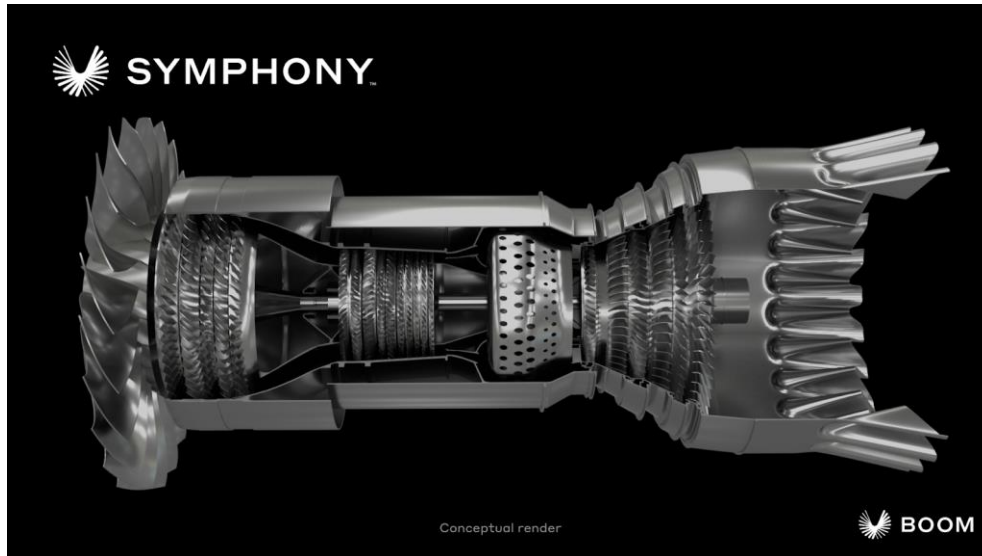
# Supersonics – ALL ABOUT ENGINES!

## A Powerplant At Last: Boom Secures Engine Makers For Its Supersonic Overture

BY JOANNA BAILEY

PUBLISHED DEC 13, 2022

The future of the project had long been in question after major engine makers declared no interest.



HAS BEEN ACQUIRED BY



### Symphony Specs

- Architecture: twin-spool, medium-bypass turbofan engine, no afterburner.
- Thrust: 35,000lbs at takeoff.
- Fuel: optimized for 100% Sustainable Aviation Fuel.
- A single-stage fan designed for quiet operation.
- Passively cooled high-pressure turbine.

# Supersonic - State of Affairs

## Third Challenge Is Environmental Pressure

- Industry Must Lead Environmental Cost-Benefit of High-Speed-Flight
- GA, BizAv and Air Transportation industries must lead with an educated, unified voice about environmental and sustainability issues
- Most attacks against High-Speed Flight lack experience, technical and contextual understanding of the aerospace transportation
- SAF fuels are a positive development-achievable by 2030
- Hydrogen and electric powerplant standards by 2035-2040 in the EU could be a constraining obstacle



“The environmental and health impacts of a new generation of supersonic aircraft could be immense”

Environmental performance of emerging supersonic transport aircraft

Authors: Anastasia Kharina, Tim MacDonald, Dan Rutherford\*  
Date: July 17, 2018 Keywords: supersonic, aircraft fuel efficiency, NOX, noise, ICAO



**FAA ASCENT is an R&D program pertaining to high speed. R&D being conducted in numerous institutions across the USA: MIT (clean sheet engine design), Penn State (Noise levels), University of Illinois (impact supersonic noise)**

# Hypersonic





# IFG Future Markets for Hypersonic Commercial air Transportation

Recently Completed market-business  
and life cycle costs studies- IT IS FEASIBLE!



# Independent Market Study

## Commercial Hypersonic Transportation

### Systems in Various Stages of Development

Aeron Supersonic shut down operations in May 2021. All images used with permission.



**S-512**  
Spike Aerospace  
Mach 5  
18 PAX



**Hermeus**  
Mach 5  
Undisclosed PAX



**QSTA**  
Lockheed Martin Corp  
Mach 7.8  
40 PAX



**JAXA**  
Mach 5  
100 PAX



**Exosonic**  
Exosonic, Inc  
Mach 7.8  
70 PAX



**Stratofly**  
European Horizons 2020 Team  
Mach 6  
300 PAX



**Overture**  
Boom Technology, Inc  
Mach 2.2  
55 PAX



**Talon-A**  
Stratolaunch  
Mach 6  
No PAX - Hypersonic test platform



**Virgin Galactic**  
Mach 3  
9-19 PAX



**X-60A**  
GOLauncher  
Mach 6  
No PAX - Hypersonic test platform



**Concorde 2**  
Airbus  
Mach 4.5  
20 PAX



**Boeing**  
Mach 5  
~100 PAX



A-12/SR-71 Mach 3+



X-1 Mach 1

Concorde Mach 2

Sound barrier broken in powered, level flight of X-1 by Chuck Yeager on October 14, 1947



P-51 440 mph



112 mph



The work in this report was conducted under subcontract to SAIC for NASA Aeronautics Research Mission Directorate

### Demand

Mach 3

#### Optimal business case

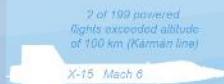
"Sweet spot" between additional revenue attracted by time savings and increased cost of operation

Demand for up to **\$78B** in revenue,  
**10M** passengers on  
**249** profitable routes

Demand figures for 1.5x subsonic premium fare prices and a vehicle range of 4,500 miles (2020 dollars)



Based on Bryce survey most high net worth individuals are interested in high-speed commercial flight



2 of 199 powered flights exceeded altitude of 100 km (Kármán line)

X-15 Mach 6

\$15B

\$9B

\$24B

Given Future demand commercial high speed trans business could support up to \$24B in RDT&E (2020 dollars)

Commercial Aviation

General Aviation

### Non-Technical Barriers to Entry

**28** Non-technical barriers identified



#### Airport Infrastructure

- 1 Insufficient runway length
- 2 Aircraft incompatibility with existing infrastructure
- 3 Special maintenance and support personnel requirements
- 4 Pre-flight inspections
- 5 Post-flight cool down
- 6 Need for specialized storage, transport, and handling of cryogenics



#### Air Traffic Control

- 7 High speed takeoff, ascent, descent approach, and terminal operations



#### Certification

- ✓ 8 Type certification in increasingly strict safety and environmental condition
- ✓ 9 Stability and control challenges across the flight envelope may create safety compliance issues
- 10 Extended operations (ETOPS)
- 11 Emergency descent and landing requirements FAR Part 25.841
- 12 New partial and full automation requirements
- ✓ 13 U.S. and international prohibition of overflight
- 14 Delays and absence of ground test equipment



#### Environmental Impacts

- 15 Sonic boom
- 16 Emissions
- ✓ 17 Hazardous materials handling and storage



#### Export Controls

- 18 ITAR restrictions and operations maintenance, and software
- ✓ 16 GNSS receivers



#### Societal

- 23 Global awareness of human-induced climate change
- 24 New technologies reducing demand for high-speed transportation



#### Insurance

- 20 Insurance



#### Weather

- ✓ 26 Impact of special materials



#### Workforce

- 27 Aircrews
- 28 Engineers and manufacturing professionals



Barriers with high consequences where government mitigation actions would have a significant impact

# Commercial High-Speed Flight 2023

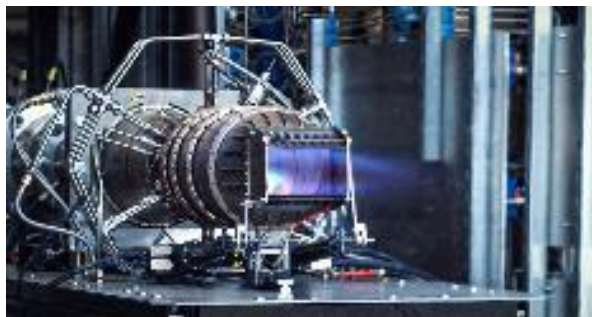
## “Game-Changers”- Hypersonics

### Commercial Transportation

Flight  
Global

Forbes

Swiss Hypersonic Startup  
Destinus Appears Destined  
For Same Path As U.S.  
Counterparts



Stratolaunch wraps critical design review, aims for hypersonic flight test in 2022  
By Garrett Reim30 September 2021



# Hermeus [www.hermeus.com](http://www.hermeus.com)

## A “Game-Changer”- Hypersonic M5.0

Worth a Look: Audio, Video, Appealing to the Mainstream Multi Generational Markets!





# Hermeus [www.hermeus.com](http://www.hermeus.com)

## A “Game-Changer”- Hypersonic M5.0

Worth a Look: Audio, Video, Appealing to the Mainstream Multi Generational Markets!



**INVESTING IN SPACE** Hypersonic aircraft start-up Hermeus raises \$100 million to finish prototype, build out fleet

PUBLISHED THU, MAR 10 20 22 11:58 AM

EST UPDATED THU, MAR 10 20 22 12:05 PM EST

[Michael Sheetz@THESHEETZTWEETZ](https://twitter.com/thesheetztweetz)

16 MAY 2022

Raytheon invests in hypersonic aircraft firm

Hermeus

by Marc Selinger

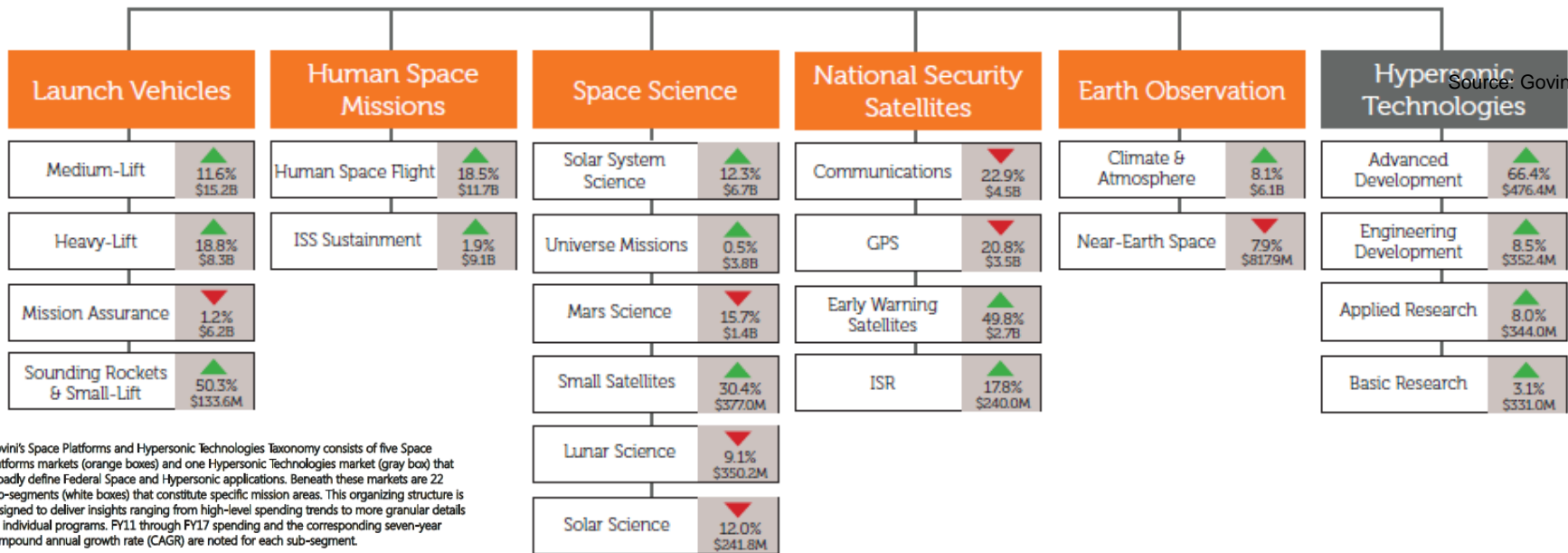


# Commercial High-Speed Flight 2023

## “Game-Changers”- Hypersonics



### SPACE PLATFORMS & HYPERSONIC TECHNOLOGIES TAXONOMY



Source: Govini

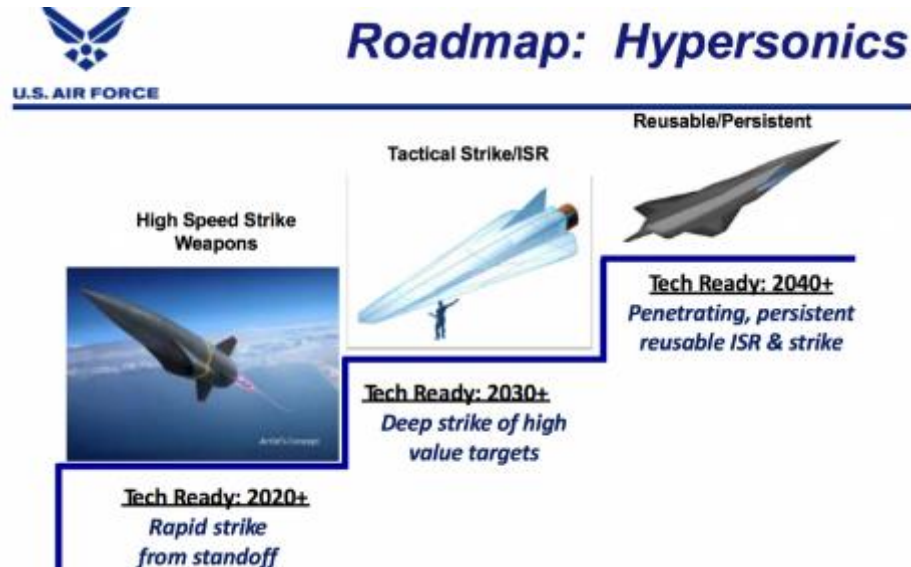
Exhibit 1: Govini's Space Platforms and Hypersonic Technologies Taxonomy consists of five Space Platforms markets (orange boxes) and one Hypersonic Technologies market (gray box) that broadly define Federal Space and Hypersonic applications. Beneath these markets are 22 sub-segments (white boxes) that constitute specific mission areas. This organizing structure is designed to deliver insights ranging from high-level spending trends to more granular details on individual programs. FY11 through FY17 spending and the corresponding seven-year compound annual growth rate (CAGR) are noted for each sub-segment.

# Commercial High-Speed Flight 2023

## “Game-Changers”- Hypersonics

### Defense and National Security

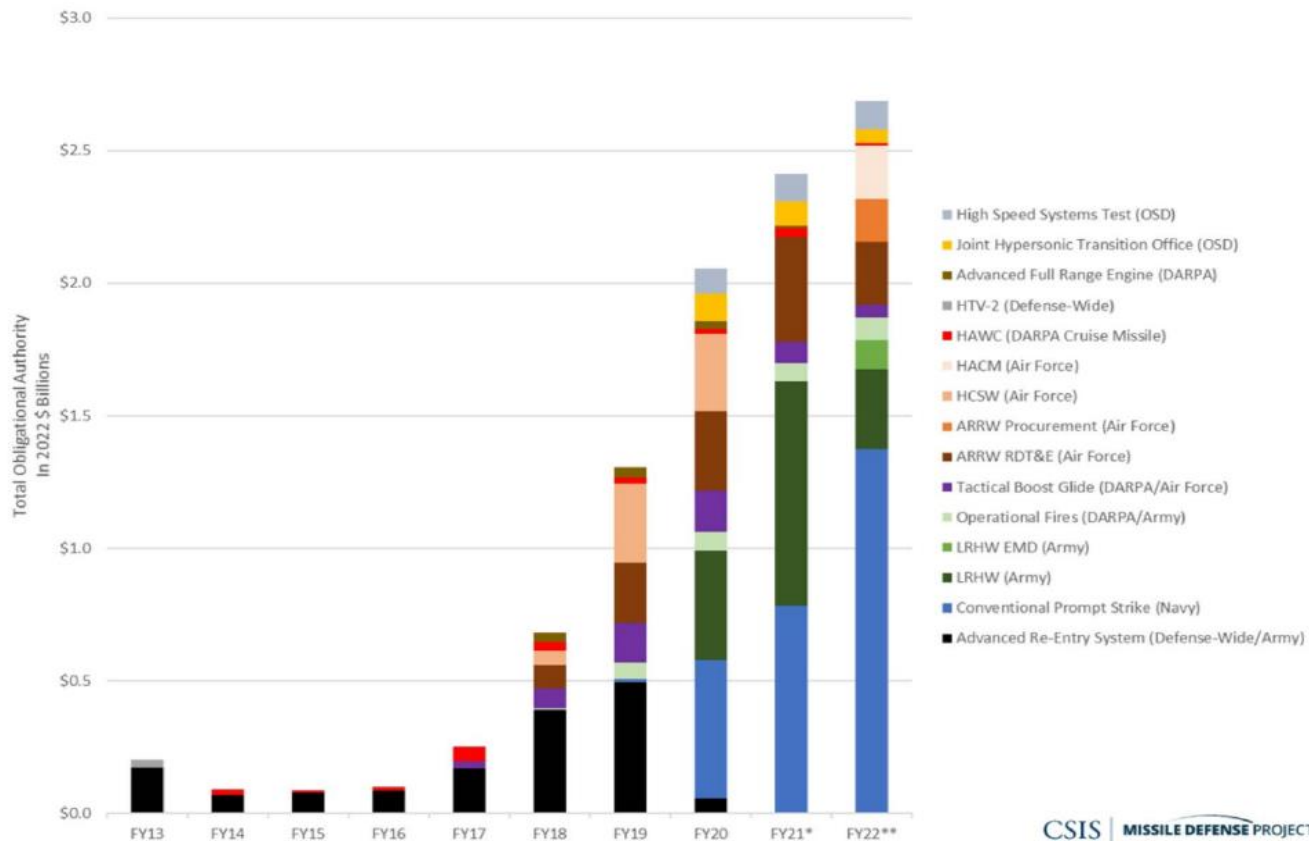
BREAKING  
DEFENSE



The USAF, in collaboration with Lockheed Martin, is testing the AASW air-to-surface hypersonic weapon. (US Air Force)

# Commercial High-Speed Flight 2023 “Game-Changers”- Hypersonics Defense and National Security

Figure 3: Selected DoD Hypersonic Weapons Programs, 2013–2022

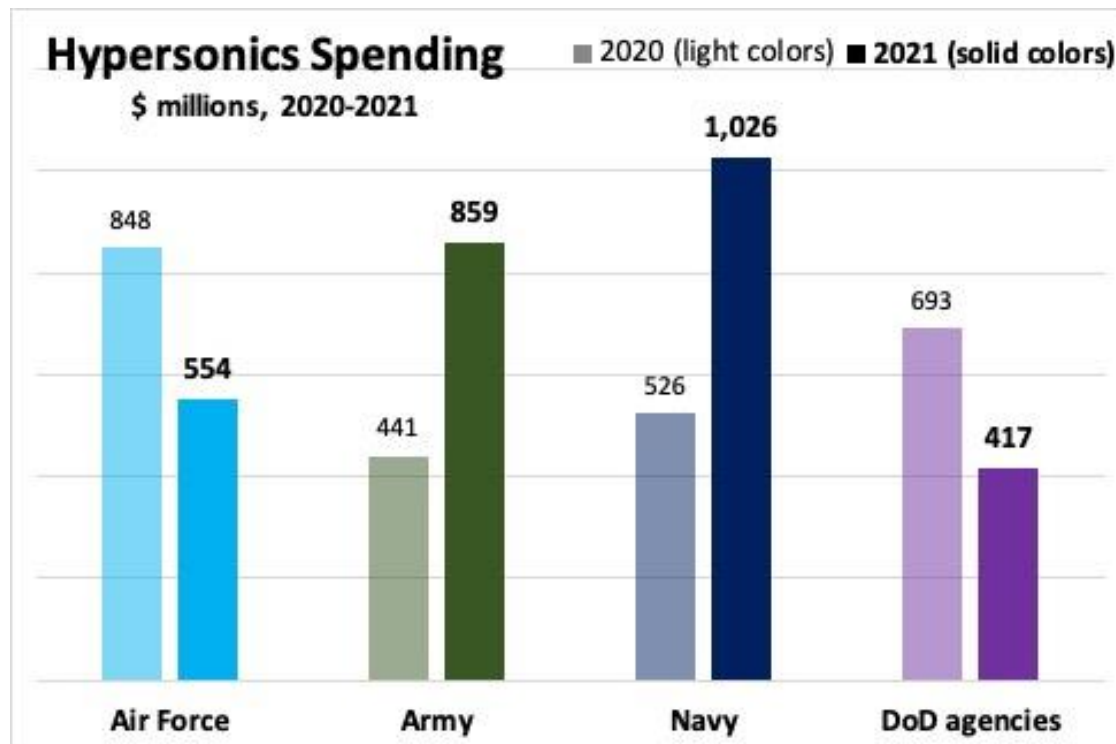


\*Appropriated dollars, \*\*Based on 2022 PB

Source: DoD Comptroller and CSIS analysis.



# Commercial High-Speed Flight 2023 “Game-Changers”- Hypersonics Defense and National Security

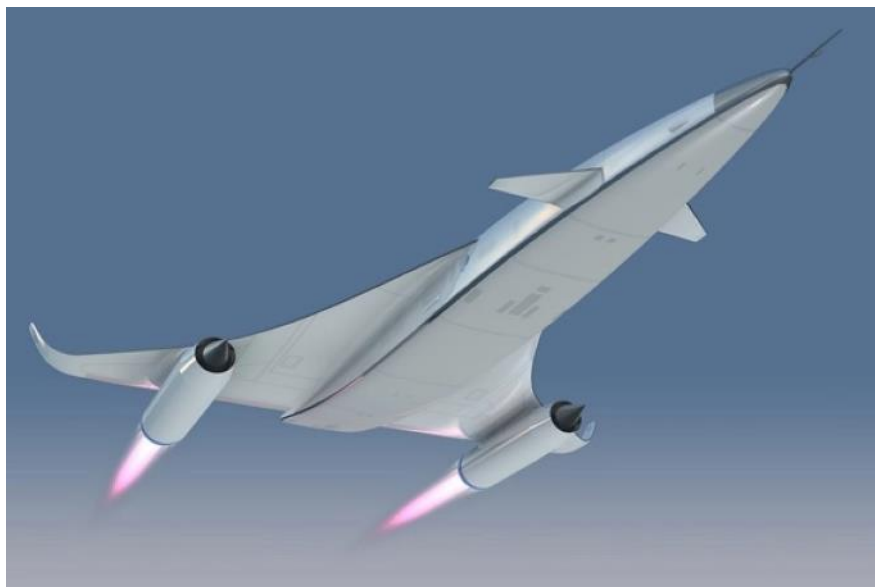


# Commercial High-Speed Flight 2023

## “Game-Changers”- Hypersonics

**Reaction Engines unveils low-carbon spin-off for SABRE technology**

By [Dominic Perry](#) 5 November 2021



# Commercial High-Speed Flight 2023 “Game-Changers”- Hypersonics



US Air Force Testing High-Mach 4 Engine Technology

9/9/2022

By [Mikayla Easley](#)

Plans for UK hypersonic aircraft revealed at  
Farnborough Airshow

22 JULY 2022 • IN [NEWS](#)

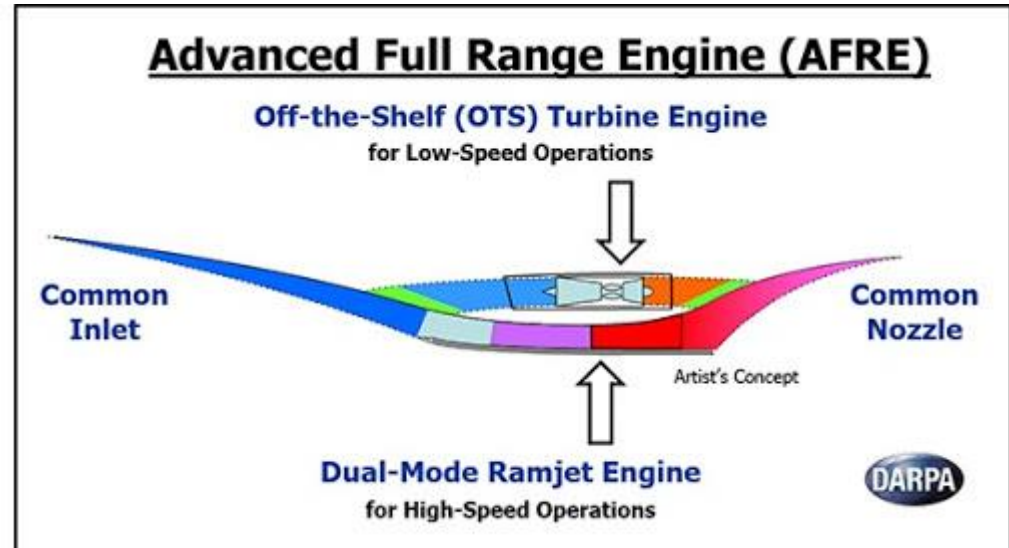
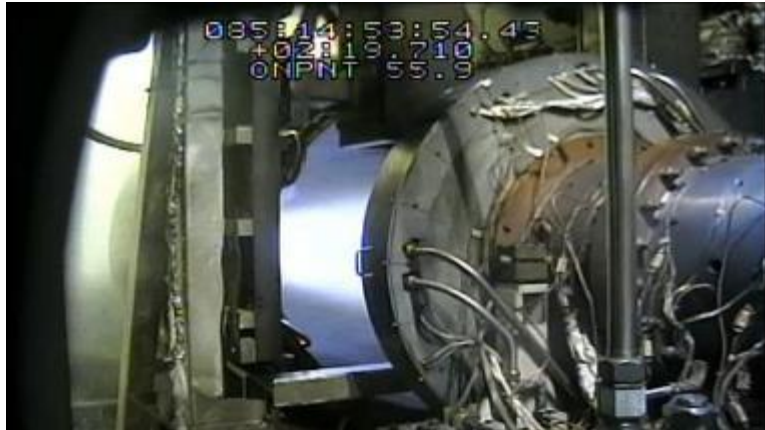


# Commercial High-Speed Flight 2022

## “Game-Changers”- Hypersonics



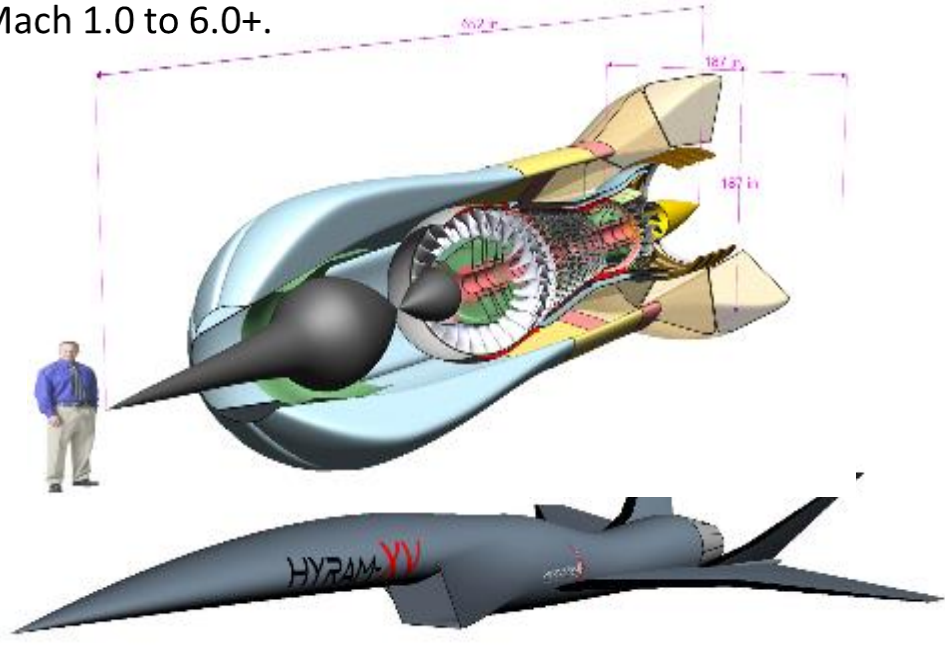
- New dual-mode ramjet/scramjet (DMRJ) engine successfully tested over a wider operating range than previously demonstrated (**58Kn sustained thrust** ~10X size of X-51 **Scalability?**)
- Successful testing brings our nation one step closer to developing hypersonic aircraft capable of conventional takeoff and landing
- Aerojet Rocketdyne has been a leader in developing hypersonic propulsion technologies for more than 30 years



# Commercial High-Speed Flight 2022

## “Game-Changers”- Hypersonics

HYSCRAM-AB is a turbine-based-combined-cycle engine (TBCC) which is hybrid (half-electric, half-jet) and shaftless with four engine cycle, turbine-ramjet-scramjet-MHD, an architecture for seamless propulsion power, Mach 1.0 to 6.0+.



# Commercial High-Speed Flight 2022 “Game-Changers”- Hypersonics



## WHAT IS THE X-60A?

X-60A is a small high-speed flight testbed for conducting research and development of future hypersonic systems. It is currently being developed by Generation Orbit® and its partners, under the sponsorship of the US Air Force Research Lab, and projected for initial flight test in 2020.

## VEHICLE OVERVIEW

The X-60A's LOX/kerosene liquid propulsion system maximizes performance and mission flexibility compared to traditional solid booster solutions. A small delta wing increases the overall maneuverability of the platform. The vehicle is a research platform with an onboard flight telemetry system for research data capture.

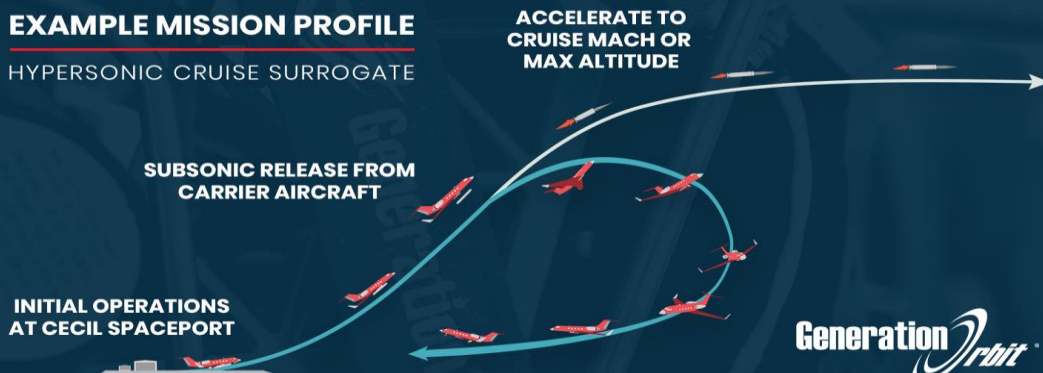


CAN REACH SPEEDS UP TO **MACH 5+**

PARAMETER	VALUE
Weight	~ 3000 lbs
Wingspan	5.5 ft
Booster Section Length	16 ft
Payload Length	up to 10 ft
Payload Weight	100's of lbs

## EXAMPLE MISSION PROFILE

HYPERSONIC CRUISE SURROGATE



Generation Orbit

# Commercial High-Speed Flight 2022

## “Game-Changers”- Hypersonics

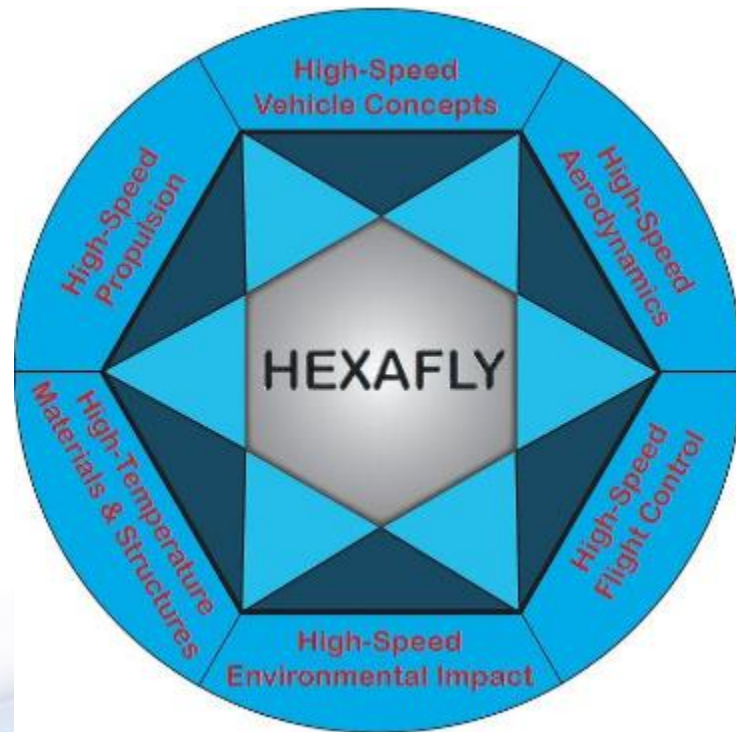


### NBC NEWS

## This Hypersonic Airliner Would Take You From Los Angeles to Tokyo in Under Two Hours

With its needle-sharp profile and advanced powerplants, Stratofly would hit speeds of up to Mach 8 — about 5,400 miles an hour

Published August 24, 2019





# Commercial High-Speed Flight 2022

## “Game-Changers”- Hypersonics Mach ~4



The AS2 is just the beginning”. Aerion chairman, president, and CEO Tom Vice He detailed a vision that includes moving on to a much larger AS3 airliner and venturing into **hybrid, all-electric power**, and—eventually—**hypersonic possibilities**.



Aerion, NASA To Jointly Explore High-Mach Speeds  
by Kerry Lynch  
- February 9, 2021



# Commercial High-Speed Flight 2022

## “Game-Changers”- Hypersonics Mach ~4

### Design and features of Talon-A vehicle

- The high-speed test-bed will have a length of 8.5m and a wingspan of 3.4m. It will fly at operational speeds of up to Mach 6.
- The launch vehicle will have the capability to perform long-duration flights at high Mach speeds. It will glide back for an autonomous, horizontal landing on a traditional runway upon the completion of the mission.
- **In addition, Talon-A vehicle will be able to take-off autonomously by using its own power.**





# Hypersonic- 2022 New Vistas

- Mach 6-20



Our three distinct breakthroughs make it possible:

IMPROVED ENGINE EFFICIENCY  
INNOVATIVE AIRCRAFT SHAPE  
LEADING EDGE COOLING TECH

Los Angeles to Tokyo in an hour - a Texas startup is building a Mach 12 hypersonic plane that could dramatically reduce travel times  
kshalvey@insider.com (Kevin Shalvey) -  
May 29, 2021





# Hypersonic- 2023 New Vistas

- Mach 4-6



# A Hypersonic World

## Anywhere on Earth in a 12-18 Hour Working Day

- **M 4-5 Flight (Low Hyper) Optimized Flight Levels ~60-100,000 ft**
- **M 5-10 (High Hyper) Optimized at altitudes of >100,000 ft**
- **Optimal, Foreseeable aircraft-vehicle architectures:**
  - **FAA Concept X** powered take off and landing
    - **Single stage engine Jet-Rocket i.e., Reaction Engines-SABRE, AJ-AFRE Engine, Hermeus Chimera**
  - Conventional jet performance-ATC handling take off to 60,000ft and Mach .8-1.0 range initial cruise
  - Rocket motor powered climb from 60,000 ft to 300-400,000 ft, acceleration up to Mach 4-10 cruise, descent to 60,000 ft and deceleration to Mach .80-1.0 range
  - Conventional jet performance-ATC handling descent from 60,000 to landing
- Solid Propellants are **environmentally friendly**, and emissions are limited to 10-30 minutes climb-acceleration +1-3 hours cruise vs. 30-60 minutes climb-acceleration and 15-20 hours cruise emissions from conventional ULR/XLR subsonic jets

# Hypersonic Flight - Market Focus

## Perceptions & Branding Drive Markets

- **Market- “ A Collection of People Who Wish to Buy a Specific Product or Service”**
  - How do we change “wishing” into “demanding”-loud and clear!
- **Air Transportation**
  - **Airline Passengers (Pax per year)**
    - International Air Transport Association (IATA Forecasts)
      - 2020 ~5 Billion (2025)
      - 2030 ~7 Billion (2035)
      - 2040 ~10 Billion (2045)
  - **Private Jet Passengers (Pax per year)-Upward Revision?**
    - InterFlight Global (IFG) ESTIMATES .3% of airline traffic (increased from .1% pre COVID)
      - 2025 ~15 Million
      - 2035 ~21 Million
      - 2045 ~30 Million

# Hypersonic Flight-Market Focus

- **Potential Market Roadmap and Size\* assumptions:**
- **Goal:** Common carriage with equivalent levels of safety and comfort to subsonic air transportation
- **Stages:** Increasing levels of safety, certification, efficient- and- routine operations (Phases 1-3):
 

➤ <u>Experiential</u> -Experimental	Tourism-Sport	Small Market-High Yields*	2030
➤ <u>Occupational</u> - Professional	R&D, Science, Tech	Medium Market-High Yields	2035
➤ <u>Transportation</u> -Common Carriage Transportation		Large Market –High Yields	2035+

\* Sources UBS, IATA, IFG (2019-2020)

# Hypersonic Flight-Market Focus

- **Economic Driver: Fundamental Commercial Flight Metric- The Passenger Per Mile-Yield**
  - **Definition of airline yield-revenue per available seat/mile**
  - **Yield is the measure of average fare paid per mile per passenger**
    - **\$ Passenger Revenue/Mile**
    - **Forecast per passenger per mile flown is a maximum of \$2 in today's dollars (including business jets)**
    - **Yield in Air Transportation today ranges from ~\$.15 Cents (Low Cost Carriers) to \$2.0 (premium classes and business jets)**
- **In New Normal environment Yields are trending upwards 15-30%**



# Hypersonic Flight-Market Focus

- Market Yield:
  - Forecast Yield per passenger per mile flown is a maximum of \$2-2.50 in today's dollars (including business jets)
  - A sample Hypersonic Mach 5.0 , 50 seat hypersonic or sub orbital vehicle flying 2 5,500 Miles Round Trip Missions per day, 330 days per year @ 3.0 hours per mission
  - IFG Forecast Revenues Per Vehicle Per Year-Revise?

➤ Potential Revenues Per Vehicle Flown	\$68,750 Million
➤ Passengers Flown Per Year	2,500
➤ Passengers Average R/T ticket	\$27,500
- Can industry produce and operate a vehicle that can fly safely, efficient, routinely and return capital and operational profits?- This question remains unanswered

# Hypersonic Flight-Market Focus

## ➤ Market Size:

- Assuming a mature hypersonic flight technology-2023 Air Transportation Global Traffic Figures
- **150 Million high yield passengers per year fly long haul long-haul market (Longer than 5,500 miles- 10 Hours flight time)**
  - **3% of high yield passengers are served by Hypersonic-High Speed transportation**
- **Potential Market revenues for hypersonic vehicles would be ~4.5MM passengers and ~\$123,750 Billion per year**
- **Total direct-indirect and induced economic impact could reach \$2-4 trillion**

“Piplica and his team estimate Mach 5 aircraft have to add \$4 trillion of global economic growth per year.”



# Suborbital-Orbital



# SEIZING THE SUB-ORBITAL P2P SPACEFLIGHT R/EVOLUTION

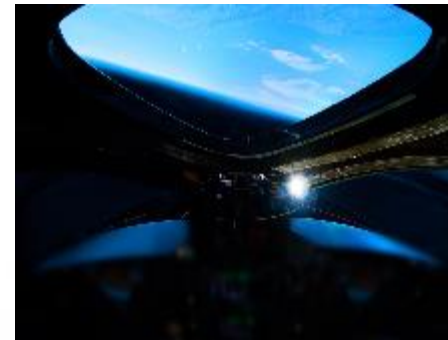
A Multi \$ Trillion Opportunity



illustration Space X-Starship

# Commercial High-Speed Flight 2022

## “Game-Changers”- Sub Orbital





# Commercial High-Speed Flight 2022 “Game-Changers”- Sub Orbital



*AD ASTRA? MORE LIKE AD AUSTRALIA —*

Virgin Galactic’s real goal may be point-to-point travel around Earth

"That world will be five to 10 years away."

Morgan Stanley | RESEARCH

December 9, 2019 05:06 AM GMT

Virgin Galactic Holdings Inc | North America

An Option on the \$800bn  
Hypersonic TAM: Initiate at  
Overweight

📊 Stock Rating  
Overweight

👁 Industry View  
In-Line

🎯 Price Target  
\$22.00



Global Research 17 March 2019

## Q-Series

Who will win the billionaires’ space race?

**The space travel and tourism opportunity**

**We see an even bigger opportunity for space to service long-haul travel**

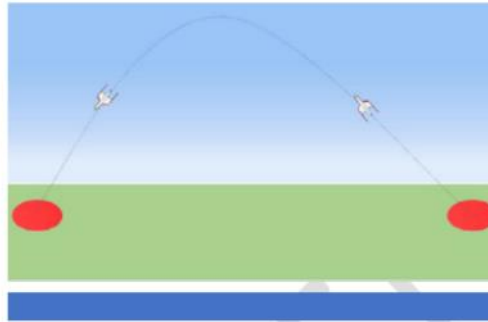
Although some might view the potential to use space to service the long-haul travel market as science fiction, we think the c800 route pairs on point-to-point flights that take more than 10 hours mean there is a large market to be cannibalized. Even if we assume only 5% of the more than 150m passengers who flew those routes in 2018 are serviced by space, at \$2,500 per trip, the opportunity would be worth over \$20bn p.a.

## IFG-FF View:

Orbital and Hypersonic P2P Industry, Technology and Markets are converging, and respective industry fundamentals will merge in the future; in terms of regulation, economics, and operational-safety standards

# Spaceport to Spaceport Airspace White Paper

- Collaboration with Global Spaceport Alliance
- S2S Working Group
- Initial Design, Taxonomies and Considerations for S2S Airspace Development
- Initial Focus: Demos
  - Suborbital-VG, Starfigthers, NFA, Dawn
  - Orbital-Starship



## S2S WHITE PAPER

SPACEPORT TO SPACEPORT AIRSPACE  
CORRIDORS FOR THE COMMERCIAL  
SPACE TRANSPORTATION INDUSTRY



## National Spaceport Network Development Plan

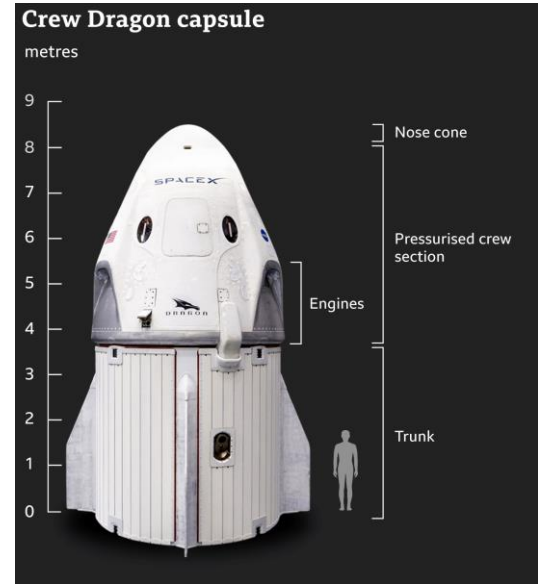
Prepared by the Global Spaceport Alliance

for the Office of Spaceports  
Office of Commercial Space Transportation  
Federal Aviation Administration

June 1, 2020

# 2021-First Commercial Orbital “Up-Down” Space Flights

4 Participants , 364 Miles-LEO,  
~M 25, ~\$200M  
First Crew ~\$50M/seat  
Cape Canaveral, FL





# Orbital Commercial Flight Steady Leadership

- A Promising Development-2023 Demo?
- US DOD-Rocket Cargo Program
  - USTRANSCOM, USSF



SPACEX



*Point-to-point space transportation presents a fundamental shift in the way the DOD could respond to contingencies and disasters by potentially reducing the number of days required for planning, coordination, and execution. In conjunction with capacity, the speed of space transportation shows the potential to offer more options and greater decision space for leaders while creating dilemmas for adversaries.*

## 2023 Spaceport to Splashdown

Orbital Flight -  
SpaceX Starship  
90 Minutes-Texas-  
Hawaii



## 2035 Spaceport to Spaceport

~1,000  
Passengers/50ton  
~M25, ~300  
Miles/LEO  
~\$1,500 One Way  
30 Minutes  
Anywhere on Earth

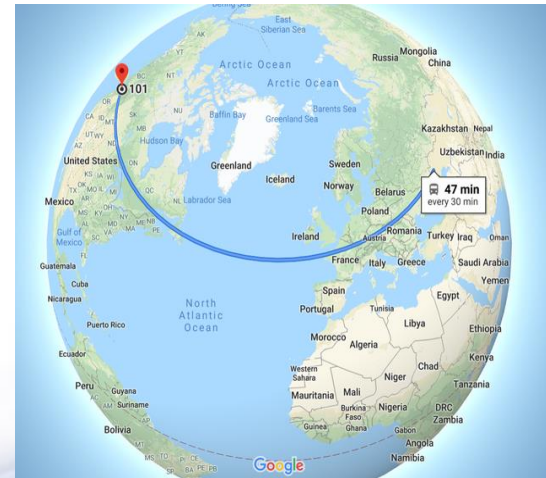


# SEIZING THE ORBITAL FLIGHT R/EVOLUTION

## New Markets-New Geo-Economic Centers of Gravity

### Major cities or capitals close to being antipodes:

- Perth (Australia)-New York (USA)
- Auckland (New Zealand) — Seville and Malaga (Spain)
- Xi'an (China) — Santiago (Chile)
- Shanghai (China) — Buenos Aires (Argentina)
- Beijing (China) — Bahia Blanca (Argentina)
- Taipei (Taiwan) — Asuncion (Paraguay)
- Bangkok (Thailand) and Phnom Penh (Cambodia) — Lima (Peru)
- Montevideo (Uruguay) — Seoul (South Korea)
- Bogota (Colombia) — Jakarta (Indonesia)
- Suva (Fiji) — Timbuktu (Mali)
- Melbourne and Canberra (Australia) — Azores (Portugal)
- Manila (Philippines) — Cuiaba (Brazil)
- Kuala Lumpur (Malaysia) — Cuenca (Ecuador)
- Singapore — Quito (Ecuador)
- Doha (Qatar) — Pitcairn Island (United Kingdom - Overseas Territory)
- Antipodes Island (New Zealand) — Gatteville-le-Phare (France)



# Orbital Commercial Flight Steady Leadership

- **Single Stage to Orbit:**
- Reaction Engines UK/USA, on track SABRE engine

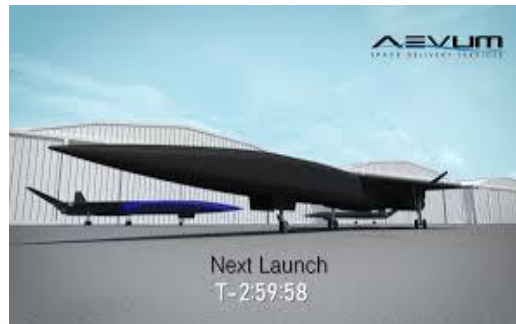
<https://www.reactionengines.co.uk/video/forward.webm>

- 2 Stage Launcher Skylon to P2P Vehicle Lapcat

“SABRE will make the world smaller through high-speed point-to-point transport. To demonstrate the uses for SABRE in Mach 5 cruise applications, Reaction Engines engaged in a 50% EU-funded project as part of Framework 6, called LAPCAT — Long-term Advanced Propulsion Concepts and Technologies. This study examined the technologies required to reduce long-distance flights, e.g. From Brussels to Sydney, to just over 4 hours while cruising at Mach 5.”



# Orbital Commercial Flight New Entrants-Critical Mass



# Orbital Commercial Flight New Entrants-Welcome Onboard Radian Aerospace

**RADIAN**  
AEROSPACE

## **RADIAN ONE**

Take off. Land.

Repeat.

Radian One is the world's first crewed, single-stage to orbit vehicle with runway-like takeoff and landing. Our fully reusable, aircraft-like configuration requires far less infrastructure than vertical launch systems and can be reflown within 48 hours.

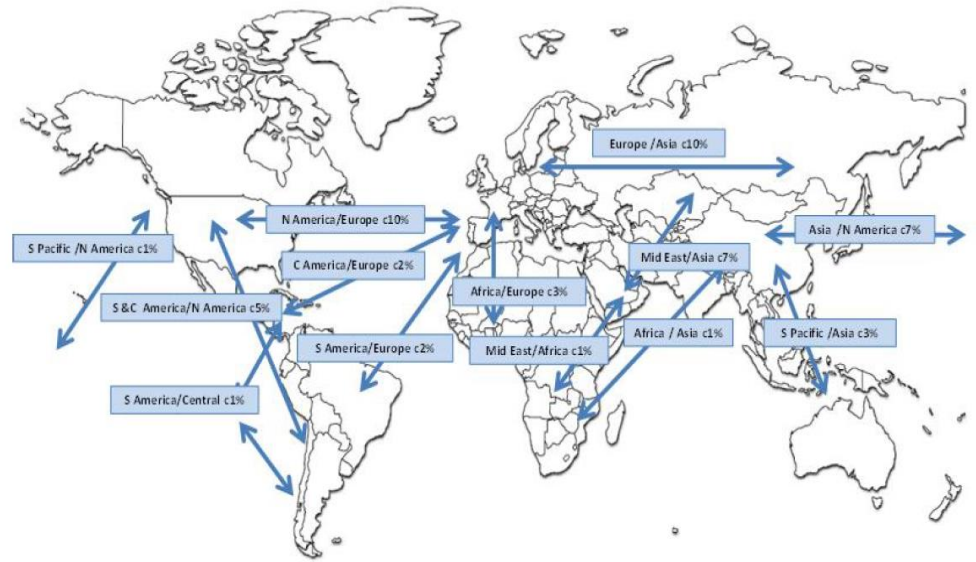


# Sub/Orbital Flight - Market Focus

## Perceptions & Branding Drive Markets

- **Space Transportation Flight Occupants-Past Data and Future Passengers Forecast**
- **To Date- Federation Aeronautique International (FAI)**
  - Aprox 600 people have traveled to space
- **Forecast- FF-IFG 2020-2040**
  - Aprox 6,000 Space Tourists per year by 2030
  - Aprox 1.5 Million Orbital Passengers per year by 2040

Figure 10: Global international traffic flows by region in 2017 (%)



Source: UBS and IATA

# Sub/Orbital Flight - Market Focus

## P2P Potential Network Evolution 2009-2015

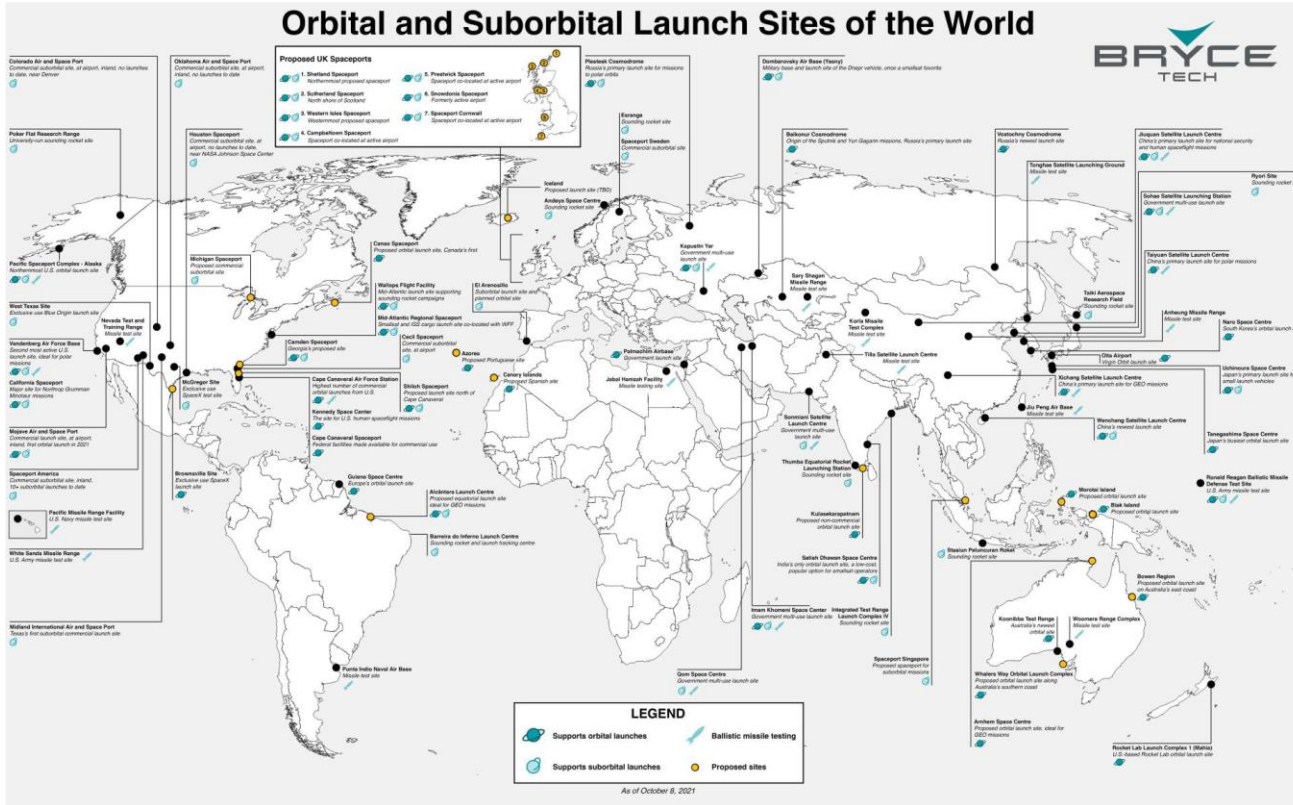


- Tier 1 Cities (7). Chosen as the initial study set based on current express package market sizes.
- Tier 2 Cities (3). Emerging regions that would be best candidates to expand the delivery network.
- Tier 3 Cities (3). Additional regions to result in more global capabilities.



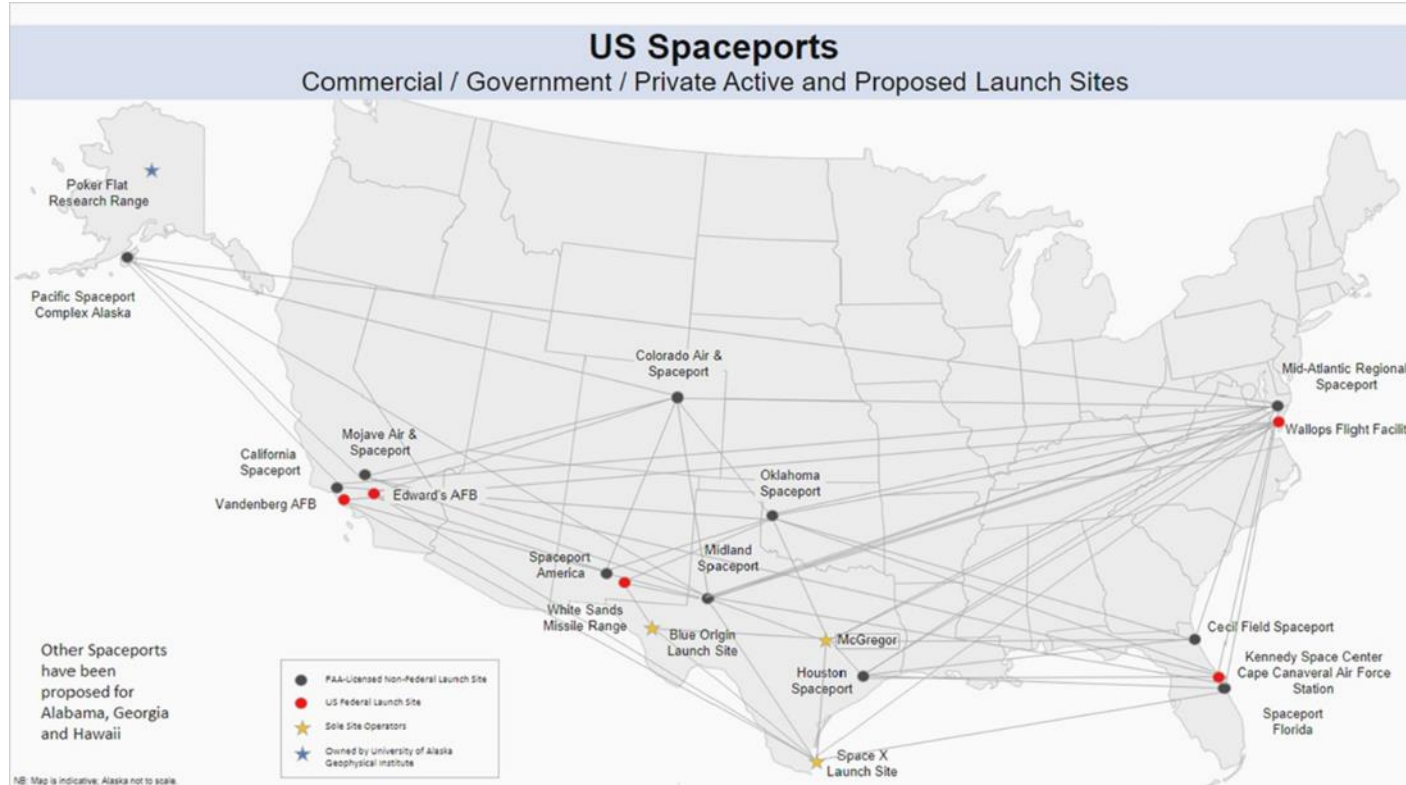
# Sub/Orbital Flight - Market Focus

## P2P Potential Network Evolution 2015-2023



# Sub/Orbital Flight - Market Focus

## P2P Potential USA Network for Demos





# HSAT Industry Challenges 2023

## ➤ Technical

### ➤ Need for Private-Commercial

- Flight Test Ranges
- High-Speed Wind Tunnels and
- Super-Hypersonic and Rocket Engine
- Test Stands and Facilities

## ➤ Regulatory

## ➤ Environmental

## ➤ Economic

## ➤ ATC/ATM/STM

- Integration
- Terminal Area
- Enroute
- High Altitude

## ➤ Spaceports and Airports

## ➤ Spaceport to Spaceport (S2S) Corridors

**Needs TRL increase for Powerplants and Airframe Materials**  
**Certification Requires 100,000's hours of R&D,T&E with ACTUAL flying and powerplant running**

**Industry leads safety and compliance (Standards)**  
**Noise, Emissions and Pollution-Standards LEADERSHIP**

**Sustainable Aerospace Fuels (SAF's)**

**Incumbent/Current Markets-Management**

**Safety and Efficiency**

SWIM, NEXTGEN, SESAR, etc

**Airports-Spaceports, SID's, STAR's**

High Speed - Altitude Gateways

**Air or Space? - New Realm**

**Integration and Infrastructure Funding**

**Standardized National and Global Airport and Spaceport Policies**

**Requires CLEAR on Orbit Regulation, Jurisdictions and Law**

# CALL INSIGHTS AND ACTIONS



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