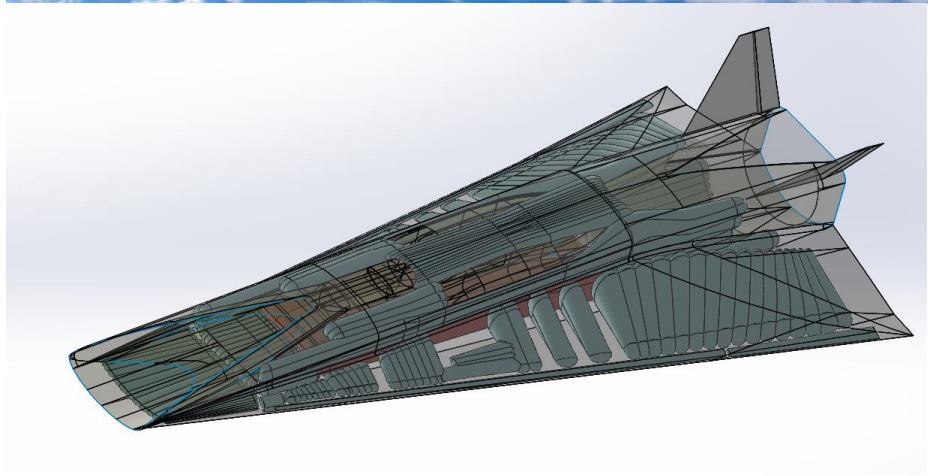
STRATOFLY Academy

M. Marini1, Nicole Viola[2], R. Fusaro[2]
[1]CIRA
[2]Politecnico di Torino

STRAT FLY
Stratospheric Flying Opportunities for High-Speed Propulsion Concepts

Table of Content

H2020 STRATOFLY Project



STRATOFLY (Stratospheric Flying Opportunities for High-Speed Propulsive Concepts) has been funded by the European Commission under the Horizon 2020 framework

Making benefit of the European heritage in this field, the H2020 STRATOFLY Project aims at assessing the potential of high-speed transport vehicle to reach TRL6 by 2035, with respect to key technological, societal and economical aspects

GOAL

STRATFLY
Stratospheric Flying Opportunities for High-Speed Propulsion Concepts

STRATOFLY CONSORTIUM: *members and competencies*

Expertise: Noise Emission — nlr

STRATOFLY Deputy Coordinator
Expertise: High-speed Propulsion Systems and Noise Emission

Expertise: Structural Analysis and Optimization — Universidade da Coruña

Expertise: Climate Impact — cnrs

Expertise: Plasma assisted combustion experiments and Pollutant Emissions — ONERA THE FRENCH AEROSPACE LAB

POLITECNICO DI TORINO — ***STRATOFLY Coordinator***
Expertise: Aircraft and Systems Design, Life Cycle Cost Estimation, Safety Assessment

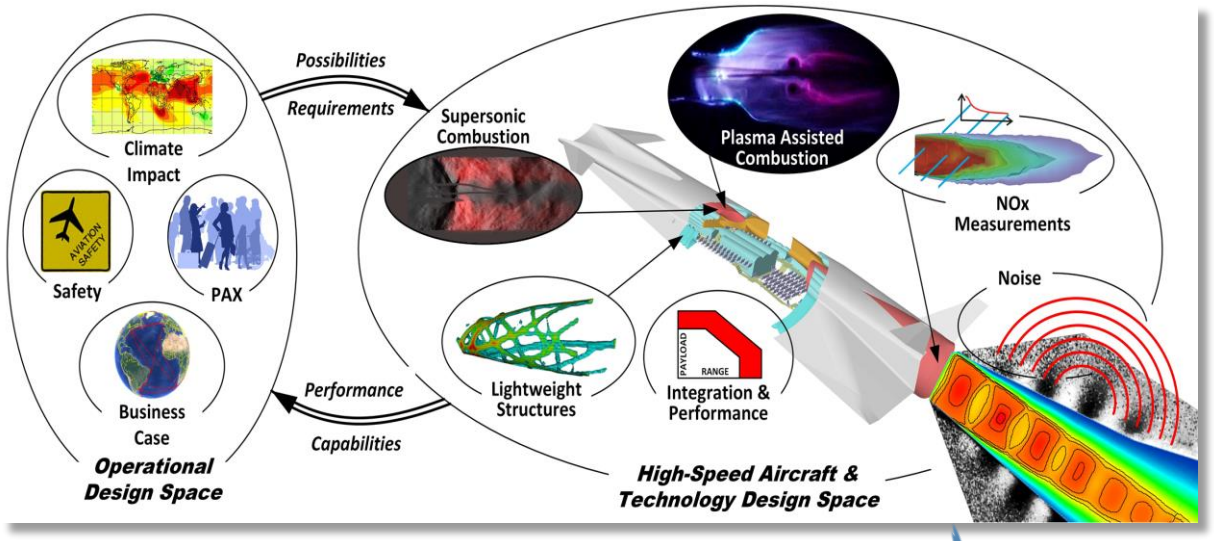
FOI — Expertise: Plasma assisted combustion

CIRA Centro Italiano Ricerche Aerospaziali — Expertise: High-speed flow analysis

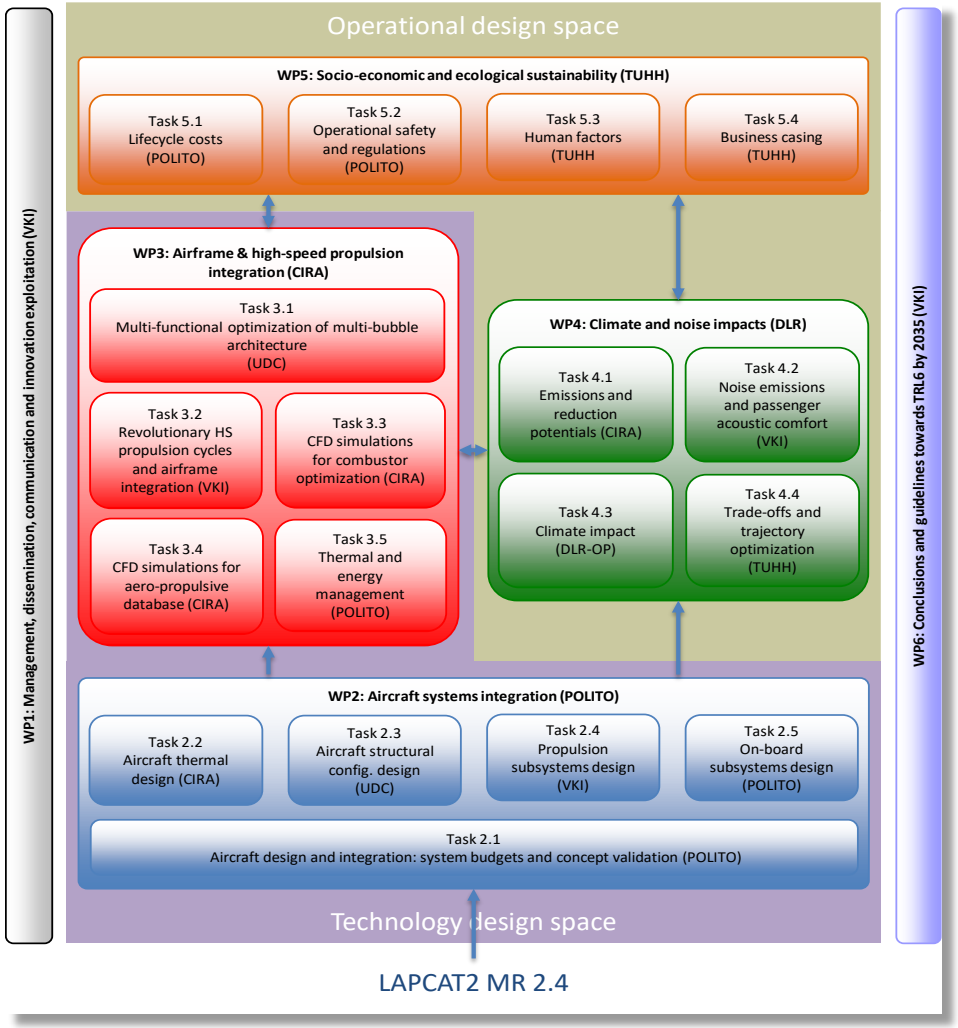
DLR — Expertise: High-speed Propulsion Systems and Climate Impact

TUHH — Expertise: Human Factors, Business Plan and Traffic Management

STRATOFLY PROJECT: *Work Packages Structure*



STRATOFLY project has a ***rational*** and ***comprehensive*** structure, consisting of two design spaces (***Technology*** and ***Operational***) mutually interacting between each other



Positive example of how to deal with ***complexity*** and ***multidisciplinary*** domains

STRATOFLY Academy

- STRATOFLY Academy is one of the dissemination actions taken by the consortium of the H2020 STRATOFLY Project

- STRATOFLY Academy aims at involving students through Theses or Project Works having topics related to high speed civil transportation

STRATOFLY Academy

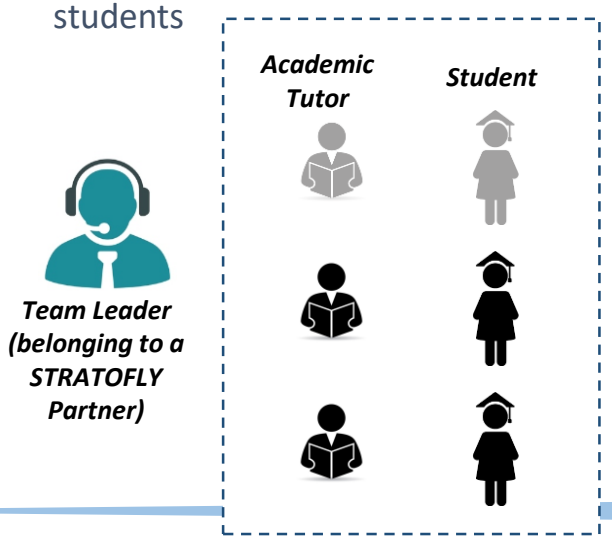
inspire young generations
and get inspired by new ideas

STRATOFLY Academy: how to participate

Are you looking for a **BSc., MSc. Or PhD Thesis?**

You will be inserted within an international student team! Your thesis work will benefit from advices of STRATOFLY specialists and from the collaboration with the other students

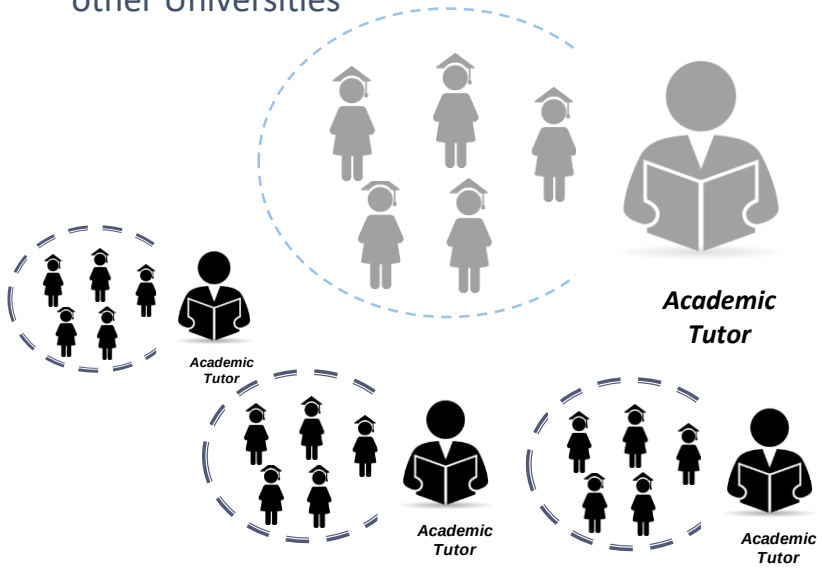
Thesis Teams



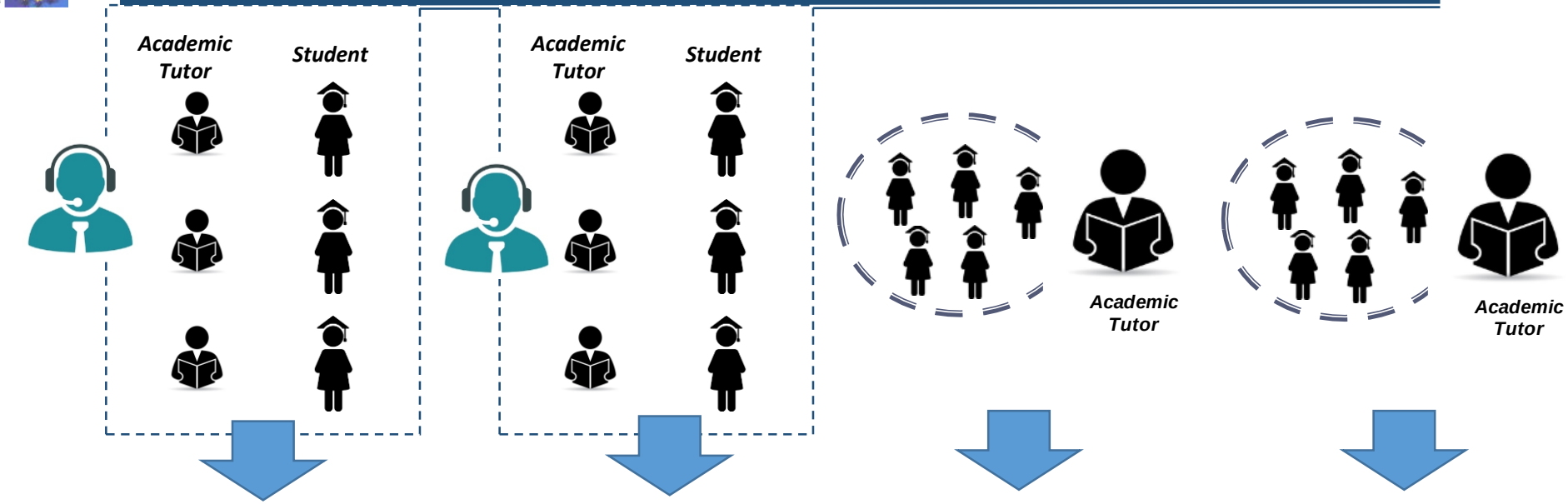
Do you have a **class team** looking for a case study?

You can work with your class mate and compete with other teams belonging to other Universities

Class Teams



STRATOFLY Academy: how to participate



Executive summaries will be evaluated by experts.
Executive summaries presented at the first STRATOFLY workshop (September 2019 @ PoliTo)

ACADEMY BOARD

Best Team Award
(scientific publication)

Best Student Award
(International Congress participation)

STRATOFLY ACADEMY: INSPIRE YOUNG PROFESSIONALS AND GET INSPIRED BY NEW IDEAS

First Challenge

STRATOFLY Academy

inspire young generations
and get inspired by new ideas

Design the future hypersonic transportation system!

GOAL of the challenge

To shorten the flight time of one order of magnitude (with respect to the state of the art of civil aviation) of at least 300 civil passengers along long haul and antipodal routes, through the preliminary design of a Mach 8 vehicle, flying at stratospheric altitudes within a future CNS/ATM scenario, exploiting existing on-ground infrastructures, in compliance with environmental compatibility and safety issues, assessing the overall economic feasibility of the solution

- Each Student can contribute through the design of a hypersonic vehicle concept, or through an in-depth investigation of one of its most critical subsystems (propulsion, structure, thermal and energy management subsystem, etc…).
- The students can both take inspiration from the STRATOFLY reference vehicle (LAPCAT MR2.4) or suggest new concept either at vehicle or at subsystem level.

Class teams overview

About 100 students all around the world

STRATFLY
Stratospheric Flying Opportunities for High-Speed Propulsion Concepts

Example of topics

Some of the topics currently under investigation

- Conceptual and Preliminary Design of a Mach 8 Waverider, exploiting LH2 fuel
- Conceptual and Preliminary Design of a Mach 8 Waverider, exploiting Hydrocarbon fuel
- Systems Engineering applied at hypersonic vehicles and mission concept
- Environmental control system design concept for the waverider configuration, Mach 8, LH2 fuel
- Conceptual and Preliminary Design for a Mach 8 with free configuration
- Conceptual and Preliminary Design for a single stage reusable access to space vehicle
- Propulsion/combustion system, Waverider, Mach 8
- Hot structures health monitoring through fibre optics technology
- Design and development of dedicated avionics equipment
- **Passenger Cabin Design and Integration for a 300-seat Hypersonic Wave Rider Configuration**
- Design and Optimization of a Cryogenic Multi-Lobe Integral Wing Tank for a Hypersonic Wave Rider Configuration
- Thermal Management System Concept for a 300-seat Hypersonic Wave Rider Configuration
- Concept of Operations of hypersonic civil transportation systems
- **Update of the AeroDataBase for a M8 waverider vehicle configuration**

Class Teams: Team 1 @ POLITO

Statement of Work

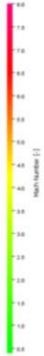
- **To design a Mach 8 waverider vehicle able to transfer 300 passengers along long haul antipodal routes**

Requirements

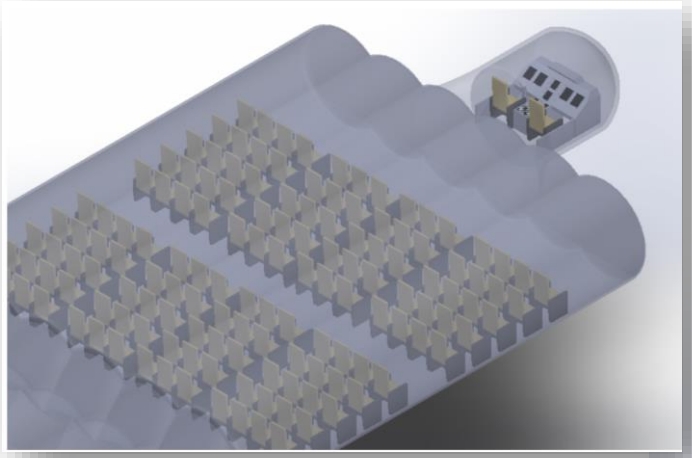
- Waverider Configuration shall be adopted
- Horizontal Take-Off and Landing capabilities shall be guaranteed
- The vehicle shall be able to reach Mach 8
- The vehicle shall be able to host 300 passengers
- The vehicle shall perform antipodal routes (e.g. Brussels – Sydney 18.000 km)
- The vehicle shall exploit ATR (Air Turbo Rocket/Ramjet) and DMR (Dual Mode Ramjet/Scramjet) propulsion system technologies
- The vehicle shall exploit LH_2 as propellant
- The vehicle shall integrate the innovative Thermal and Energy Management Subsystem (TEMS) on-board

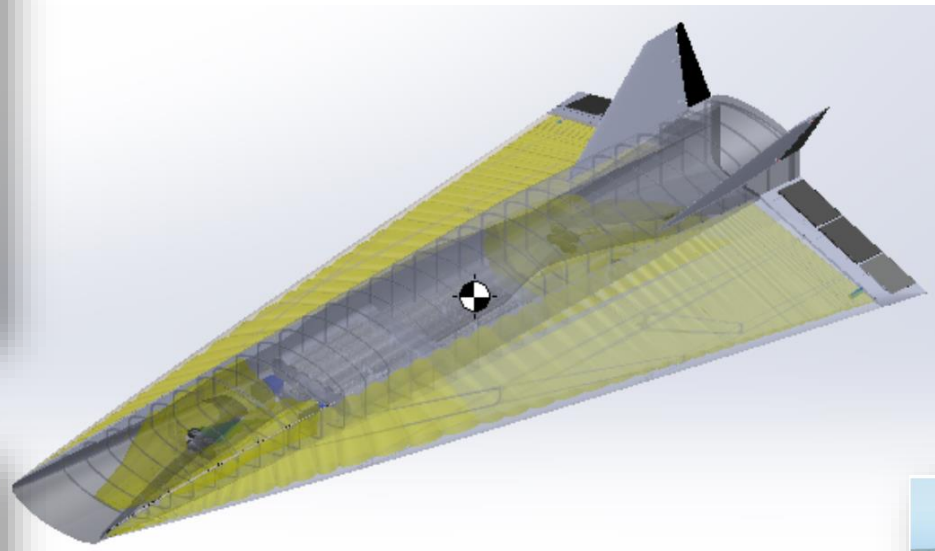
Reference Vehicle

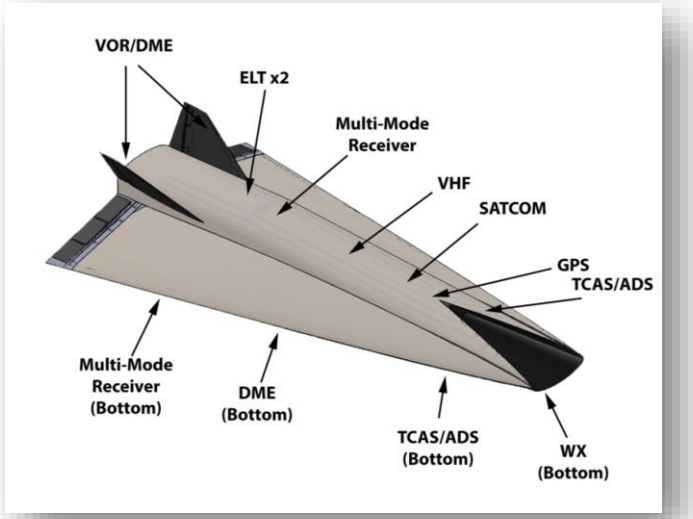
- **Length**: 90 m
- **Span:** 30 m
- **MTOM**: 400 t
- **M_{fuel} :** 200 t
- **Max Speed**: Mach 8
- **Cruise Altitude:** 25 km



Class Teams: Team 1 @ POLITO







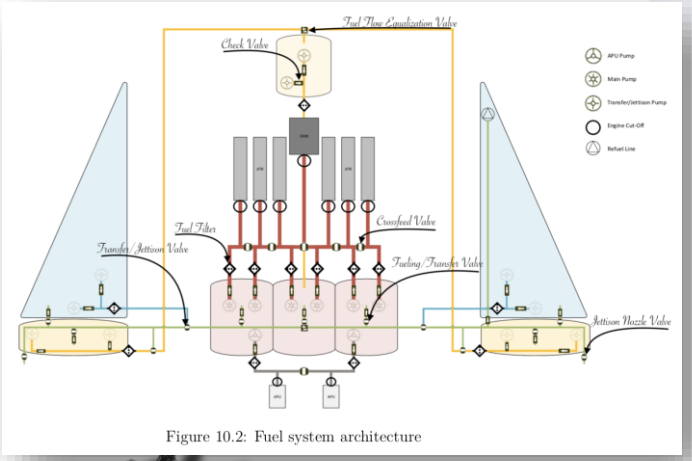


Figure 10.2: Fuel system architecture

Some results of TEAM 1

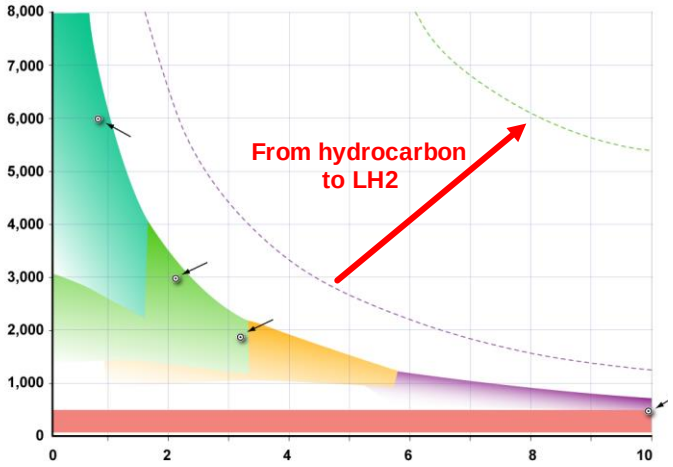
Class Teams: Team 2 @ POLITO

Statement of Work

- **To design a Mach 8 waverider vehicle, exploiting hydrocarbon fuels**

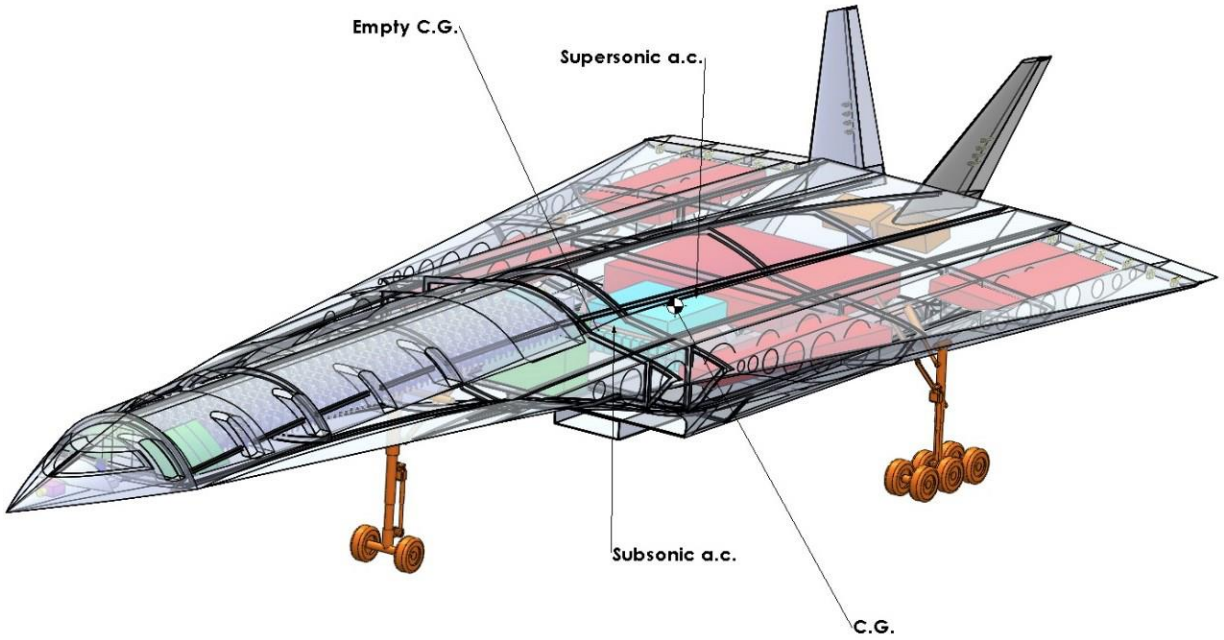
Requirements

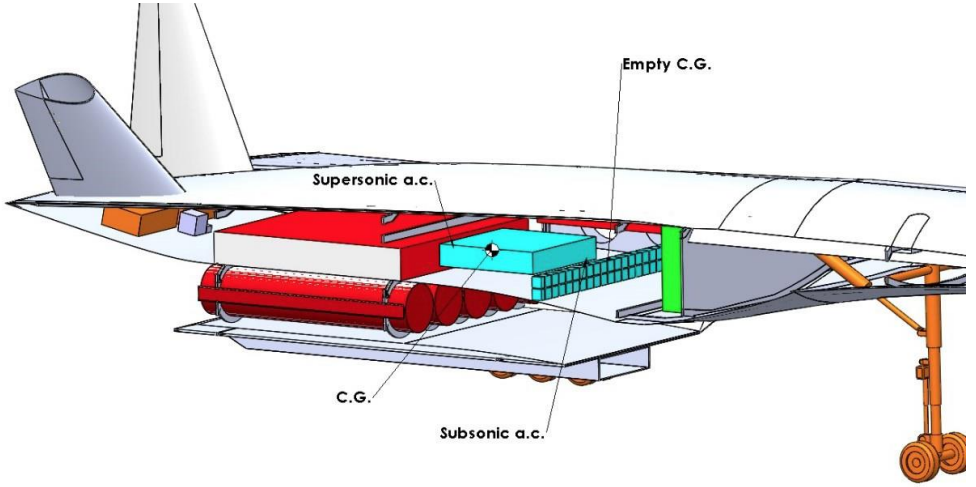
- Waverider Configuration shall be adopted
- Horizontal Take-Off and Landing capabilities shall be guaranteed
- The vehicle shall be able to reach Mach 8
- The vehicle MTOM shall not exceed 400 t
- The vehicle shall exploit hydrocarbons as propellant
- Environmental impact shall be mitigated

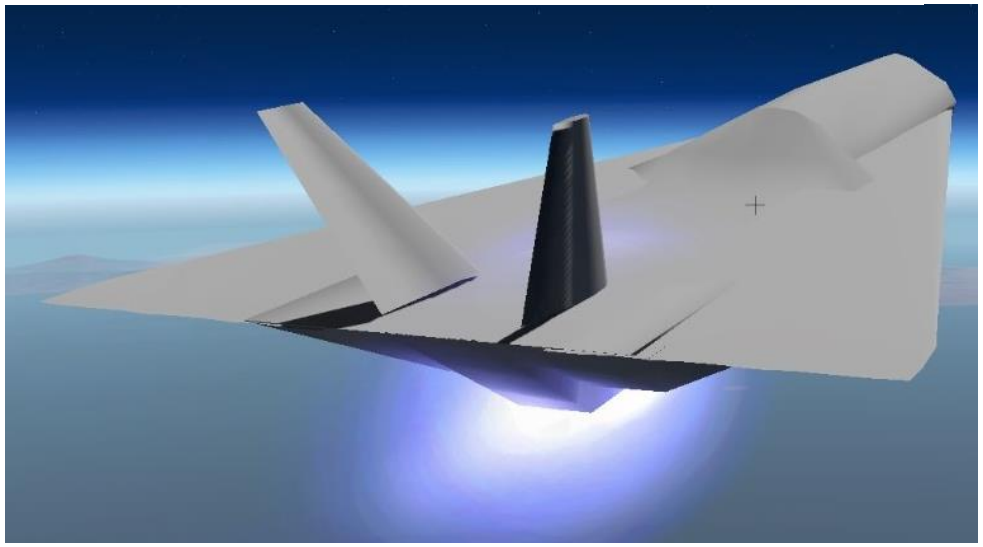


- **Two available design options:**
  - To carry 300 passengers along medium haul routes;
  - To perform antipodal routes carrying less than 300 passengers

Class Teams: Team 2 @ POLITO







Some results of TEAM 2

Class Teams: Team 3 @ POLITO

Statement of Work

- **To design a Mach 8 vehicle, able to transfer 300 passengers along antipodal routes**

Requirements

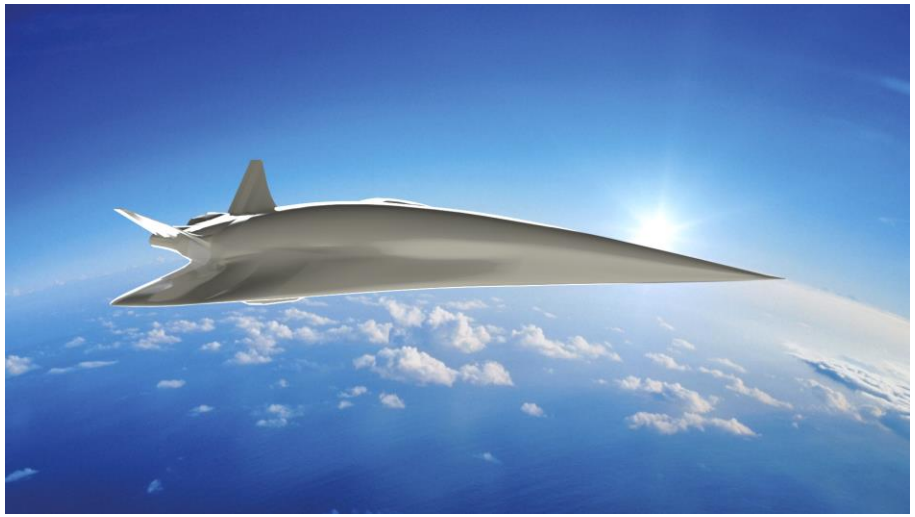
- High L/D configuration
- The vehicle shall be able to reach Mach 8
- The vehicle MTOM shall not exceed 400 t
- Horizontal Take-Off and Landing capabilities shall be guaranteed

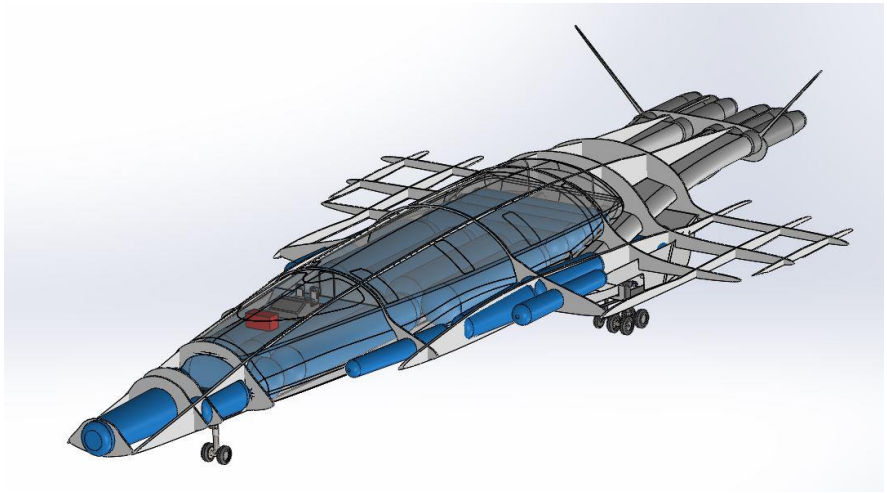
Trade-off

- Number of stages
- Propulsion System (rocket vs airbreathing)
- Propellant (LH2 vs Hydrocarbons)
- Aircraft configuration

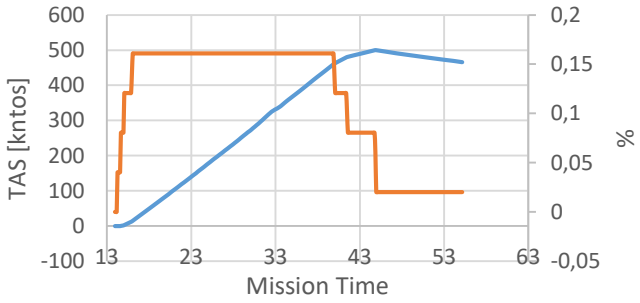
Class Teams: Team 3 @ POLITO

Some results of TEAM 3

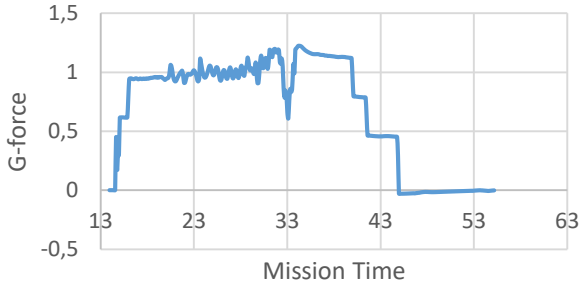




Speed and throttle



G-force



Class Teams: Team 4 @ POLITO

Statement of Work

- **To design an unmanned Reusable Access to space Vehicle able to bring payload Mass in LEO**

Requirements

- The vehicle shall be able to bring 20 t payload in Low Earth Orbit
- The vehicle MTOM shall not exceed 400 t
- LH2 shall be considered as propellant
- Airbreathing propulsion technologies shall be exploited
- Single stage configuration shall be adopted
- Horizontal Take-Off and Landing capabilities shall be guaranteed
- A complete reusability shall be achieved
- The cost/kg shall be drastically reduced with respect to expendable launchers

Conclusions

STRATOFLY Academy

inspire young generations
and get inspired by new ideas

- Currently, more than 100 students are involved in the STRATOFLY Academy, coming from more than 10 different Countries all around the world
- In **September 2019** there will be the Award Ceremony for the First Challenge of the STRATOFLY Academy. The award will consist In the participation at an International Congress and/or a journal publication.
- In **October 2019**, a second challenge will be kicked off with a wider community. We would also like to involve non engineering students to increase the multidisciplinary aspect (Medicine, Space Law, Economics, etc…)

STRAT FLY Academy

inspire young generations and get inspired by new ideas

Join us!

Write an email to
nicole.viola@polito.it and
roberta.fusaro@polito.it

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769246

Thank you for your attention

STRATOFLY
An H2020 Project funded by
Innovation and Networks Executive Agency
EC-H2020 Grant Agreement - 769246

STRATOFLY

Stratospheric Flying Opportunities
for High-Speed Propulsion Concepts