



The MAAT Project – Multibody Advanced Airship for Transport

General Introduction



The Consortium



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Project Leader:
Università degli Studi di Modena
e Reggio Emilia



The University of Hertfordshire
Higher Education



Southern Federal University



Engys Ltd.



Alma Mater Studiorum –
Università
di Bologna
eDL S.A.



Universidade da Beira Interior



LogisticNetwork Consultants GmbH



Politecnico di Torino



University of Lincoln



Aero Sekur S.p.A.



Vrije Universiteit Brussel

The Consortium - Roles



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Project Leader:
Coordination & Overall
System Design



Flight Mechanics and PV
Coverage



Controls and Telecommunications



CFDs Flight Mechanics



Overall System Design



Cabins, Cargo and Transfer Systems



Energy and Propulsive
Systems



Dissemination and Logistics



Energy and Propulsive Systems



Energy and Propulsive Systems



Cabins, Cargos and Transfer
Systems



Cruiser/Feeder Docking and Joints

Current Situation in Transport



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Today, Transport of people and freight is characterized by critical conditions such as ...

- the emission of green house gasses,
- the consumption of fossile fuels,
- increasing transport costs related to fuel prices and to costs for environmental impacts,
- high costs for the construction and maintenance of transport routes (train, motorways, airports),
- Additionally, classic transport systems are facing an increasing number of people wishing to travel.

Current Situation in Transport



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... these aspects inevitably result in:

- Traffic congestion,
- Large consumption of soil for new infrastructure-related projects,
- Noise pollution (cars, trains, aircraft),
- Increasing costs,
- Increasing emissions of greenhouse gasses.

Therefore, a new mode of transport - both economically and ecologically attractive - is necessary.



One answer to the manifold problems faced by modern society is the MAAT Project.

What is MAAT? Key features



MAAT is a ...

- ... zero emission,
- ... low cost,
- ... high capacity and
- ... flexible aerial **transport solution**
conceptualized as a cruiser/feeder system for
- ... long and
- ... middle range distances.



How is MAAT composed?



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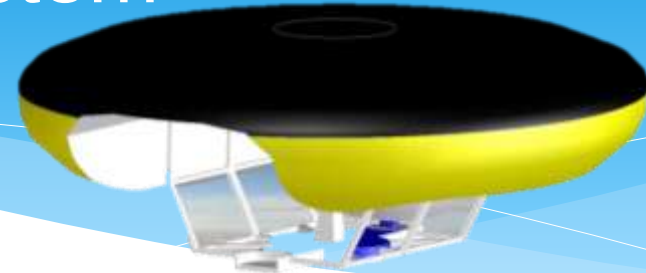
The MAAT system is composed by three modules:

- **PTAH (Photovoltaic Transport Airship for High-altitudes)** is a heavy payload and high quote cruiser which remains airborne on stable routes;
- **ATEN (Air Transport Efficient Network feeder)** is a VTOL feeder airship by gas buoyancy linking the cruiser to the ground;
- **AHA (Airship Hub Airport)** is a new concept of low cost vertical airport hub joinable by ATEN, easy to build both in towns and in logistic centres.

The Cruiser/Feeder System



Feeder: ATENs
(Aerial Transport Elevator Network)



Number of passengers:
approx. 300

Capable of landing in urban,
densely populated areas.

Although limited in speed, the
"airborne" exchange of
passengers and goods via the
feeders allow reduced
transport times.

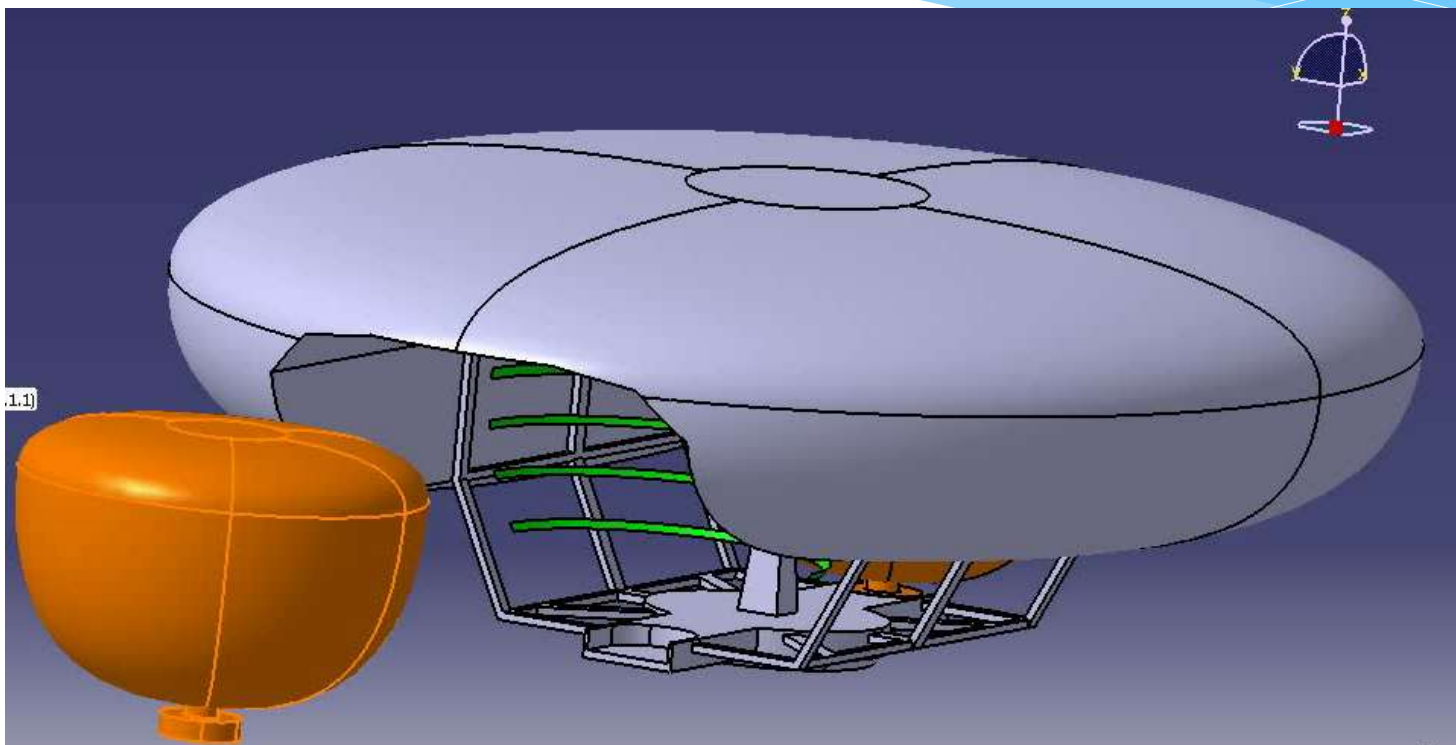


Cruiser: PTAH (Photovoltaic Transport
Aerial High Altitude System)

Docking Operation Animation



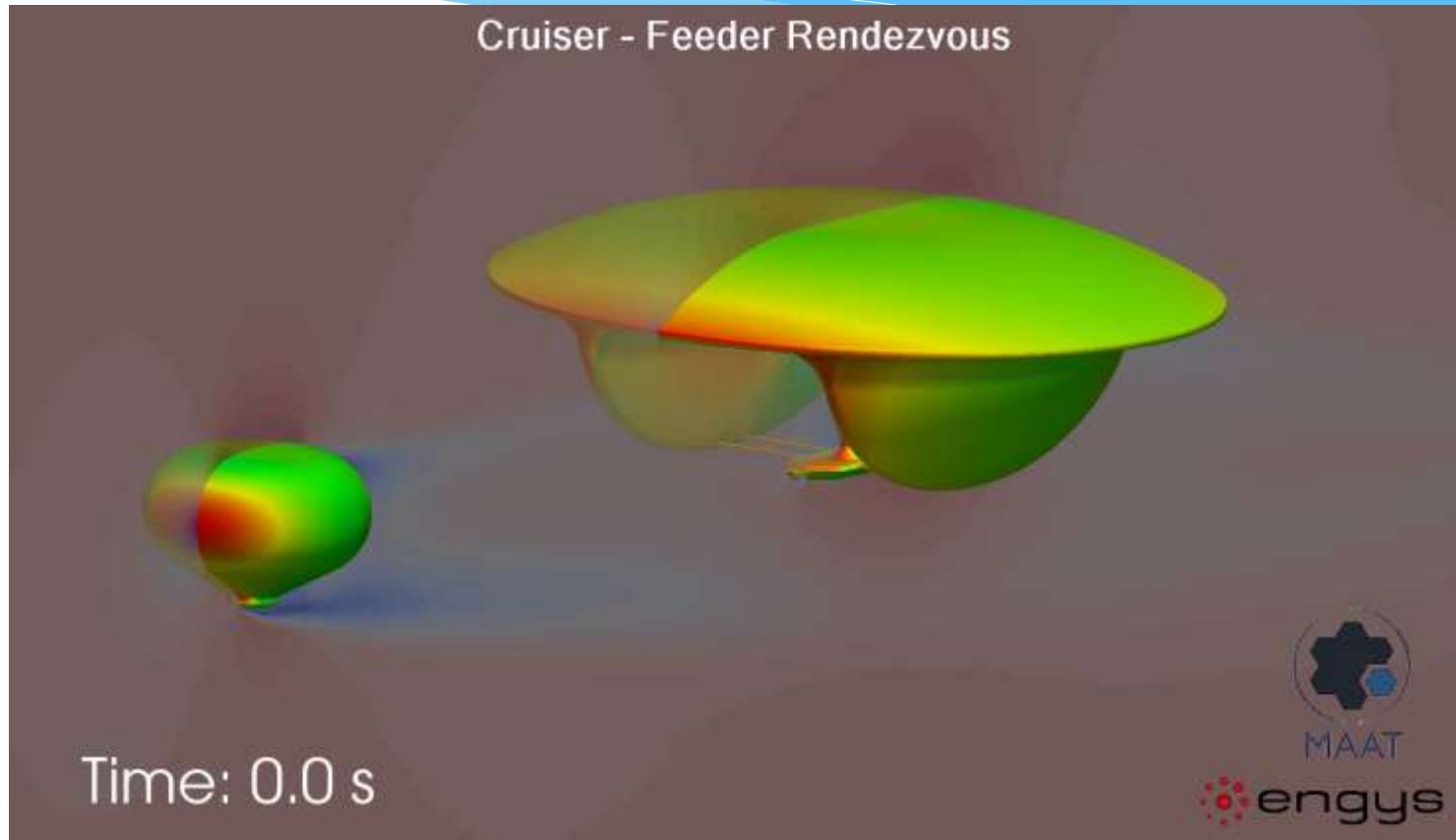
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Docking operation simulation



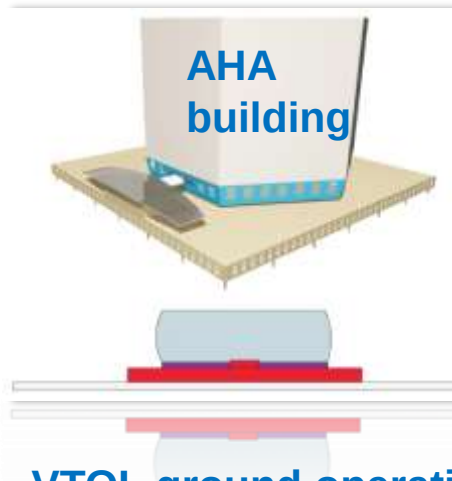
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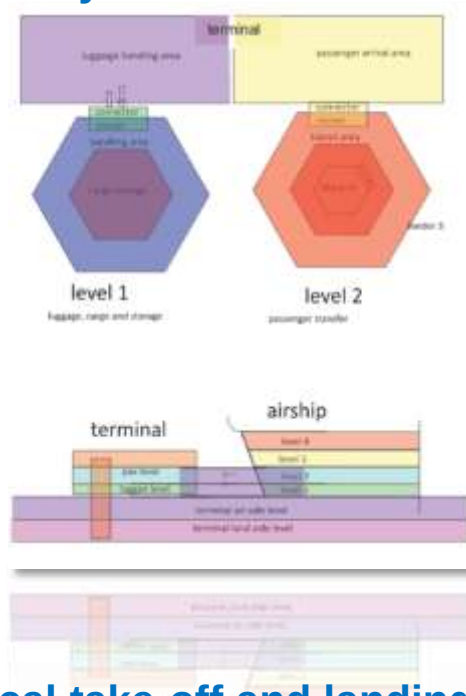
Airship Hub Airport (AHA)



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Layout of an AHA:



Examples of an Airship Hub Airport (AHA).

No soil consumption is necessary, as already existing facilities can be used (landing on skyscrapers, railway stations etc.).

Moving times for passengers will be reduced.

VTOL ground operations (Vertical take-off and landing).

What is the MAAT-Project aiming at in scientific terms?



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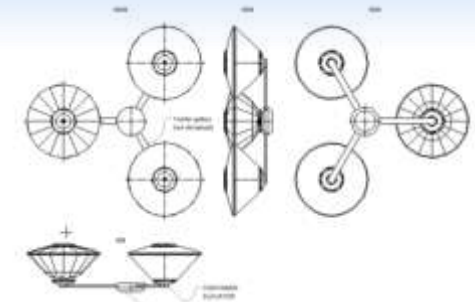
1. Identify and design the most **functional cruiser/ airship architectures** based on a discoid innovative airship able to remain airborne for long periods of time and to travel great distances.

2. Design the **best type of propulsion** both for cruiser and feeder so they can contribute together to the propulsion of an innovative modular airship.

3. **Minimizing environmental impacts** by annulling fossil fuels energy consumption as both cruiser and feeder are energetically autonomous.

4. Design the best procedure of **docking operations** in order to obtain the minimum disruption to passengers and the maximum safety for themselves and for goods.

5. Study the different **possible ways of approaching** and joining between ATEN and PTAH, and consequently the release of ATEN from PTAH.



Alternative Configurations



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How will MAAT perform?



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The cruiser constantly remains in the stratosphere (15 km height), only the feeders reach the earth's surface.

Exchange of feeders between 2 cruisers take place in motion!



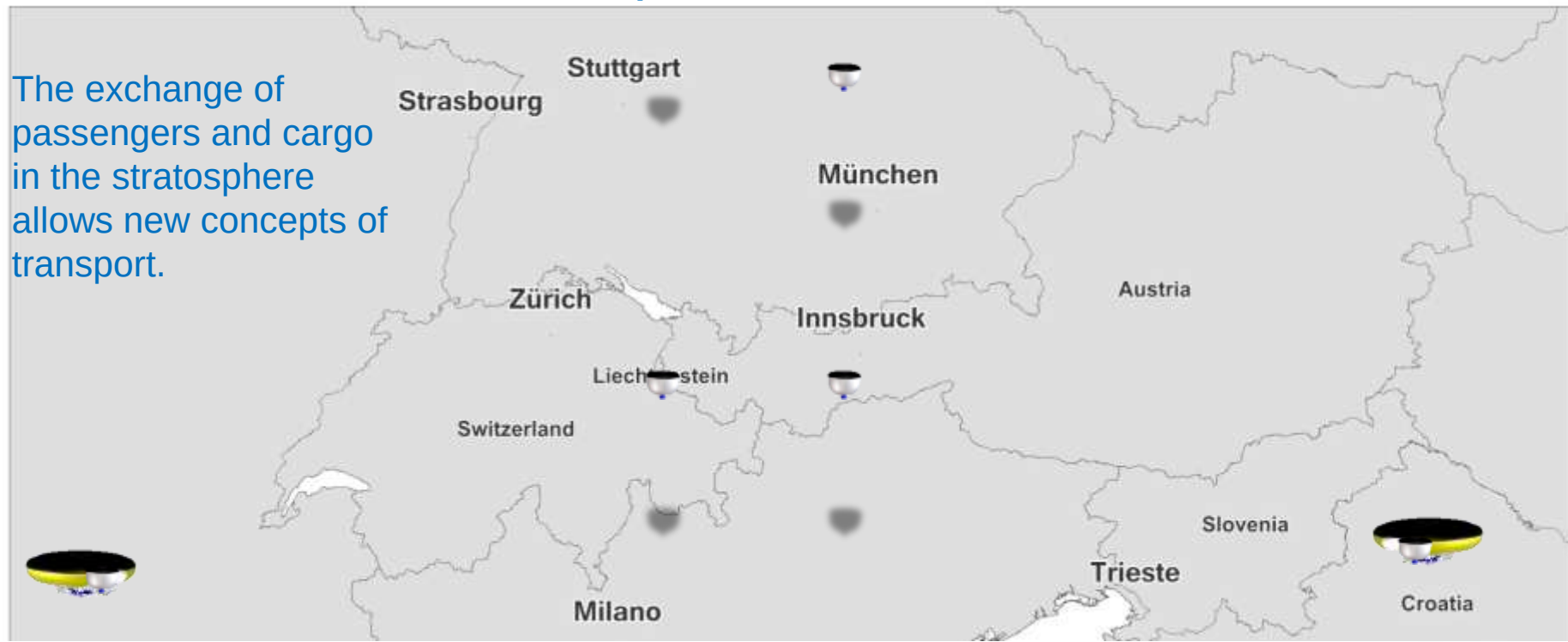
New transport networks



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MAAT allows for new chains of transport

The exchange of passengers and cargo in the stratosphere allows new concepts of transport.





Example: How will MAAT perform?

Two single Cruiser loops with
each Cruiser: each Cruiser has
its own path and one Feeder-
Docking-Station

Cruiser Loop I

Cruiser Loop II

The interchange area of
the two cruisers is the
closest point of two
loops.

Here, the passengers
and cargo can
exchange.

Finally, the Cruiser loop
will start all over again

At the respective breakpoints two
Feeders associate with passengers
and cargo, which start simul-
taneously, on the one hand
towards the ground and the other
hand from the Cruiser toward the
ground

 **Cruiser**
 **Feeder (AHA)**

Comparison with Traditional Aircrafts



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Comparison with traditional aircrafts

Aircraft name	B747-8	B777-300	A340	A380	MAAT	Units
Selling price	317	284	275	375	400	mIn. USD
Passengers	467	365	380	525	510	Number
Empty weight (no fuel)	186	168	246	277	500	Ton.
Max range	14.8	14.7	14.4	15.2	20000	km*10 ³
Service ceiling	13.7	13	12.5	13	16	km.
Max fuel capacity	64.2	47.9	43.1	85.5	0	US gal*10 ³
Fuel price	4	4	4	4	0	USD/US gal
Fuel consumption for 1 km	15.6	11.7	10.8	20.2	0	l/km
Average cost for km	16.5	12.4	11.4	21.4	0	USD/km
Average cost for passenger and km	3.71	3.57	3.16	4.28	0	10 ⁻² USD/(pass* km)
Other costs	3.5	3.5	3.5	3.5	4	10 ⁻² USD/(pass*km)
Total costs	7.21	7.07	6.67	7.78	4	10 ⁻² USD/(pass* km)
Lifetime	50	50	50	50	100	Hours*10 ³
Annual cost	74	56	55	90	24	mIn. USD

Operative Conditions of MAAT



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Dimension of Cruiser: 70 m height, diameter 350m

Speed: approx. 200 km/h in calm air

Altitudes: 13 - 17 km

Annual Costs: 24 million US \$ (estimated)

Lifetime: 10 Years (estimated)

Maximum Range: 20 million km

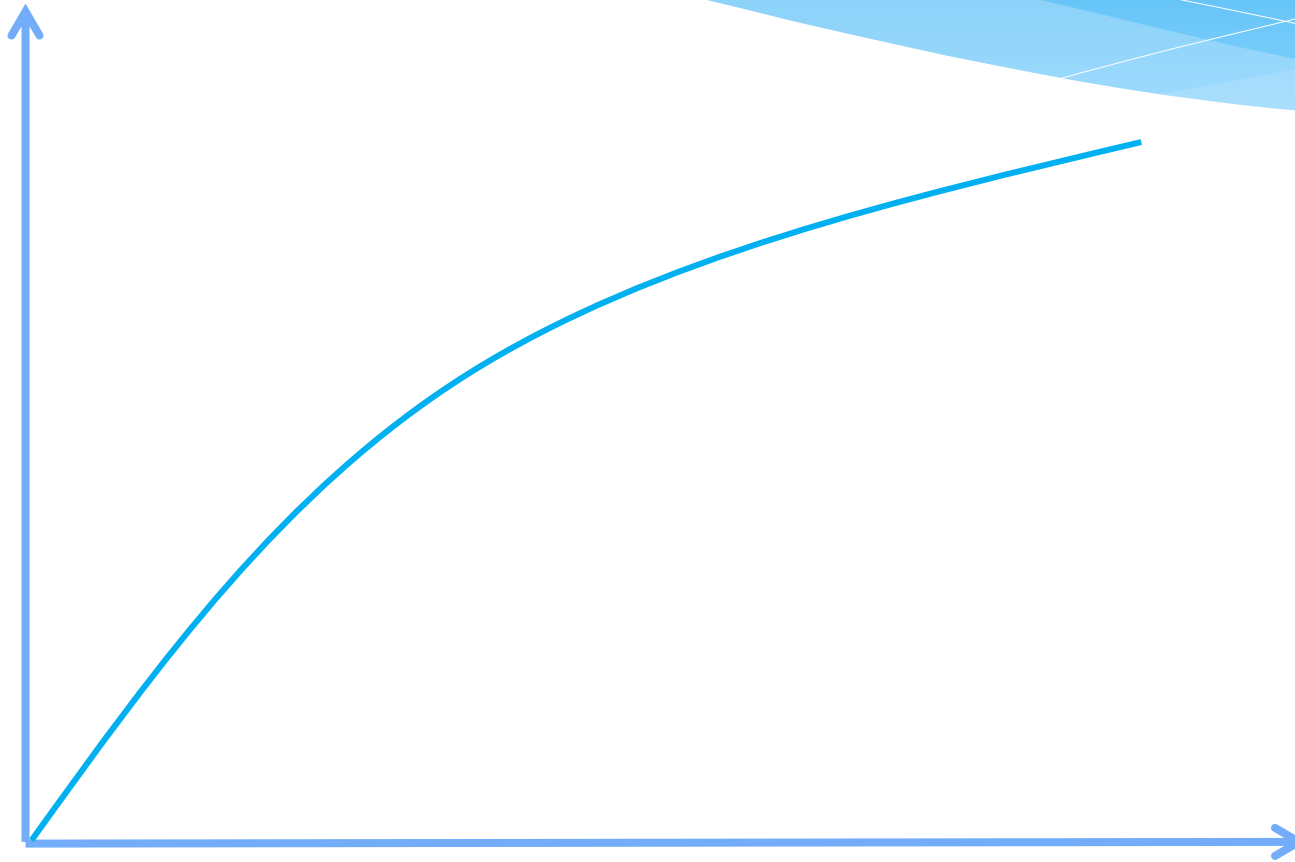
Empty Weight: 500 tons



Comparison with other Means of Transport - Speed



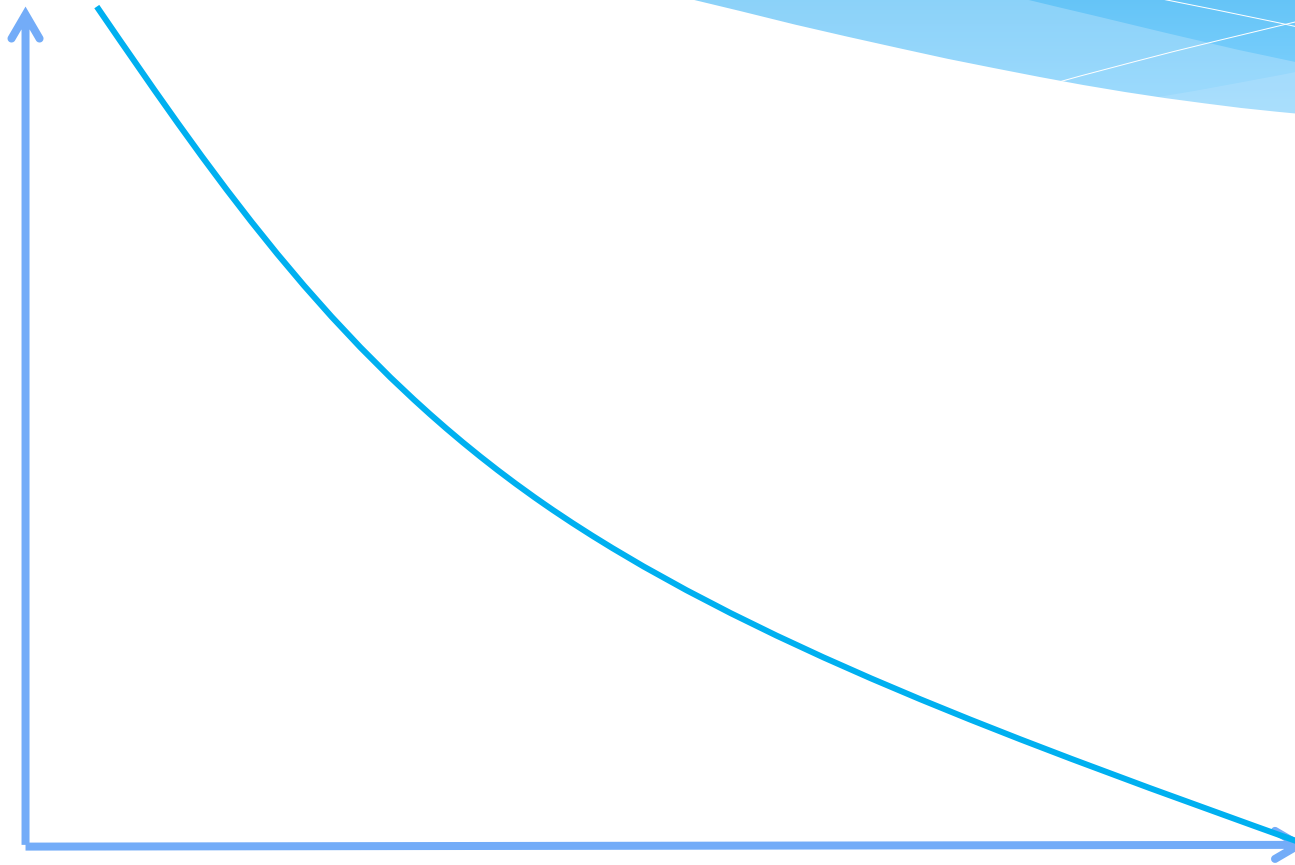
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Comparison with other Means of Transport - Fuel Consumption



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Energy Requirements and Environmental Impact



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The most significant advantage of the MAAT system is that it is **energetically self-sufficient**.



Daytime: the photovoltaic system produces hydrogen and oxygen.

Night: hydrogen based fuel cells supply the needed electric energy.

If properly sized, the energy system allows for a practically 24/7-operation.



The Strengths of the MAAT Concept at a Glance



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VTOL Ground Operations (Vertical Landing)

Operative altitudes higher than traditional civil routes

Heavy payload, low cost of transportation and non-stop flight

Possibility to act as a flying integrated logistics centre

Self sufficient by photovoltaic propelling system

Silent landing and take-off operations

Reduced consumption of soil, no fossile fuels

Intended Demonstration of MAAT

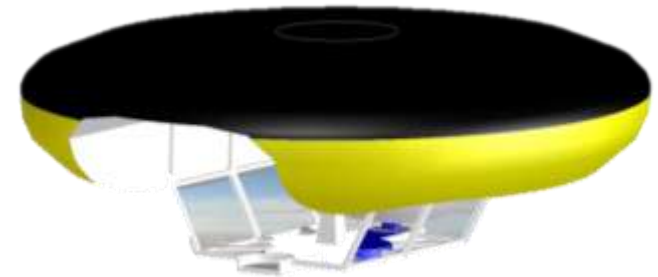


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A number of model airships will be built for demonstration purposes.

Targets:

- Testing of long endurance
- Testing of Docking/undocking operations
- Testing of Materials
- Testing of Control Systems



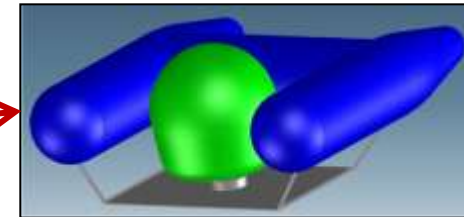
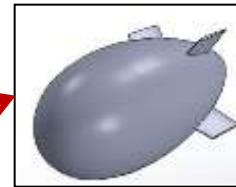
Intended Demonstration of MAAT



Reduced scale prototype to test different technical solutions.

Three types:

- Control Demonstrator
- Docking Demonstrator
- Cruiser Demonstrator



Control system demonstrator



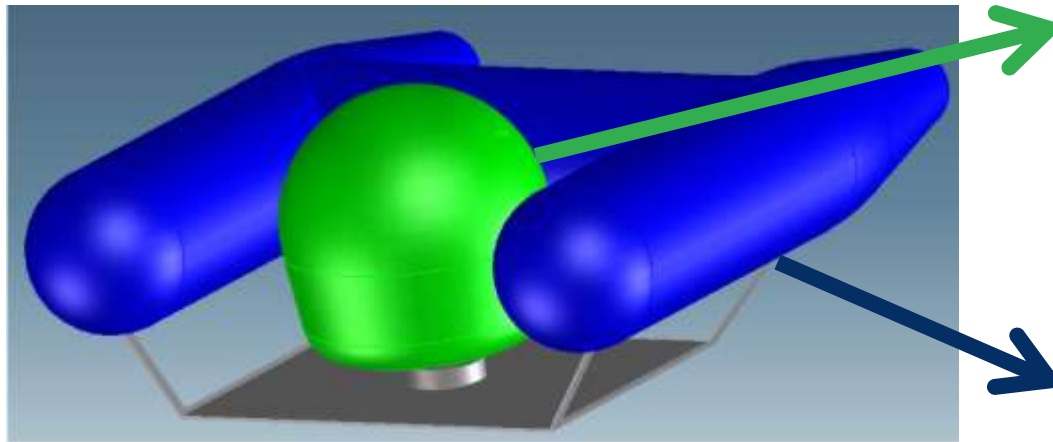
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Docking demonstrator



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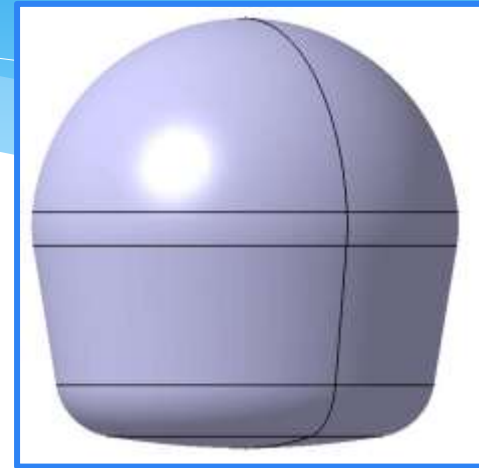


- A muffin shape Feeder (green) very similar to the possible full scale Feeder's shape
- A horseshoe shape Cruiser (blue) which allow the docking manoeuvre both from front and from top

Demo feeder



Inverted truncated cone shape surmounted by a hemisphere. Cone radius ratio to maximize the volume: 0.85.



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Two possible rigid structure to hold the payload:

- Single vertical element
- Four elements

Two possible type of payload's shape:

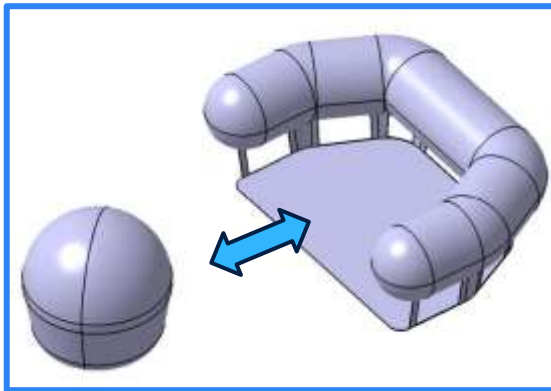
- Rectangular
- Round

Demo docking system

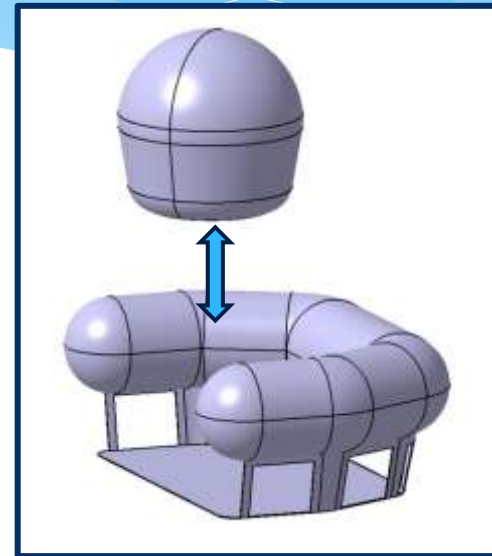
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Two possible procedures:

1. Horizontal operations: both cruiser following feeder or feeder following cruiser.
2. Vertical operations: feeder over cruiser (with feeder moving in the cruiser downward).

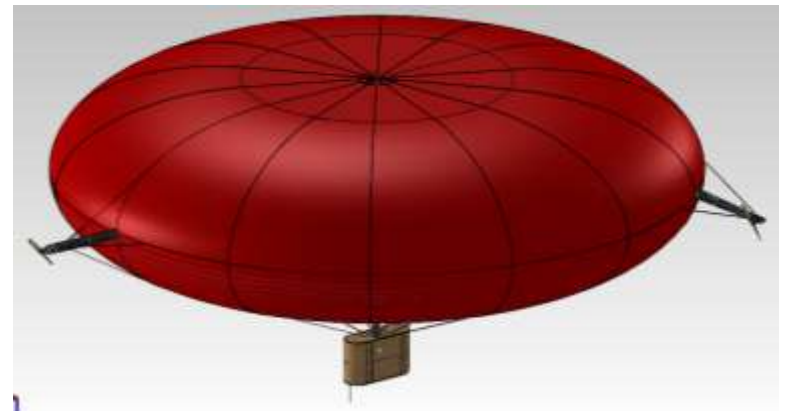


Horizontal rendezvous can be done also in movement while vertical rendezvous operations require to be performed only in static hovering conditions.



Cruiser demonstrator

- Discoid airship with engines mounted on the balloon in an external position, on the vertices of an ideal circumscribed equilateral triangle.
- A lower cabin suspended by ropes and a central vertical column are adopted to lower the centre of mass of the system as much as possible.
- This technical choice is conceived to increase the intrinsic stability of the system.



Material	Application	Unit weight
Polyurethane, Nylon ripstop	Balloon	50 - 170 g/m ²
ABS, carbon fiber, epoxy resin, balsa, aluminum	Nacelle and structure	70
Hydrogen	Buoyancy	0.09 kg/m ³

Specifications	Unit
weight	310 Kg
Volume	310 m ³
Height	6 m
diameter	12 m

Time Schedule

August 2012:

- preliminary mathematical models
- energetic system evaluation
- preliminary design of cruiser/feeder propulsion system
- preliminary analysis of cruiser/feeder engagement/disengagement

September 2012:
Project Start

Feb. 2013:

Preliminary design of:

- telecommunications
- position control systems
- control system hardware

Detailed studies of:

- safety systems
- design of pressurization system

August 2014:
Demonstration
of prototype
models.
Project End.

The Work Package Structure



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Contact

A project within the Seventh Programme „MAAT – Multibody Advanced Airship for Transport“

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