# Fast20XX research project – ideas for travelling at hypersonic speed

*11 December 2012*

The vision is enticing – board in Europe, sit back, and disembark 90 minutes later on the other side of the world, in Australia. But before the SpaceLiner, which is being developed by the Institute of Space Systems at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), can fly a route like this for the first time, new technologies still have to be tested and basic requirements defined. Scientists from Germany, Austria, Spain, Switzerland, Italy, Belgium, the Netherlands, France and Sweden have been carrying out research for the Fast20XX (Future high-Altitude high-Speed Transport) project, which is supported by the EU, for three years. The results of the project, which has now been concluded, will influence the future design of the DLR SpaceLiner and the Aerospace Innovation GmbH ALPHA aircraft.

**Flying like a space shuttle**

The concept already exists; the DLR SpaceLiner is intended to stand upright like a space shuttle before launch and take off on its journey using rocket engines. After the initial burn, the reusable booster stage will separate from the orbiter, in which there will be a capsule with a capacity of 50 passengers. The glide phase will start eight minutes later, at 20 times the speed of sound. The landing, around 80 minutes later, will take place on a normal runway like a conventional aircraft. It is a project for which there are no existing examples: "We are having to define the dimensions ourselves and use computer models of the SpaceLiner to feel our way," says DLR project coordinator Martin Sippel. "The SpaceLiner is a challenge in terms of both technology and operations." So it is that the 17 partners in the Fast20XX research project have not been designing an aircraft, but rather investigating important interdisciplinary aspects for an aircraft capable of air and space travel. Multiple DLR institutes have been involved in the project; besides the Institute of Space Systems, the Institute of Aerospace Medicine, the Institute of Structures and Design and the Institute of Aerodynamics and Flow Technology have also contributed digital and experimental results.


Video: SpaceLiner with Martin Sippel and Olga Trivailo

**Computer simulations**

One important issue is cooling the space plane during flight. After the drive phase, the SpaceLiner glides, during which time it encounters friction from Earth's atmosphere. At this stage, temperatures can reach up to 1800 degrees Celsius. The solution is active cooling on the aircraft nose and the leading edges of the wings. The idea is that water will escape from porous ceramic components and provide cooling as it evaporates. The DLR Institute of Structures and Design is developing and manufacturing suitable ceramics for this transpiration cooling and is simulating their flow on computers. Following work on Fast20XX with tests in the plasma wind tunnel at the DLR site in Cologne, the engineers are now certain that active cooling is possible using porous ceramic materials.

The scientists are also researching the airflow around the aircraft itself and are using computer programmes to model this. "The SpaceLiner will reach a flight altitude where atmospheric pressure is very low, so the flow phenomena change," explains Sippel. Models were tested in a special wind tunnel at the DLR site in Göttingen and compared with digital simulations from Italian partner organisation CIRA. The agreement between the measurements and the simulations was sufficiently high that the simulations are being used to support the future design of the space plane.

**Basic requirements for the high-speed aircraft**

Besides researching the aerodynamics, materials and cooling, projects such as the SpaceLiner require numerous other types of research as well. For example, is flight at hypersonic speed even tolerable for the passengers? The Institute of Aerospace Medicine has given a green light. What approval requirements do the constructors of high-speed aircraft face? To what extent will the environment be affected – even though the SpaceLiner will only emit water as it flies? The 17 partners in the Fast20XX research project are also collating data and researching these topics. "Moreover, we have also worked out the situations in which a flight will need to be aborted and how to respond to situations such as an engine failure," says Sippel. It is already clear that the SpaceLiner can only be launched far from inhabited areas – and that high-speed flight must take place at high altitudes in order to protect inhabited regions from sonic booms.

Many questions are still unanswered; how can the rocket engine be made to operate reliably and safely? What should the tank pressurisation system look like? How must the thermal protection system for the entire aircraft be designed? And what requirements must the passenger cabin meet, since it will also act as a rescue capsule in the event of an emergency? Then, the network of rescue centres on the ground would have to function flawlessly.

**From space tourism to scheduled flights**

For Martin Sippel, a first step on the road to transportation for long haul flights is Project ALPHA by Aerospace Innovation GmbH. This space plane, which was also researched in Fast20XX, is

intended to be launched from an Airbus A330 at an altitude of 14 kilometres with two passengers and one pilot, and then reach an altitude of 100 kilometres. "Space tourism like this might be the first step and be achieved this decade – it is a test to see whether the market for such space vehicles exists," explains the DLR researcher. The SpaceLiner is not intended for short flights in space, but for transporting passengers and goods in point-to-point travel over large intercontinental distances, and is to be principally privately financed, as normal flight is today. This is a long-term vision, according to Sippel, that will not start to happen before 2050. "We want to acquire a new, big market for spaceflight technology and so significantly reduce the costs for transporting satellites into space."

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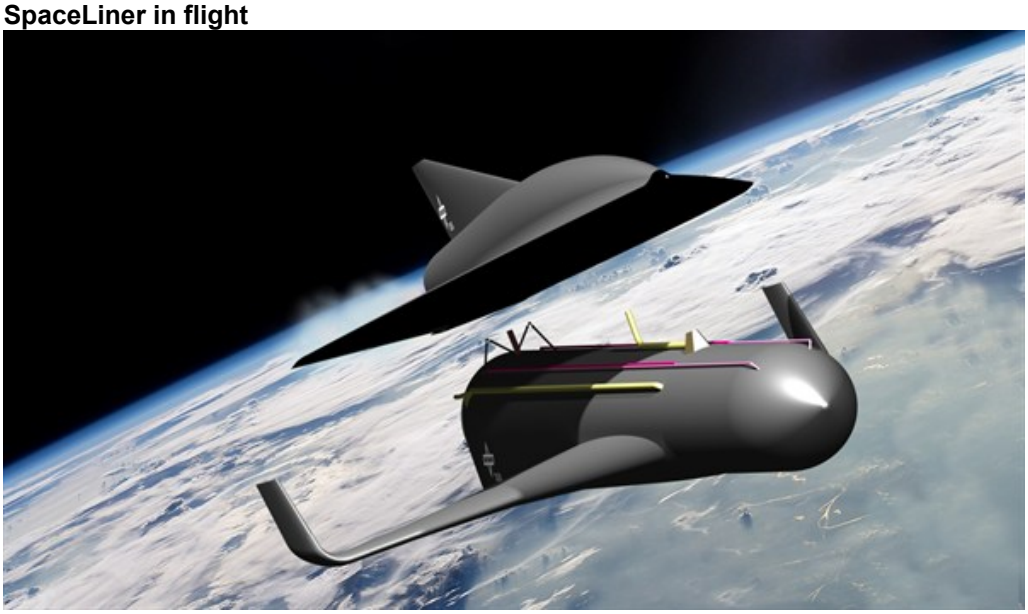
### SpaceLiner in flight



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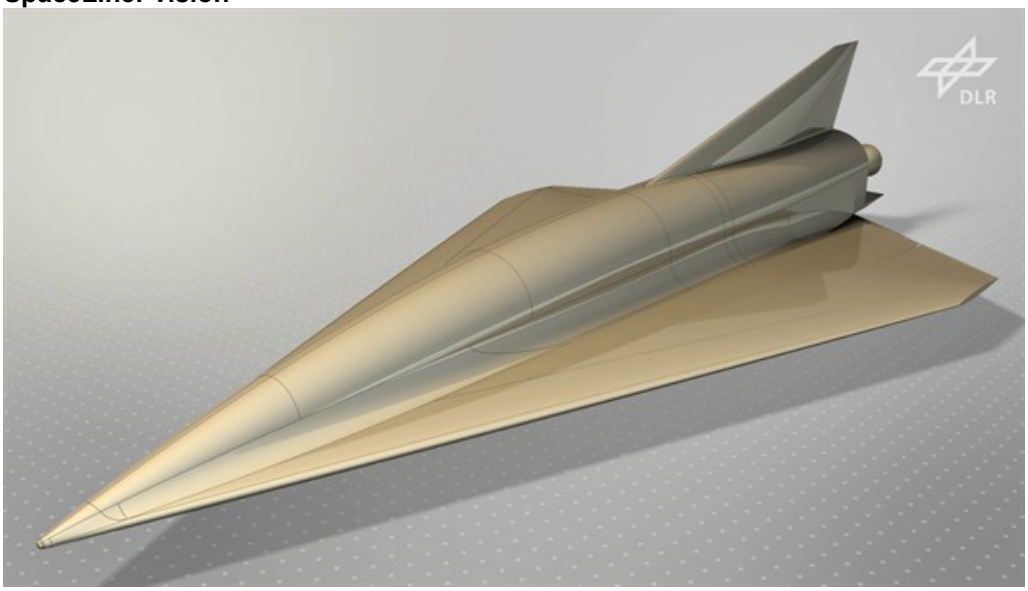
**SpaceLiner vision**

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Credit: DLR (CC-BY 3.0).

**Model of the SpaceLiner**


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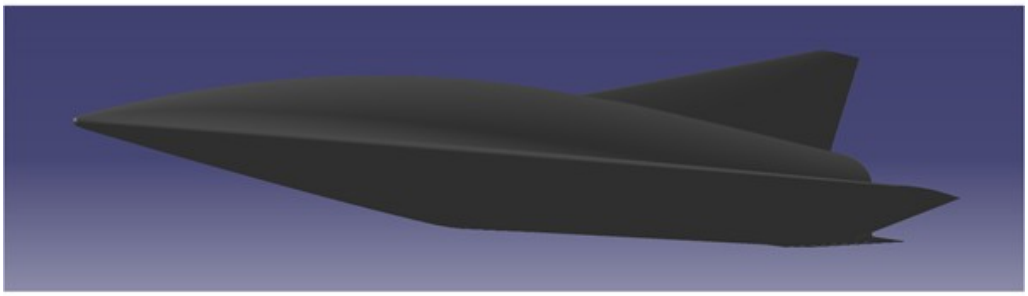
Credit: DLR (CC-BY 3.0).

**The SpaceLiner – a revolutionary concept on the boundary between air travel and spaceflight**



The SpaceLiner is a revolutionary concept on the boundary between air travel and spaceflight. With this ultrafast glider, passengers are expected to be able to cover the distance between Europe and Australia in just 90 minutes. The concept is based on an environment-friendly rocket engine that uses hydrogen and oxygen.

Credit: DLR (CC-BY 3.0).

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