pplane

THE PERSONAL PLANE PROJECT

Newsletter #2 01 October, 2012

SEVENTH FRAMEWORK PROGRAMME

Overview

PPlane is a research project funded by the European Commission with the aim of defining a viable Personal Air Transport System of the future (2030 and beyond - see project website www.pplane-project.org). Such a system will avoid the ever increasing congestion on European roads and offer an alternative to the current conventional transport system across Europe. PPlane will provide in all European countries, an additional component of a future efficient European multimodal transport system aiming at allowing European citizen to travel anywhere in Europe, gate to gate, within 4 hour or less. The PPlane consortium is coordinated by ONERA (France) and includes leading organizations from 11 European countries and associate states from aviation domains in industry, research and academy.

A systematic and innovative approach has been developed and implemented within the PPlane project in order to understand and analyze customers' needs and to propose novel ideas for a Personal Air Transport System (PATS). In order to satisfy the end users' need at large the PATS should be affordable, and should respect all environmental and social constraints.

PPlane has the following characteristics: fully automated transport enabling use of the aircraft without any prior expertise; fly in various weather conditions; "push button" navigation including the integration into the airspace. The aircraft is part of a "system" that enables the "user" to manage his flight from take-off to landing and get help and information from the ground, when and if needed, including emergencies.

Several air vehicle configurations have been examined. The six distributed electric engine configuration (Figure 1) is a promising candidate.

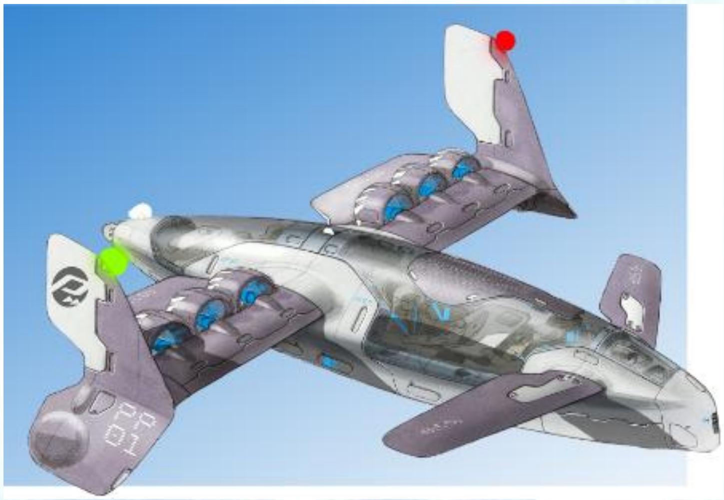

Figure 1: Example of PPlane air vehicle concept

Partners

ONERA, France (Coordinator) www.onera.fr

Israel Aerospace Industries, Israel www.iai.co.il

Airnet d.o.o, Slovenia www.airnet.aero

Bologna University, Italy www.eng.unibo.it

Brno University, Czech Republic www.vutbr.cz

CIRA, Italy www.cira.it

Intergam communications Ltd, Israel www.intergamcommunications.com

Warsaw University Of Technology, Poland http://eng.pw.edu.pl

German Aerospace Center, Germany www.dlr.de/en

Instituto Nacional de Técnica Aeroespacial, Spain www.inta.es

National Aerospace Laboratory, Netherlands www.nlr.nl

University of Patras, Greece www.upatras.gr

REA-TECH Engineering and Architect Ltd.

Figure 2 shows the other elements of the PPlane system. The air vehicles would utilize high density 4D operations airspace, supported by a dense, safe and secured networked environment. This includes an air-to-air network (illustrated in yellow) and a ground-to-air set of links (illustrated in blue).

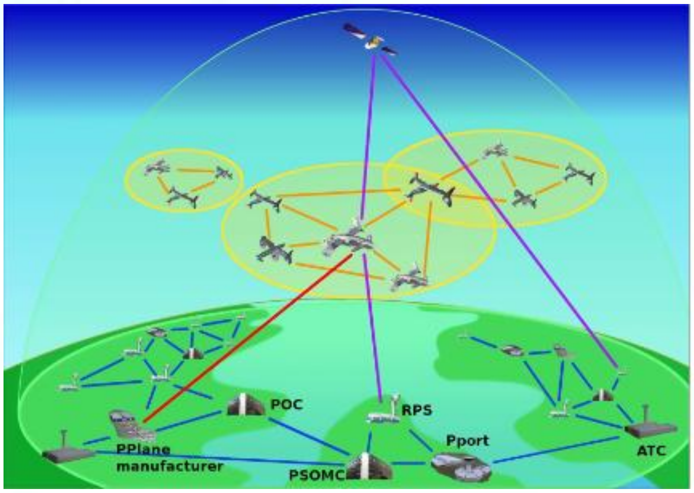

Figure 2: Left: The PPlane ATM environment supported by redundant data link networks
Right: Concept of a Remote Pilot Station (RPS)

Approach

The main issues that have been addressed are divided into five domains: security and safety, automation and control, environmental impact, energy constraints, human factors and social acceptance. In each domain, areas such as technologies, regulation, and affordability are considered resulting in the design of viable systems ideas.

During the first phase of the project, a comprehensive methodology was implemented in order to select and prioritise the "concepts of operations" and the attributes of the PPlane system. The methodology consists of two complementary means: a "Delphi" survey and a design engineering tool named "House of Quality" (HoQ). The Delphi Survey was conducted among several hundred external experts in aeronautics and related fields such as regulation, air traffic control, aircraft design and manufacture, safety and security. The experts were asked to suggest and rank operational parameters, technical features and attributes of future PAT systems from the end-user prospective. The survey resulted in a comprehensive set of "customer needs". The top rated attributes: safety, door to door time and accessibility. Other parameters: expected flight Range 300 – 540 km, capacity 4 – 6 seats cruise speed 230 – 340 km/h, cost 1.5 – 2.6 times terrestrial.

The "House of Quality" method (Tier 1 and Tier 2) was used to prioritise and select the desired system. PPlane system attributes were listed and ranked resulting in multiple "concepts of operations" and scenarios. Parameters that were listed and weighted included "Aircraft Characteristics", "Recovery Systems", "Mission", "Type of Runway", "Guidance", "Class of Airspace", "Visibility", "Wind" and many more. This methodology enabled to identify and classify the most promising system concepts and scenarios for further analysis.

Concepts of Operation

The selection process resulted in several roadable and non-roadable scenarios. The roadable scenarios were eliminated because of multiple constraints (e.g. environment, energy, safety). The leading scenario for non-roadable vehicles suggests a 4 to 6 seat plane equipped with electric engines that can make one or more stopovers depending on the distance to be covered and payload to be carried. In the future, onboard electricity generation or storage could be made possible for small scale aircraft through other disruptive technologies (e.g. low energy nuclear propulsion).

The global concept suggests that PPlane system will be one element of an intermodal transportation system relying both on highly developed ground transportation means and personal flying vehicles as illustrated in Figure 3.

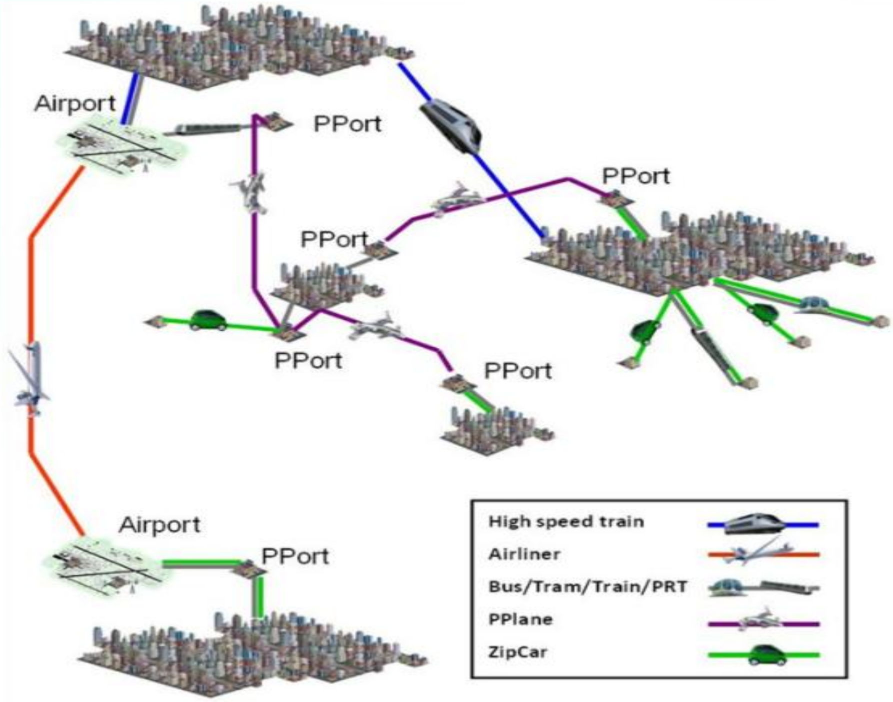

Figure 3: PPlane as a part of future multi-modal European transport system

Main Results

Human Factors : PPlane vehicle should be used by a 'regular Joe' with no specific competency or training, only passengers on board - pilot on the ground (GP), a pre flight briefing will be required (emergency procedures), In flight information is required including voice communication with ground. PPlane Ground Pilot should have a specific license and type rating.

Safety and Security: Need to develop new type of highly reliable FCS and autopilot, design of FCS system could be based on existing designs for higher category aircraft, 4D contract managed at the PPlane system level, multiple engine recommended. Command & Control Data link is critical.

Environment: Emissions of NO_X, CO, CO_2 and H_2O with combustion engines - no direct emission with electric engines. Nearly no noise for electric engine, significant noise for combustion engines. Propeller used with both types of engine, 4D contracts will enable optimized flight path, electric engines will answer most environmental problems.

Automation & Control : Separation management: automated; Detect and avoid - new paradigm. Model-based FDI techniques should lower hardware redundancy needs. GNSS based systems + vision based technologies still require further work; complex issues - share functions between on-board automation, ground automation and humans. Aid to piloting tools & remote pilot situation awareness.

ATM: On board 4D trajectory management is required, ATC monitoring of aircraft compliance to planned 4D trajectory remains a problem for safety and efficiency including conflict management and latency in aircraft reaction to ATC instructions. Self sense and avoid system not practicable - a 4D contract based, preplanned, Air Traffic Management is needed.

Topics for further investigation: Technical issues: Aircraft characteristic and performance, associated ground support systems, high automation level that is needed for such a system. Overall system architecture: Identification of user's needs and expectations, integration to the overall transportation system, management of abnormal situations. Social issues: Safety of over-flown population environment concerns (emission, noise, etc).

EC Roadmap matches PPlane's vision: "*Automation has changed the roles of both the pilot and the air traffic controller. Their roles are now as strategic managers and hands-off supervisors, only intervening when necessary.*"

Cost Analysis

In order to assess the alternative low cost terrestrial solutions, a wider study was conducted on valid transportation solutions, which include trains, cars, buses and airplanes. In order to set a common scale for price comparison, all travel price tags had been normalized to cost (in Euros) per seat per km.

Figure 4 presents a comparison of costs travel in [€/seat/km] units, between the different transportation means. The columns of this graph are representing the average, as for today, values of travel alternatives that had been studied. From the Delphi survey, the typical "Acceptable Cost per Kilometre" for PPlane with an average capacity of 75% (LF) to be 0.15 to 0.52. Calculations based on the MDO model resulted in “total” transportation costs of 01.91 €/seat/km.

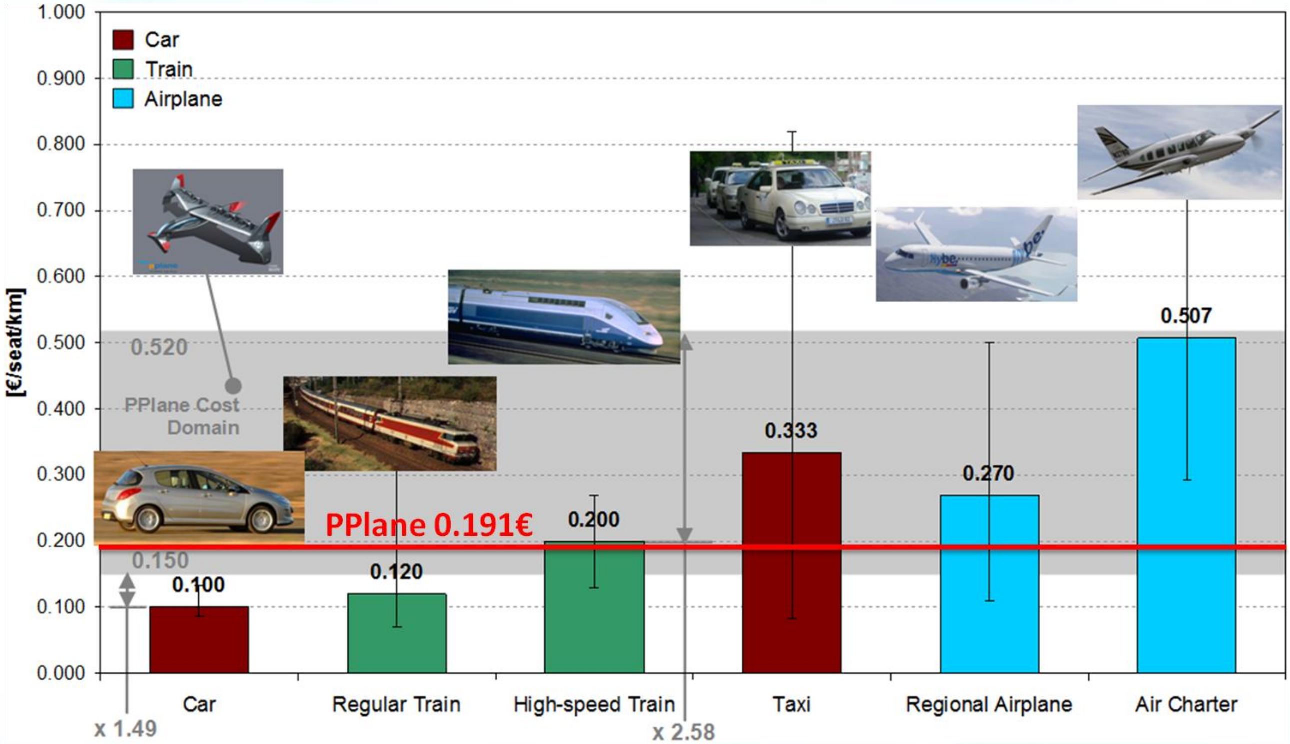

Figure 4: Estimated Cost per Km per Seat (Load Factor of 75%)

Conclusions

The PPlane project team has addressed many areas of the overall proposed system such as safety, security, automation, human factors, environmental impact, cost and social acceptance. No potential show stoppers have been identified. Further research is needed in order to continue the European effort to pioneer the air transport of the future.

Figure 5: PPlane meeting attendees – Budapest, 2012

Contact: Claude Le Tallec (project coordinator): Claude.Le_Tallec@onera.fr

Dr. Moshe Harel (Project Secretariat): mharel@netvision.net.il