



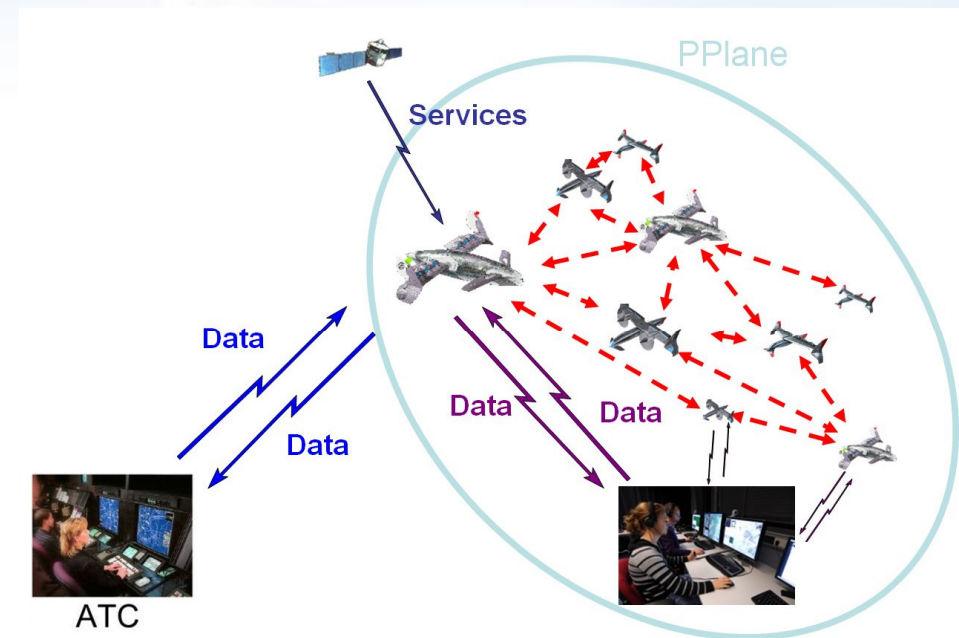
Overview of the European PPlane project

Claude Le Tallec
Onera - France

SAT-Rdmp Kick-Off meeting, January 12 & 13, 2011
Institute of Aviation, Warsaw

OUTLINE

- PPlane Project information
- Methodology of the project
- PPlane systems
- Concepts of operation
- What type of ATM for PPlane?



**It is not for us to forecast the future,
but to shape it.**

Antoine de Saint-Exupery

PPlane (The Personal Plane Project)

Acronym: PPlane

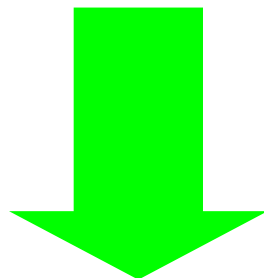
- 7th Framework Programme, second call
- Type of funding scheme:
 - **Collaborative Projects**
 - **Small or medium-scale focused research**
- Work programme topics addressed:
 - **Activity: 7.1.6 Pioneering the air transport of the future**
 - ***AREA: 7.1.6.3 Promising Pioneering Ideas in Air Transport***
 - **AAT.2008.6.3.3. Personal air transport systems**
- Budget: 4.4 M€ (3.3 M€ from the European Commission)
- Duration: 30 months
- Start date: 1st of October, 2009

Project specific objectives

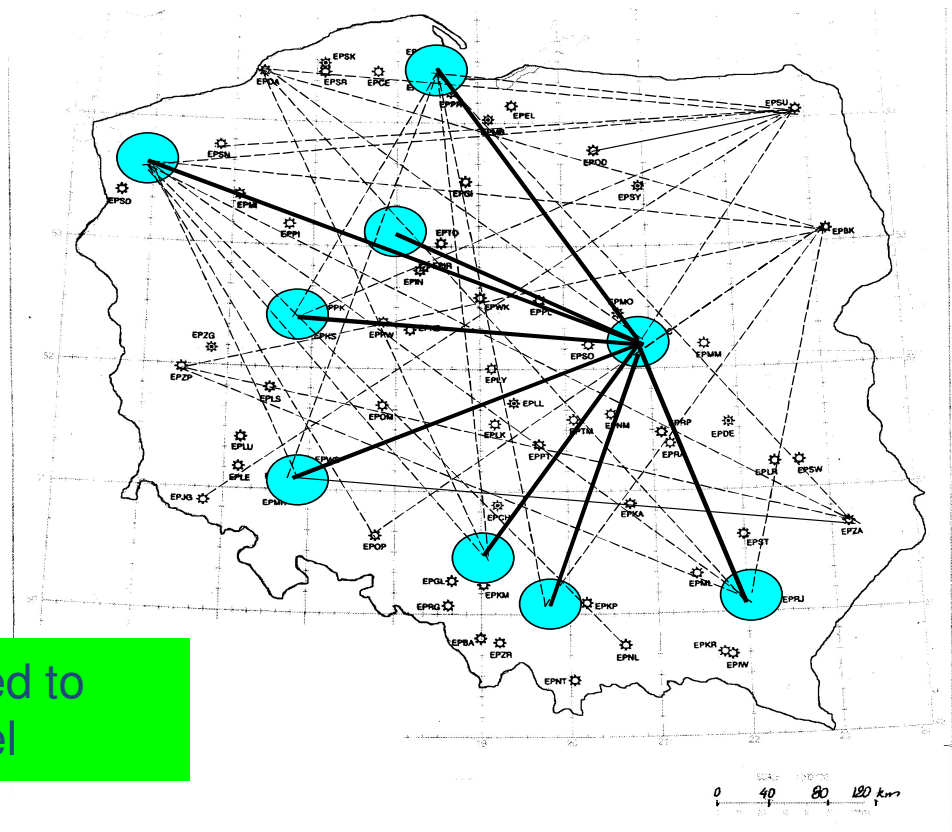
Aims at developing system ideas to enable individual air transport

- To avoid the ever increasing congestion on European roads
- To offer an alternative for the current transport system in new European Member States

Estimated foreseen demand of personal transport from the European Personal Air Transportation System (EPATS) Specific Support Action (6th Framework program)



389,000 personal aircraft needed to substitute long distance car travel



Personal Plane ??

Preliminary thoughts:

- Automatisms developed to allow a “regular Joe” to use his own aircraft without any prior expertise
 - In various weather conditions
 - Easy command and control
 - “Push button” navigation including the integration into the airspace (other sky users, class of airspace, Special Use Airspace)
- Aircraft safe in a large flight envelope
- Aircraft is part of a “system” enabling the “user” and the “pilot” to manage the flight
 - asks for a destination
 - monitors the flight until reaching that destination
 - gets help and information from the ground when, and if, needed

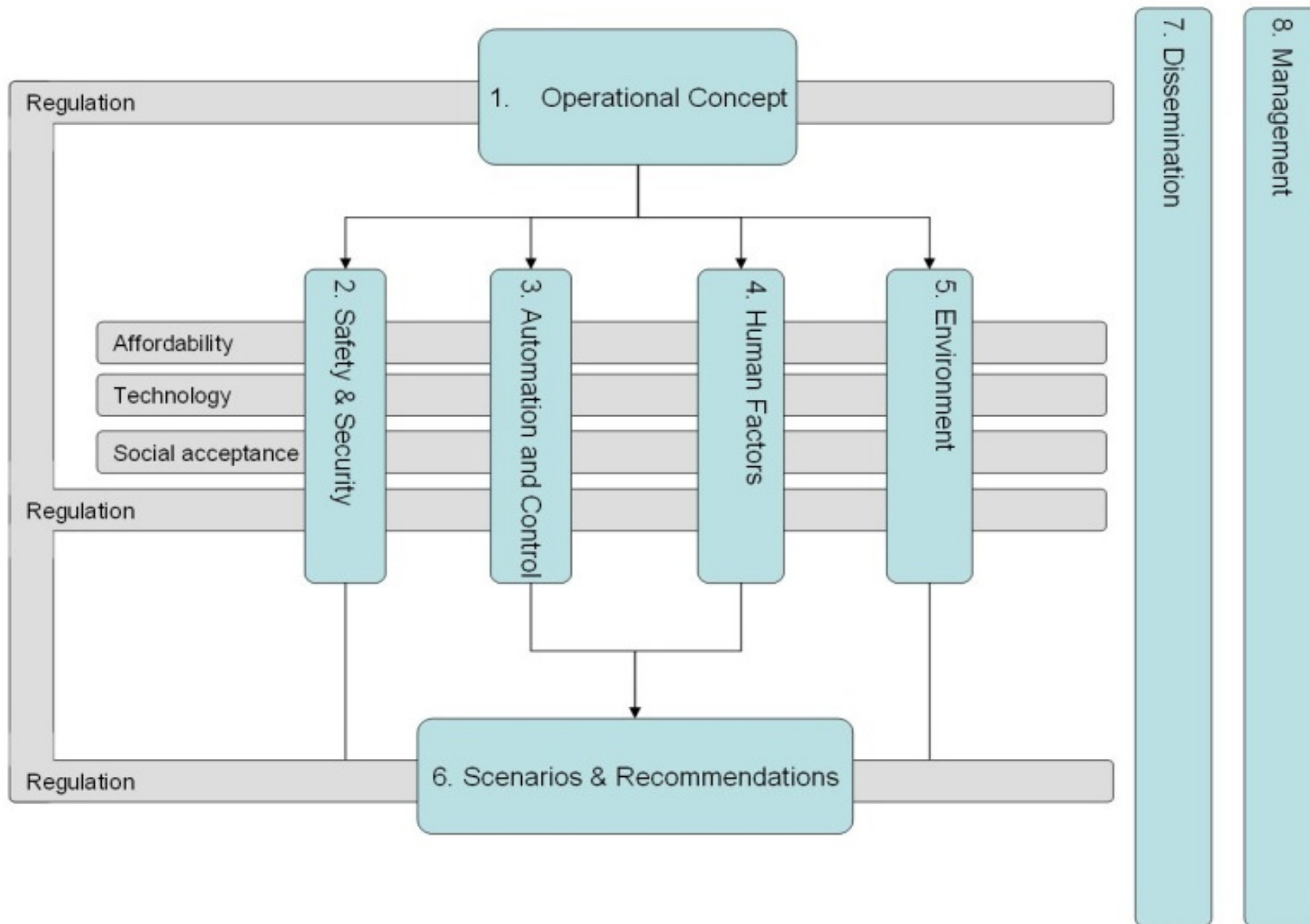
Project Approach

- Implements a systematic approach to propose radical and novel ideas for Personal Air Transport System (PATs):
 - Definition of several operational concepts for the personal air transport system of the future
 - Implementation of an optimisation model including several selection criteria to suggest and analyse these concepts:
 - “Security and safety” (Including Regulatory issues)
 - “Automation and Control”
 - “Environment” (Environmental impact, energy)
 - “Human Factors” (Role of the human in ATM – including pilots, HMI)
 - Consideration of horizontal areas such as technologies, **regulation** and affordability in each of the above criteria
- Resulting concepts are analysed and compared
- Recommendations for implementation across Europe will be provided

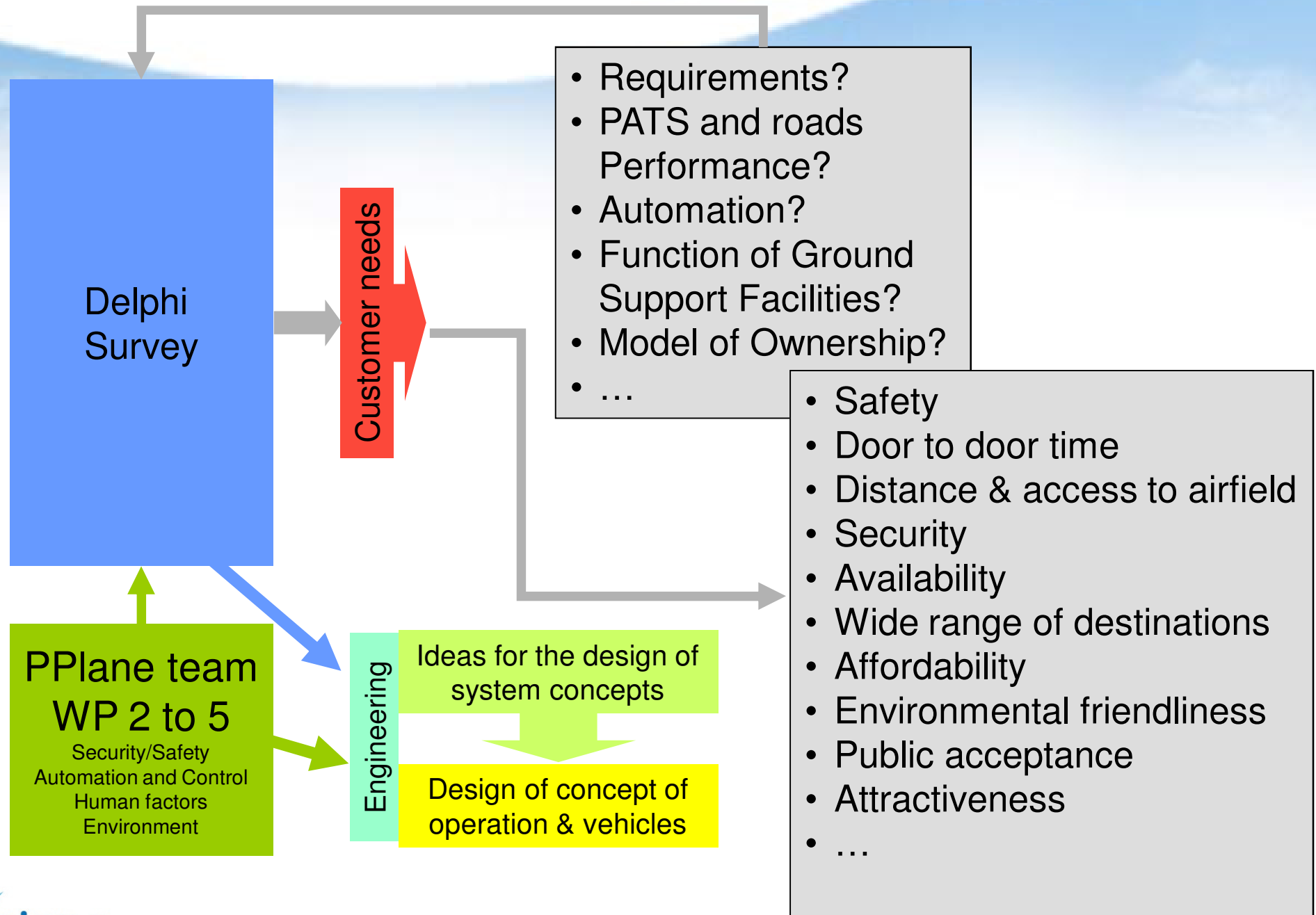
PPlane Partners

1. French Aerospace Lab	ONERA	France
2. Israel Aerospace Industries	IAI	Israel
3. Airnet	AIR	Slovenia
4. Bologna University	UNIBO	Italy
5. Brno University	BUT	Czech Rep.
6. CIRA	CIRA	Italy
7. Intergam Communications Ltd.	ITG	Israel
8. Warsaw University of Technology	WUT	Poland
9. AT-One, German Aerospace Center	DLR	Germany
10. Instituto Nacional de Técnica Aeroespacial	INTA	Spain
11. AT-One, National Aerospace Laboratory	NLR	Netherlands
12. University of Patras	PAT	Greece
13. REA-TECH Engineering and Architect Ltd.	REA	Hungary

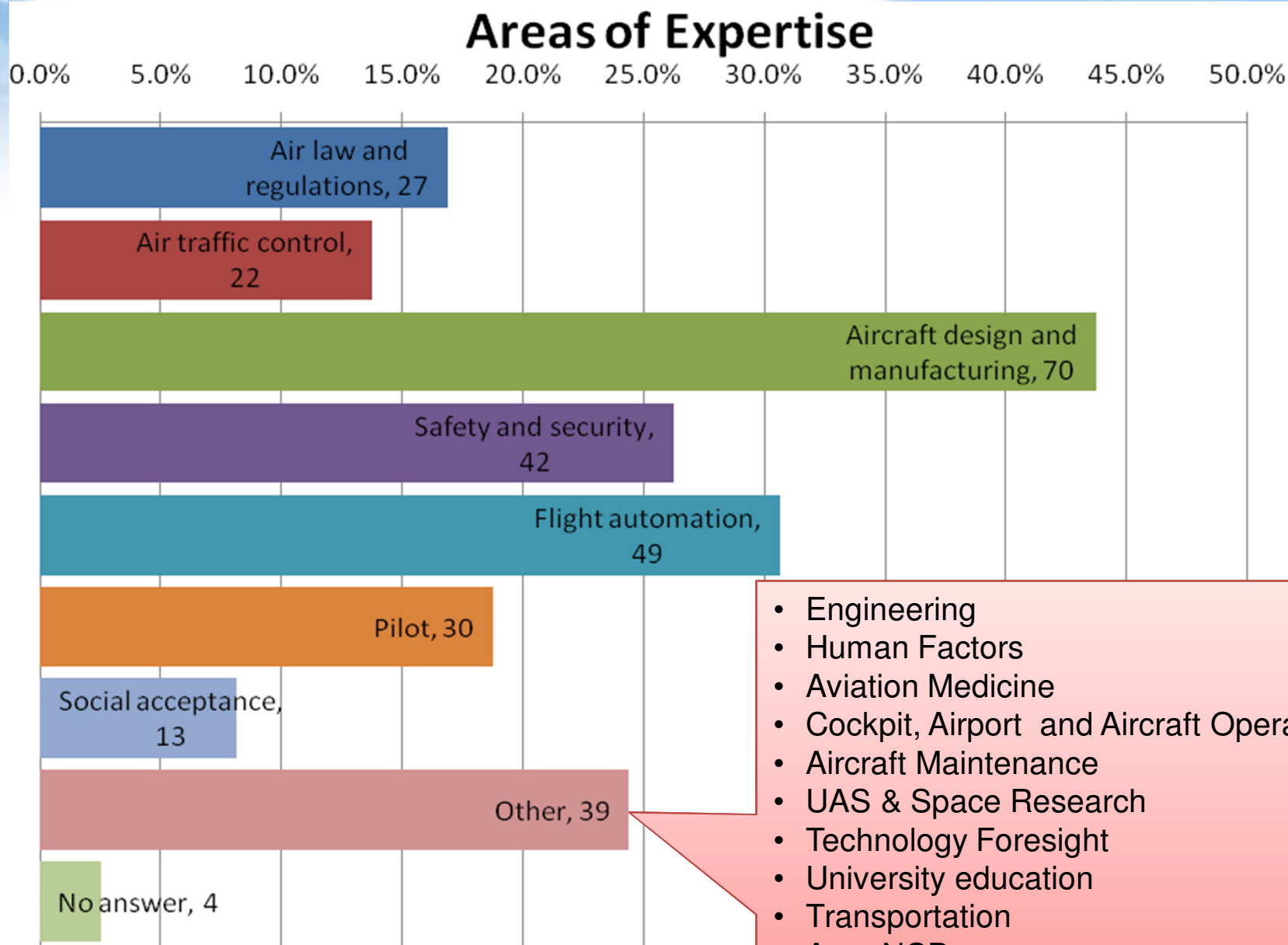
Workflow



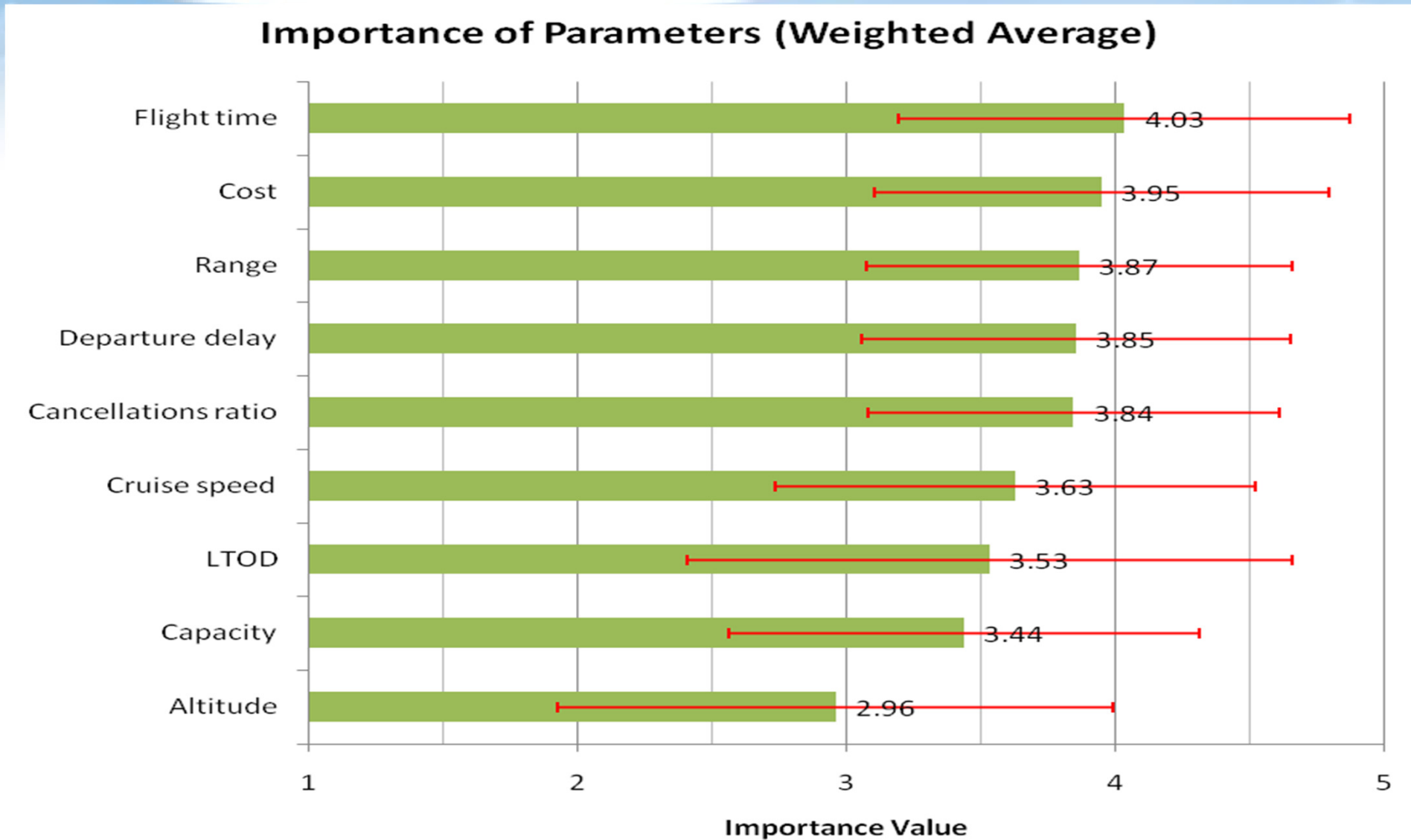
Project methodology – Delphi survey



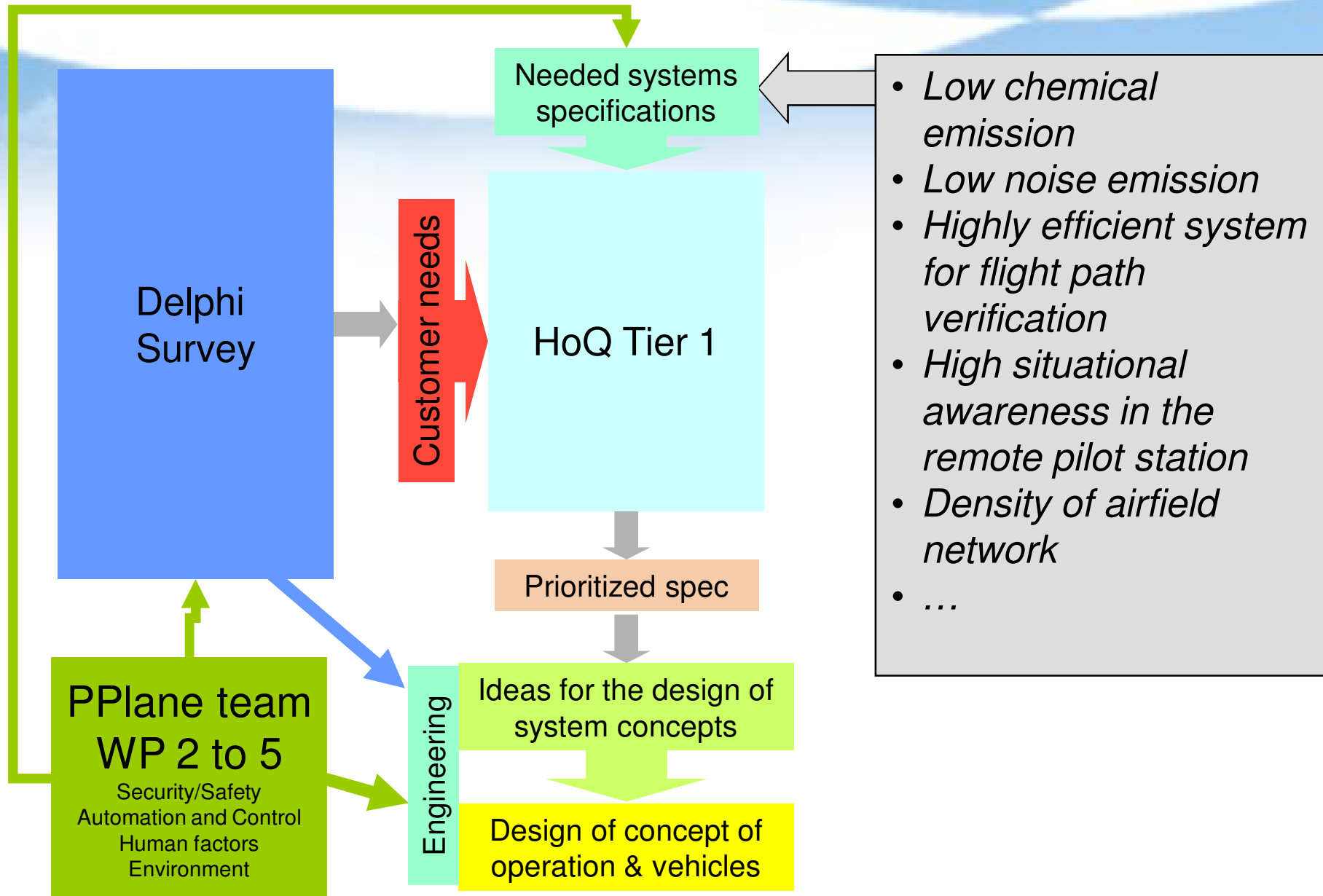
Delphi survey: Experts' Areas of Expertise



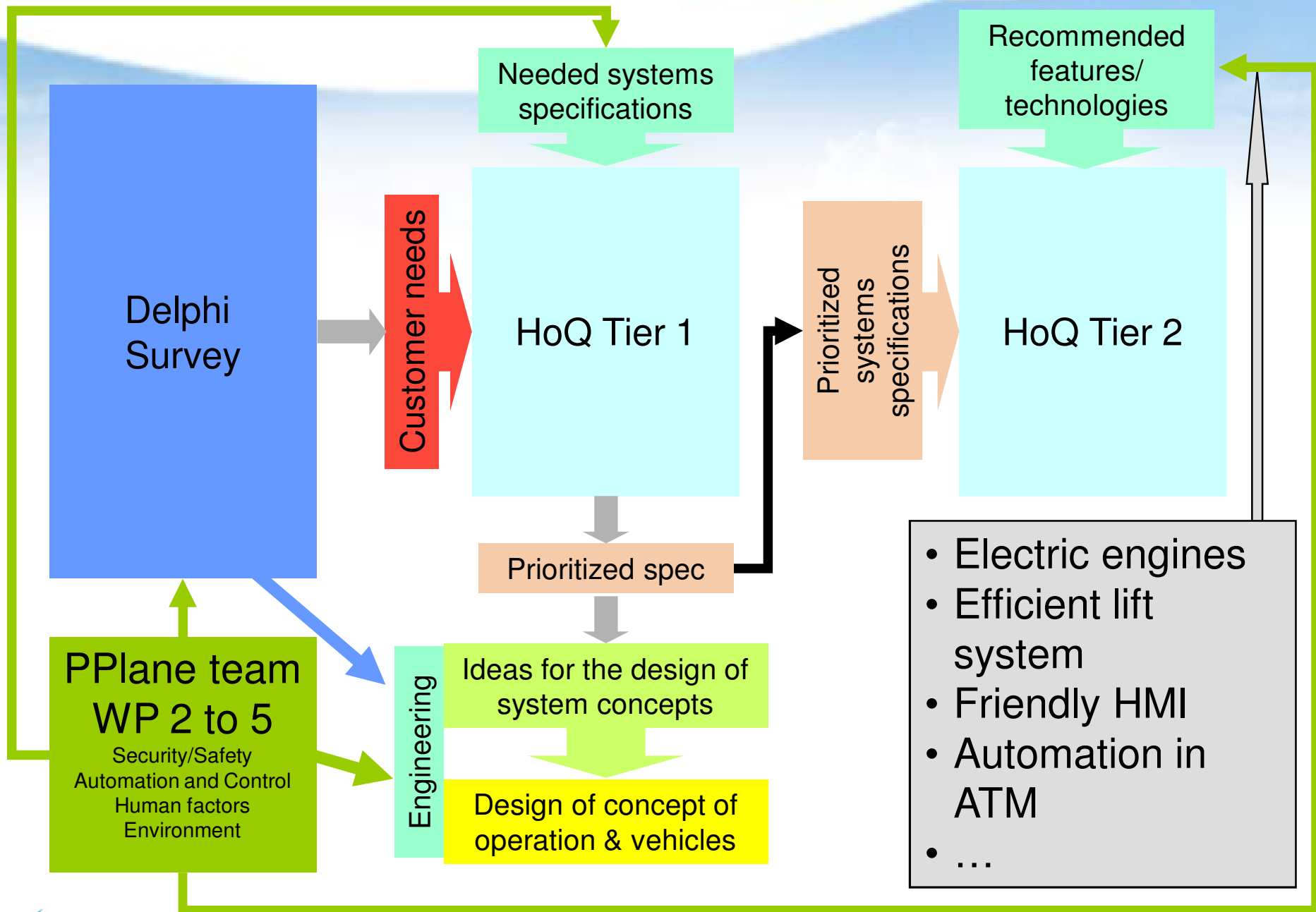
Delphi output: Performance - importance



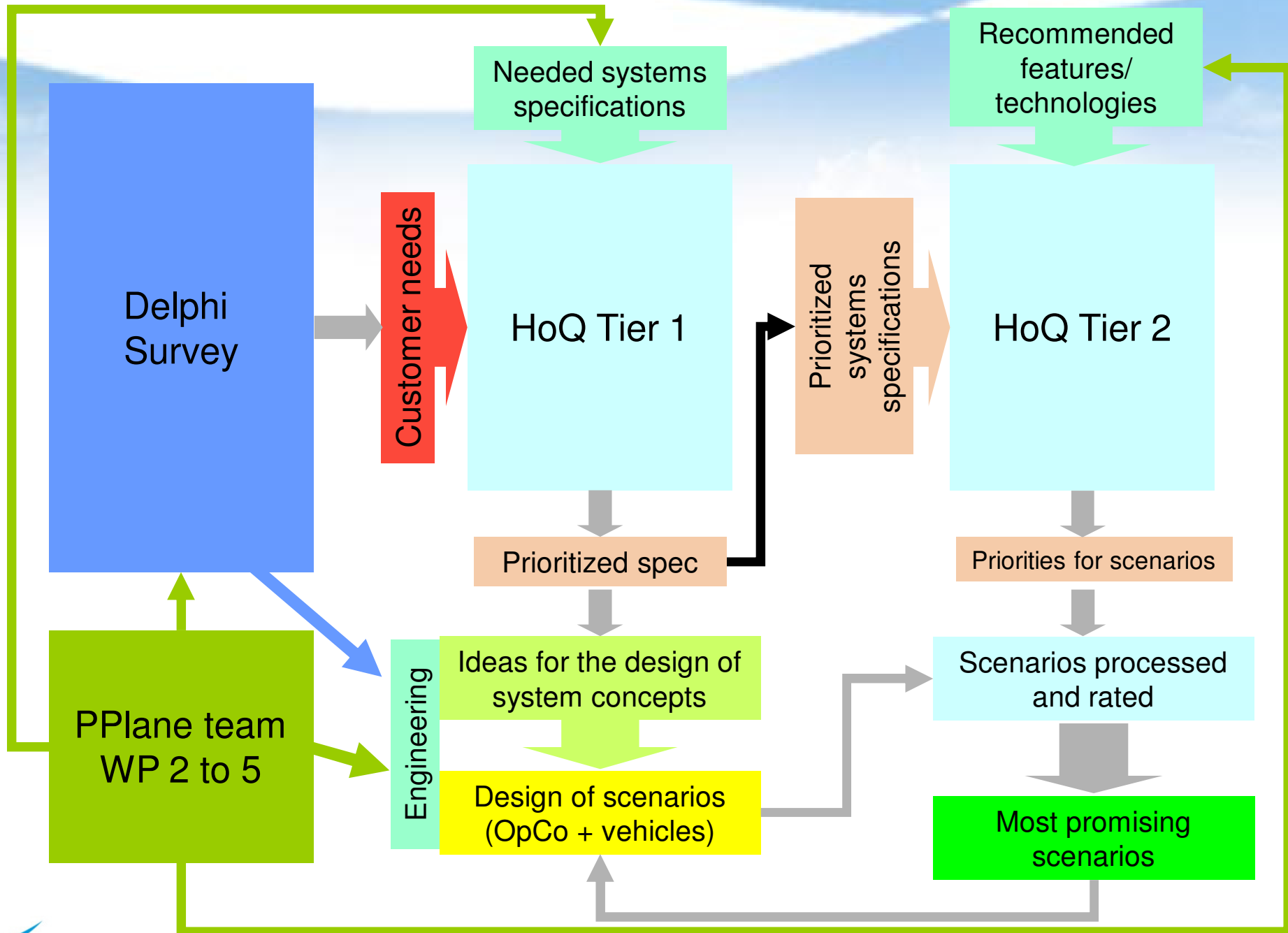
Project methodology – House of Quality Tier 1



Project methodology – House of Quality Tier 2



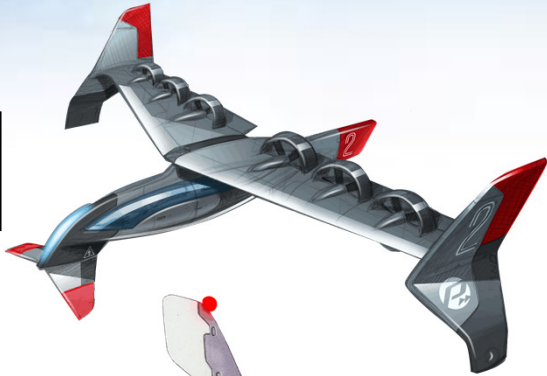
Project methodology – Ranking scenarios



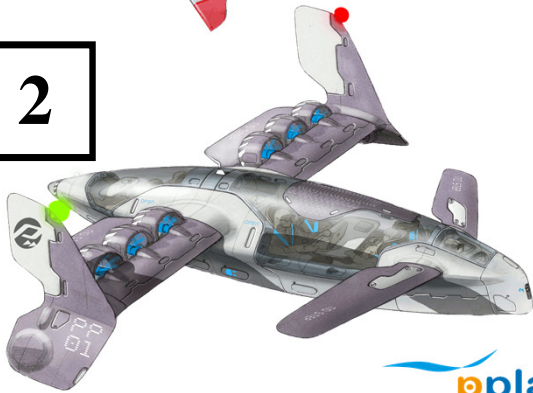
Potential concepts of PPlane vehicles

Preliminary ideas

1



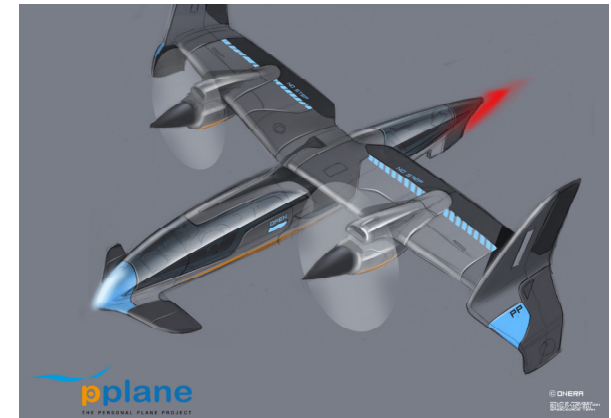
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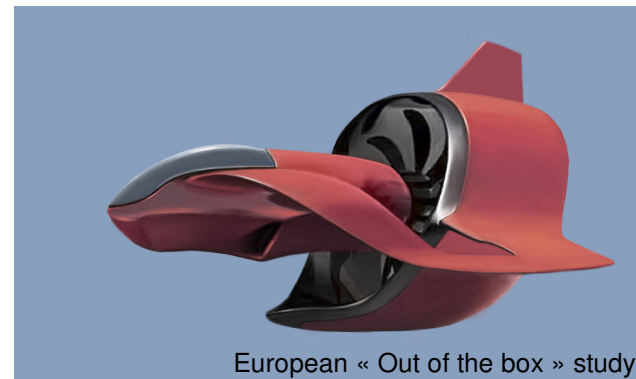


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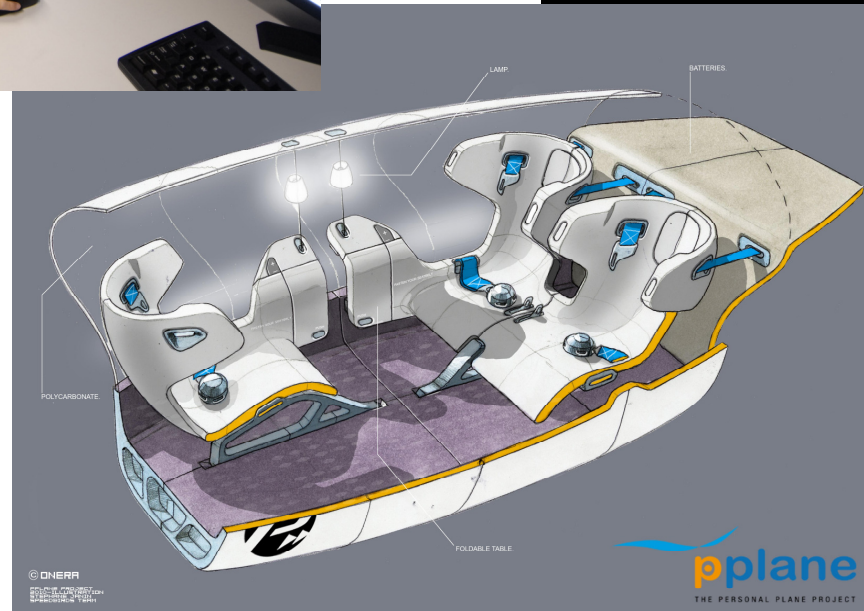
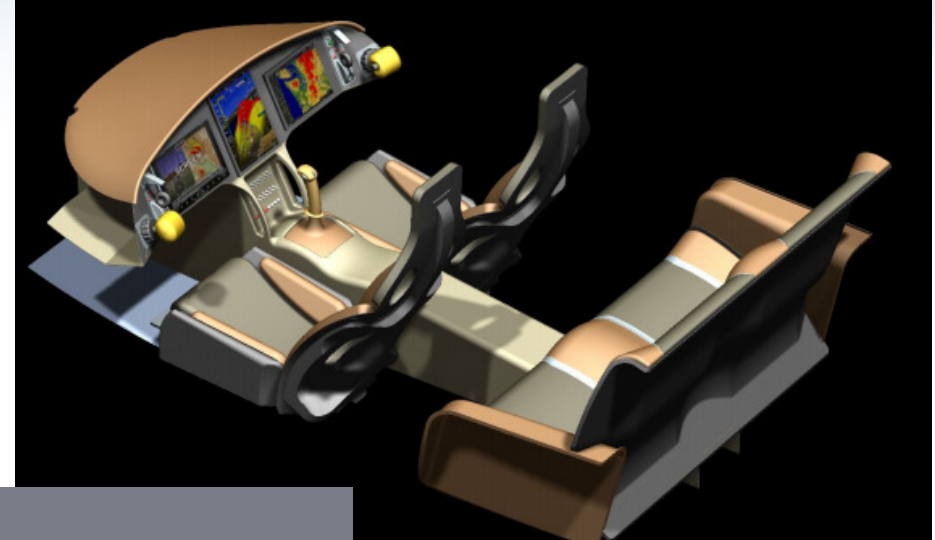
European « Out of the box » study

PPlane ground segment

PPlane air vehicle cabin/cockpit layout



Preliminary ideas

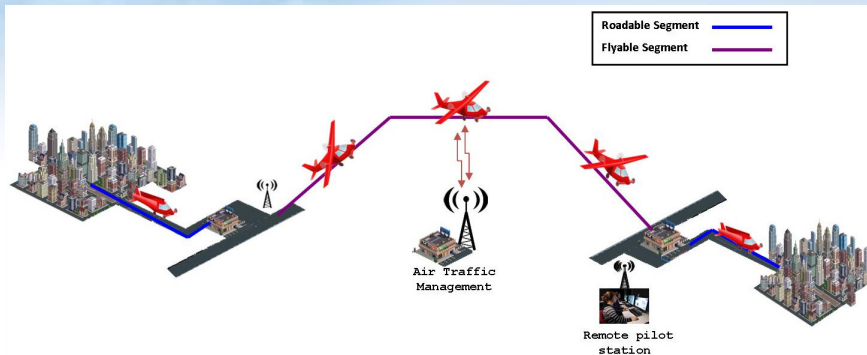


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ET DE L'ESPACE

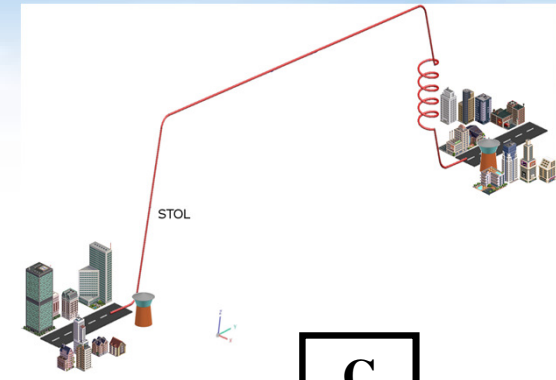
pplane
THE PERSONAL PLANE PROJECT

PPlane concepts of operation and scenarios

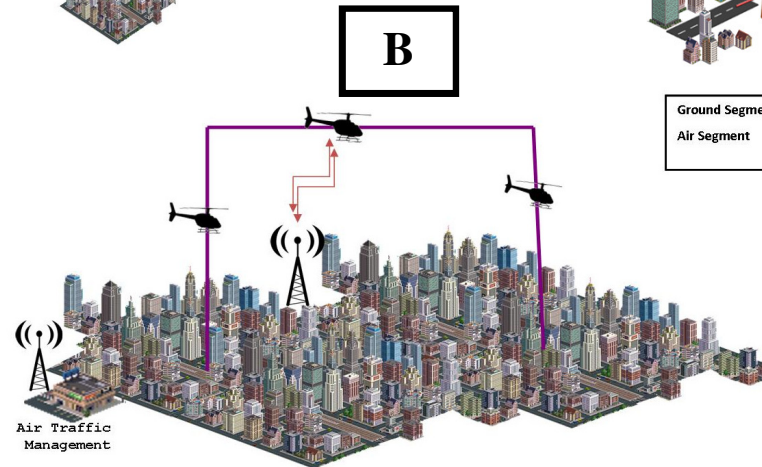
Preliminary ideas



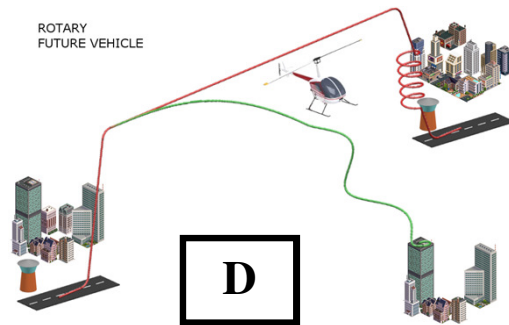
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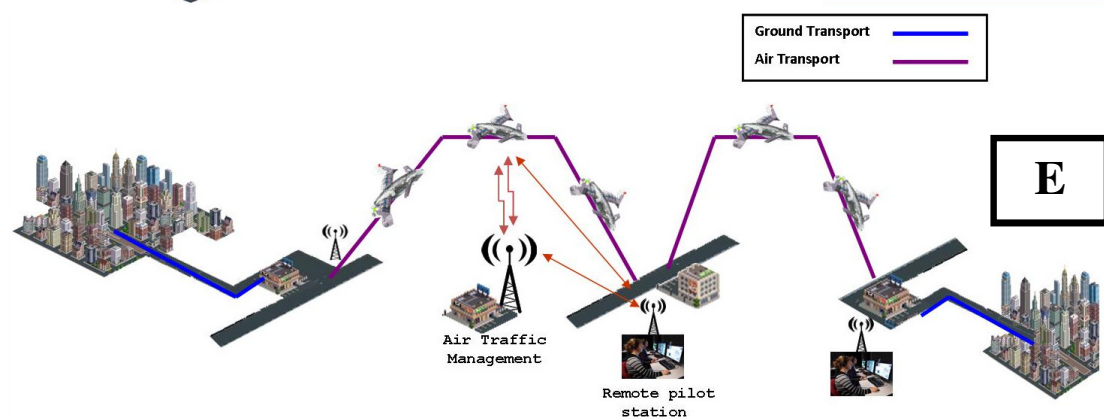
C



B



D



E

What type of ATM for PPlane?

- Conventional voice messages between ATCos and pilots are not an option
- 4D trajectory based, preplanned, ATM is needed
- ATC monitoring of aircraft compliance to planned 4D trajectory remains a problem for safety and efficiency
 - Conflict management
 - Uncertainty in aircraft future positioning
 - Latency in aircraft reaction to ATC instructions



Need for a 4D contract based ATM

What type of ATM for PPlane?

The 4D trajectory concept



- Being at a given geographical position at a given time
- Already exists and has been widely studied
- Main drawbacks:
 - compliance of the actually flown 4D trajectory with the planned one has to be constantly monitored by the Air Traffic Control (ATC)
 - aircraft 4D trajectory may vary due to e.g. weather conditions
 - regardless if a pilot or a controller is in charge of trying to keep the aircraft on the planned 4D trajectory, this is a challenging task
 - difficulty to regulate the traffic (limitation of flights for a given schedule)

What type of ATM for PPlane? Any solution?



- Aircraft automation with a 4D FMS (Flight Management System) partly solves this problem
- Question that still remains is: who will be in charge of maintaining separation between aircraft?
- Predicting the real 4D trajectory from the ground is not an easy job

The 4D contract concept has been designed to solve the trajectory prediction problem

What type of ATM for PPlane?

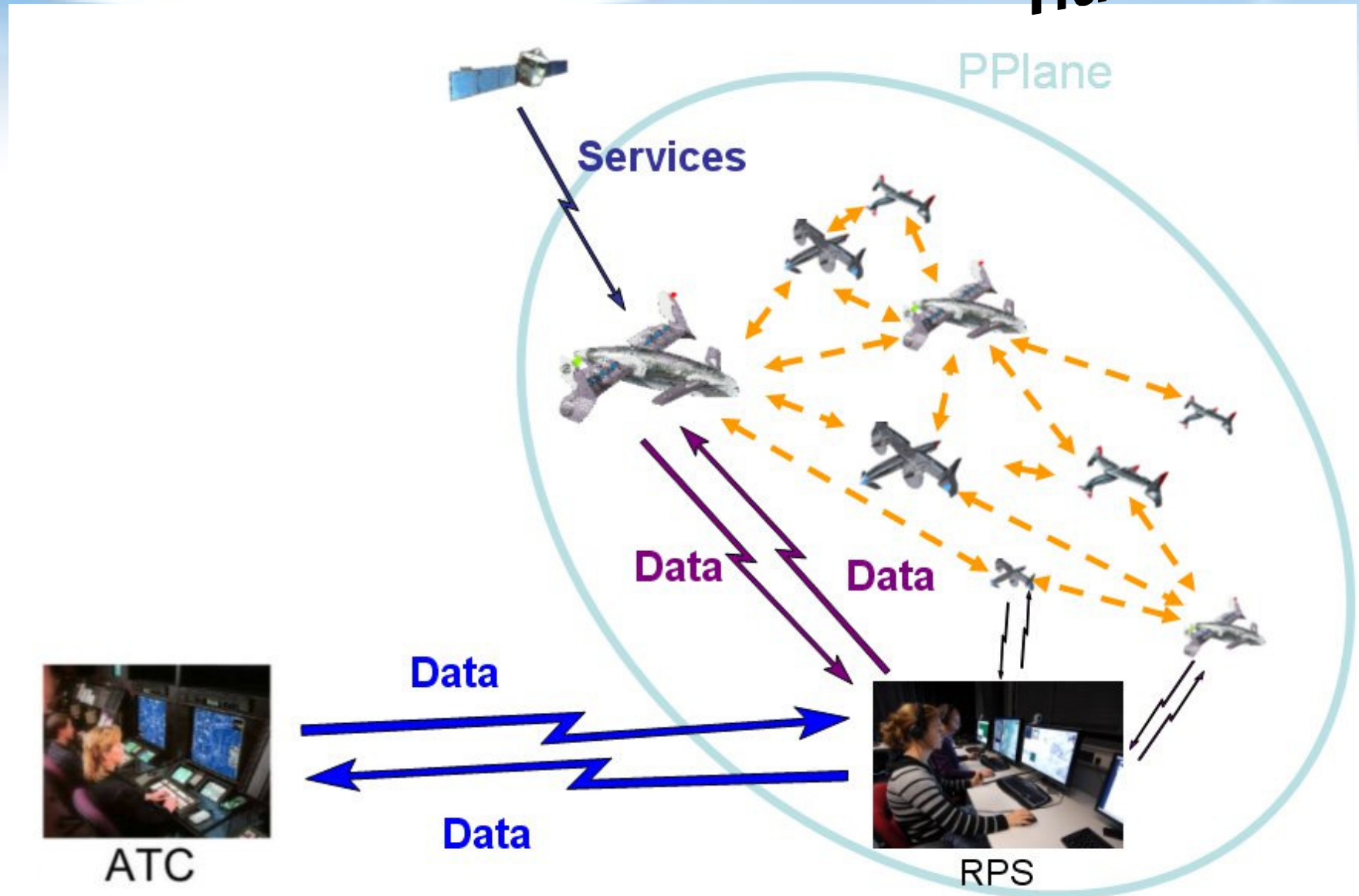
The 4D contract concept



- The ground segment of the system is in charge of generating conflict-free 4D trajectories according to the demand and to the airspace and **airport capacity**
- Aircraft are assigned the resulting 4D contracts
 - The aircraft are in charge of monitoring their own compliance with their own contract
 - They have to stay inside their assigned 4D moving volume, or to ask for a new contract if they cannot
 - Doing so, the aircraft are guaranteed to fly conflict-free trajectories
 - There is no need to predict trajectories on the ground: trajectories will be executed as initially planned, unless a modification is required by the aircraft or by ATC to re-plan

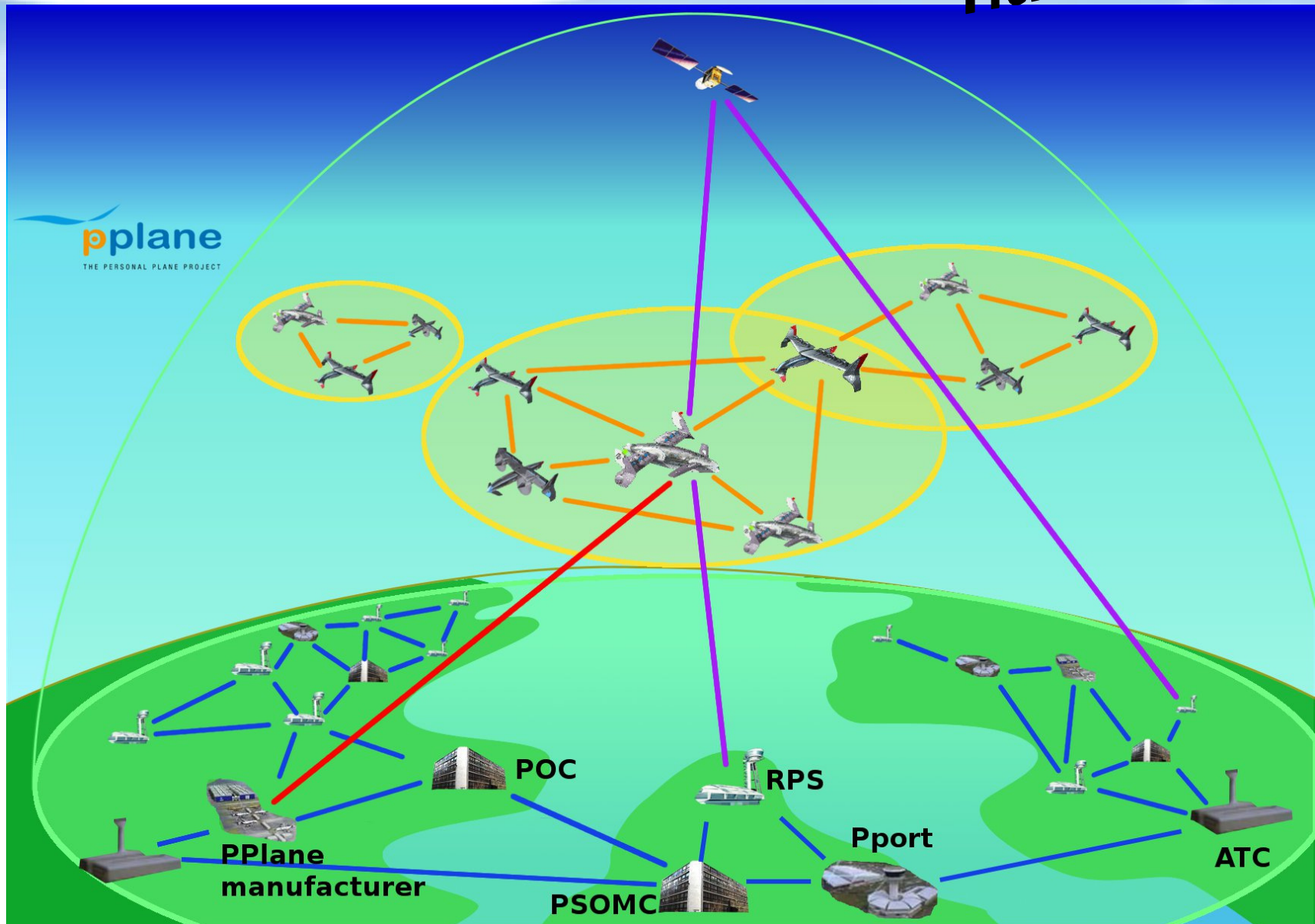
PPlane system elements

Preliminary ideas



PPlane Network Centric Architecture

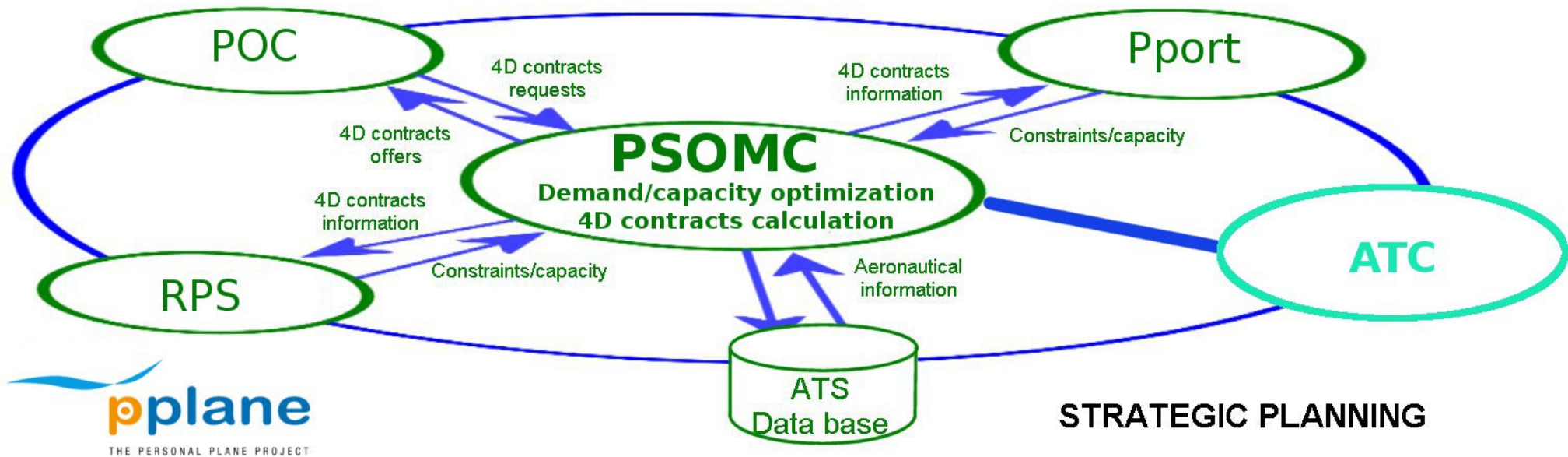
Preliminary ideas



Strategic planning

Preliminary ideas

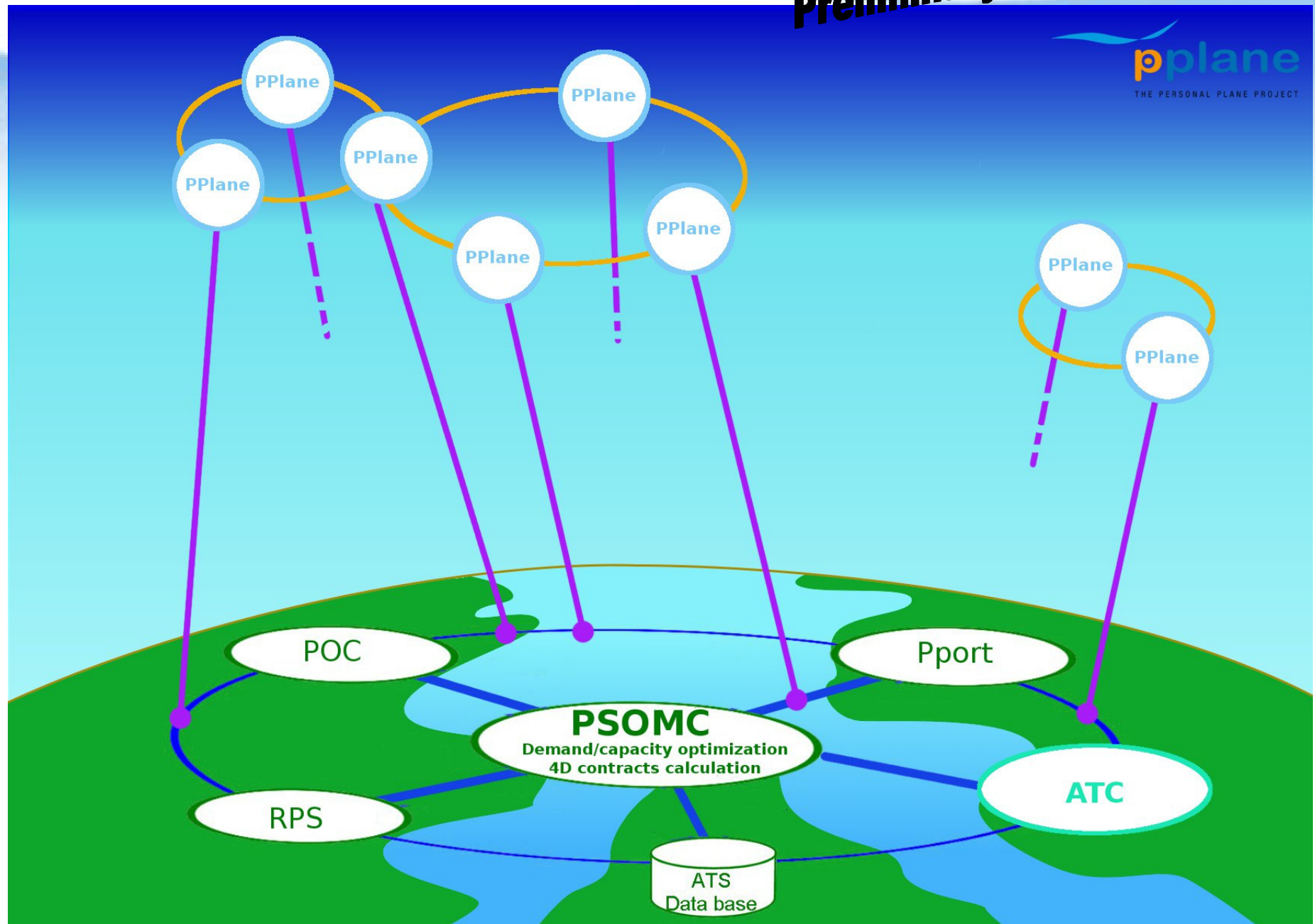
- Conflict free 4D contracts are generated at a planetary scale, taking into account PPlane operators wishes and Pport capacity, under the management of a **PPlane System Operation Management Centre (PSOMC)**



- 4D contracts are updated just before the flight

Tactical operation

Preliminary ideas



Concept overview

• 4D contracts generation

- At a planetary scale, taking into account PPlane operators wishes and PPort capacity
- Generation of conflict free flight paths → 4D contracts
- **Departure**
 - 4D contract updated just before the flight (during passenger boarding)
 - Slot assignment when the PPlane is ready
 - Automatic taxiing and direct take off (assisted landing on specific strips ?)
- **En route**
 - PPlane follow 4D contracts, or ask for a new one
- **Arrival**
 - Automatic landing (assisted landing on specific strips ?)

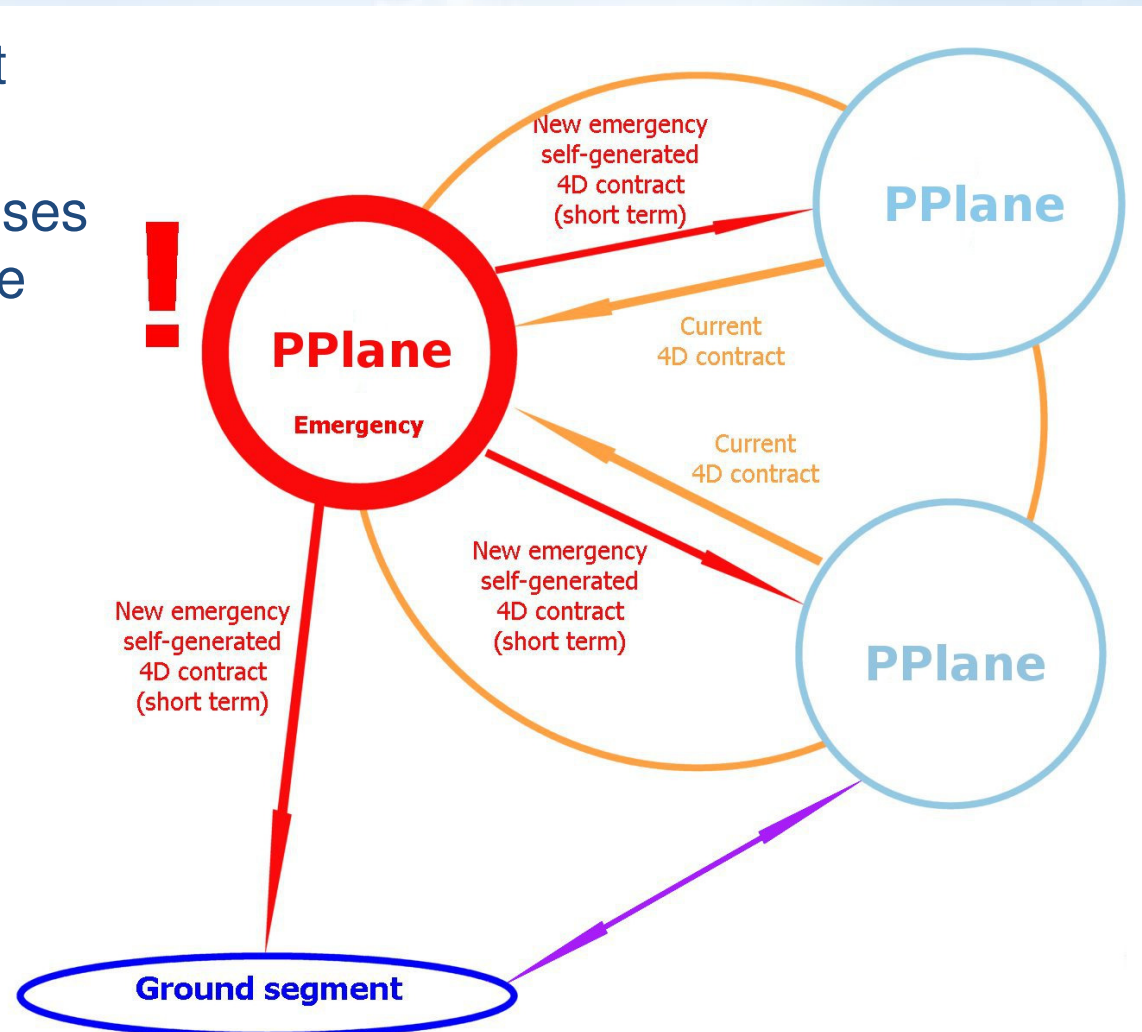
4D contracts

- Each PPlane requires a 4D (x, y, z + time) contract before its flight
- 4D contracts are generated by PSOMC in connection with ATC
 - At a strategic level (well before the flight)
 - Updated just before the flight (accurate weather, etc.)
- 4D contracts ensure a conflict free traffic
- The PPlane has the responsibility to respect its 4D contract
 - If possible, all along the flight
 - If not: the PPlane asks the PSOMC for a new one
- 4D contracts are given with reasonable margins allowing ground speed variation due to weather

Tactical operation

Preliminary ideas

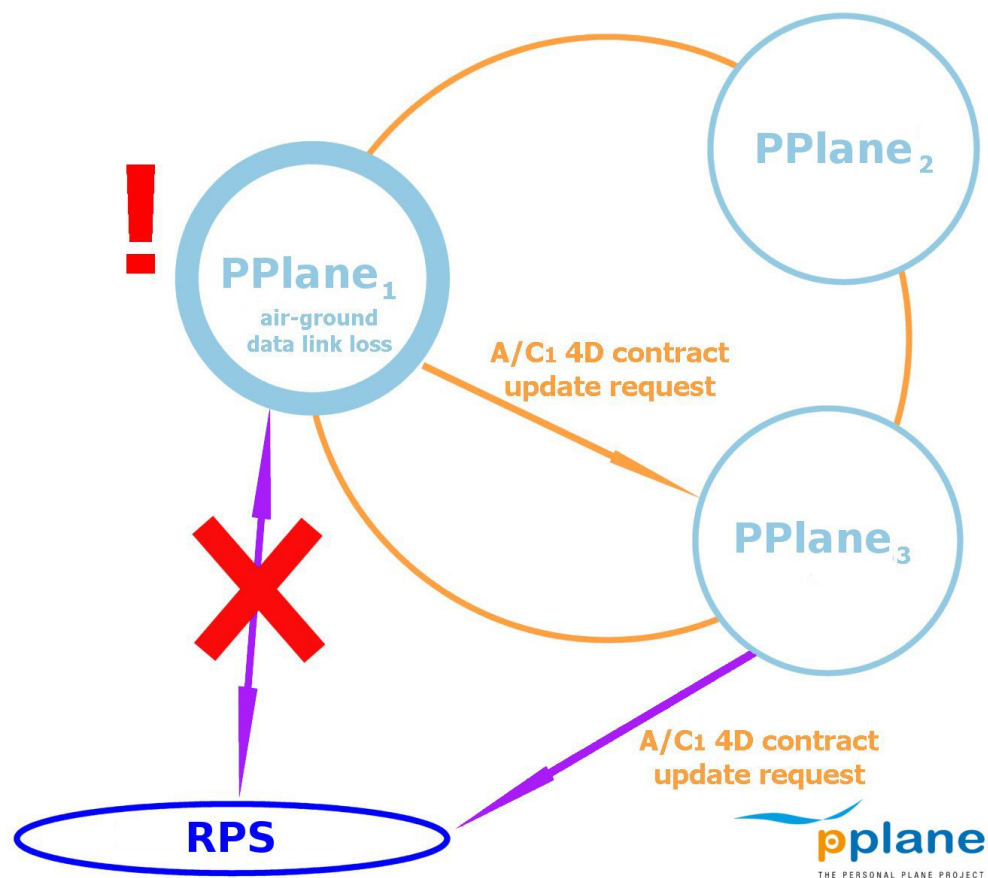
- Emergency management
 - There is no time for contract renegotiation
 - The PPlane in emergency uses its own information about the local traffic
 - It generates a short term conflict free flight path
 - If not possible, it asks neighboring aircraft to allow such a contract



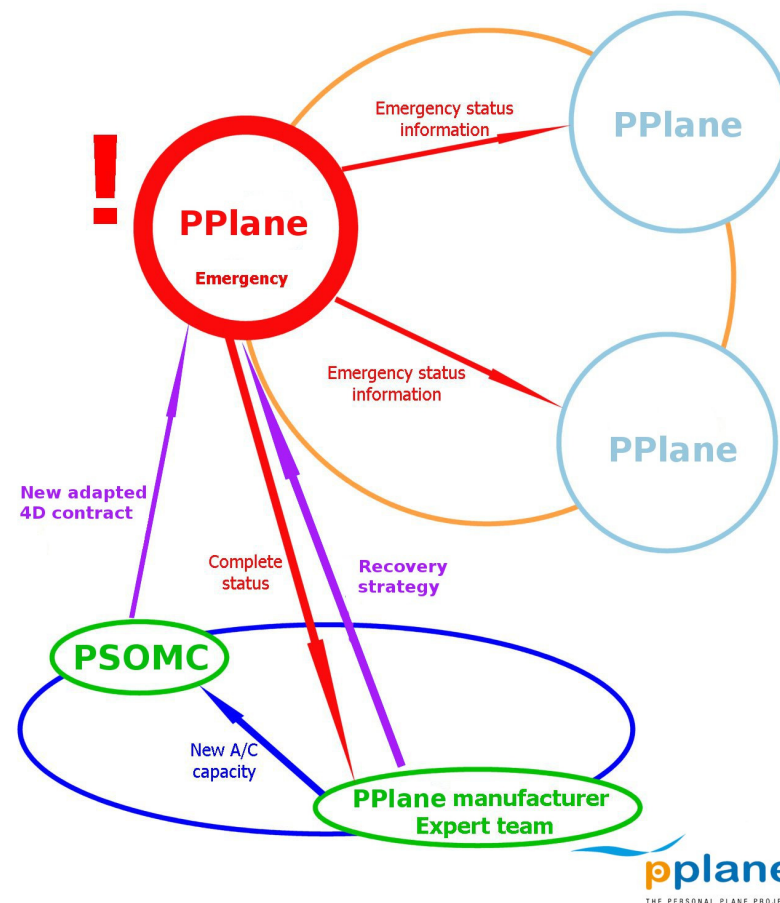
Tactical operation

Preliminary ideas

- Failure/emergency management illustrations



Expected failure: preplanned strategy is automatically applied



Unexpected failure: ground experts consultation

Thank you
Any questions?

