iFly Project

Airborne Separation in Advanced En-Route ATM

Petr Cásek

Honeywell Brno

ERASMUS PMC, 19 March 2008

Honeywell

Project Facts

Innovative project for EC DG-TREN
(6th Framework)

Consortium: 11 universities + 7 from ATM/aviation

iFly project duration: May 2007- August 2010

Total effort: ~ 50 person-years

Builds on theoretical results of HYBRIDGE project for EC DG-INFSO (2002-2005)

Project Consortium

- National Aerospace Laboratory (NLR)
- Honeywell
- Isdefe
- University of Tartu
- Athens University of Economics And Business
- Eidgenossische Technische Hochschule Zurich
- University of l'Aquila
- Politecnico di Milano
- University of Cambridge
- National Technical University of Athens
- University of Twente
- Ecole National de l'Aviation Civile
- Dedale
- UK NATS En Route Ltd.
- Institut National de Recherche en Informatique et en Automatique
- Eurocontrol EEC
- DSNA-DTI-SDER
- University of Leicester

iFly Overview

Honeywell

What?

iFly's objectives

Why?

Airborne Separation in SESAR/NextGen

How?

Project Structure

Previous Research

Main research areas

iFly Objectives

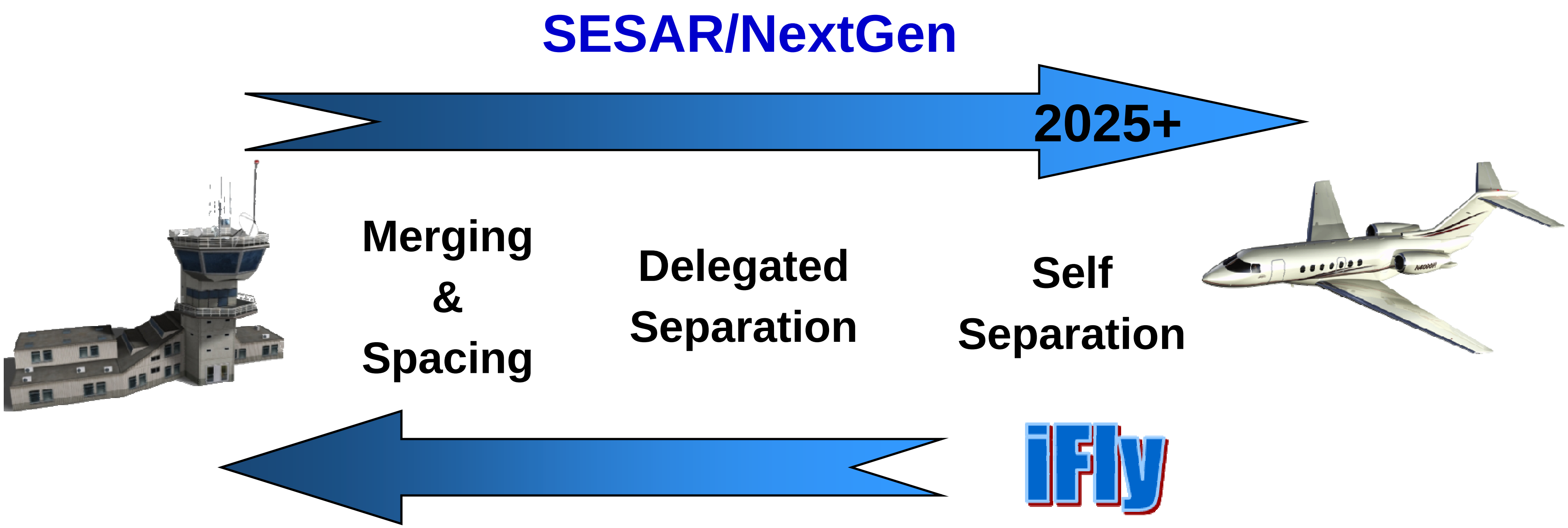
Develop & Validate

Highly automated ATM design for en-route traffic based on autonomous aircraft concept.

Key design aspects:

- Human responsibilities
- Traffic Complexity
- Safety Assessment using SESAR compliant safety targets

Airborne Separation in Future ATM



iFly's Scope:

- ✓ High Density Traffic
- ✓ Only Self Separation Capable Aircraft

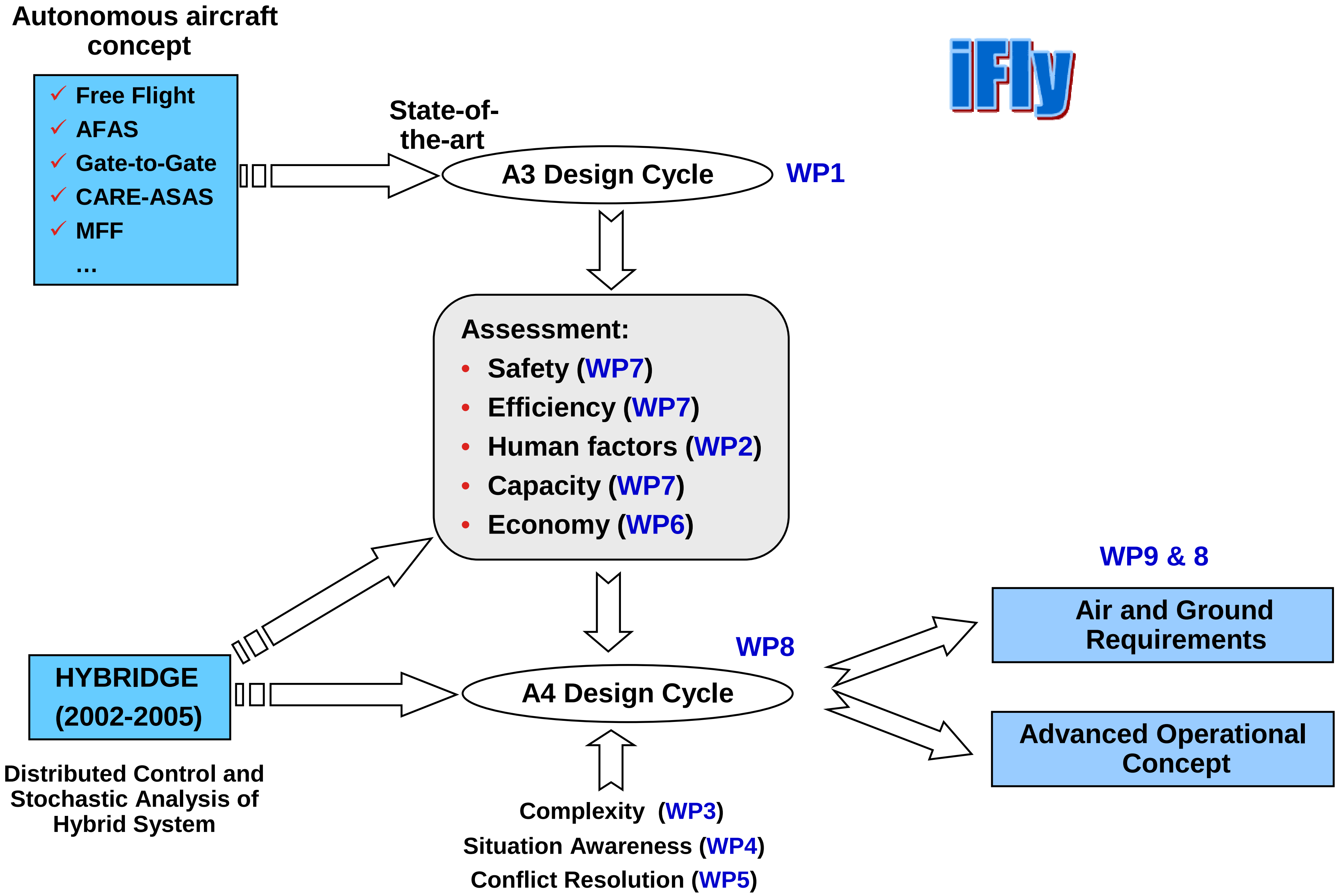
Research Questions

Two Design Cycles To Answer Two Main Research Questions:

- Up to which en route traffic demands is (pure) Self Separation sufficiently safe? (A3 design cycle)
- Which complementary support services from ground ATM are needed in order to accommodate higher traffic demands ? (A4 design cycle)

iFly Project Structure

Honeywell



Previous Research

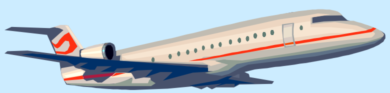
Honeywell

Theoretical Methods – Hybridge

- Novel methods in rare event modelling and estimation.
- Novel methods in conflict modelling and resolution.
- Accident risk simulation results for Mediterranean Self Separation.

Free Flight (Self Separation) Concept

- Free Flight
- AMFF
- DAG-TM (AATT)



Main Research Areas

Honeywell

- Safety simulations (rare event modelling)
- Human factors
- Complexity metrics and prediction
- Situation awareness & modelling of complex hybrid systems
- Conflict resolution methods

Safety Validation

Honeywell

Hazards Identification

Safety Assessment – Rare event modelling based on the Hybridge project (TOPAZ)

Complex System Modelling – Piecewise Deterministic Markov Processes represented by Dynamically Coloured Petri Nets

Air Traffic Simulation – Sequential Monte Carlo Methods

Relevant Standard considered: RTCA/Eurocae ED78a Safety Assessment

Human factors

Honeywell

Two Essential Tasks:

1. **Provide Input To Both Design Cycles**
2. **Analyse and Identify Bottlenecks of Designed Systems and Propose Solutions**

Main Issues

- **Analysis of the current pilot’s en-route tasks,**
- **Cockpit crew responsibility analysis,**
- **Pilot’s workload studies**
- **Situation awareness maintenance**
- **Identification of bottlenecks**

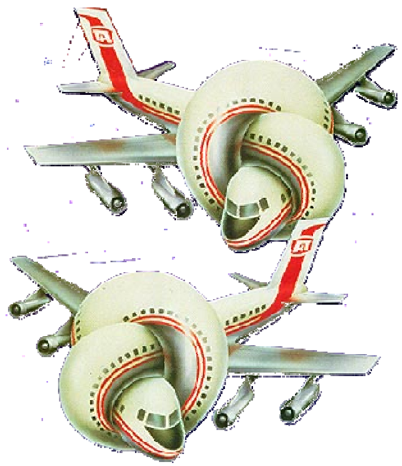
Complexity Metrics

Main Issues

- Complexity has not unique definition.
- Requirements are typically application-dependent.
- Existing metrics of Air Traffic Complexity are mostly related to the controller's workload (e.g., dynamic density).

Considered Approaches

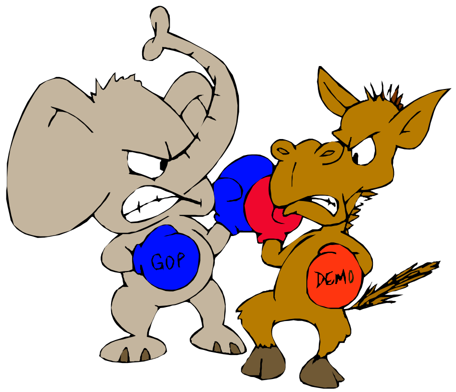
- ✓ Intrinsic metrics (not application dependent) – e.g., some topological or geometrical characteristic.
- ✓ Application dependent – tightly related to the CR methods (both airborne or ground-based).



Conflict Resolution

Honeywell

- **Long Term CR Methods (behind one hour)**
  - **Both centralized (ground-based) and distributed methods**
- **Mid Term CR (tens of minutes)**
  - **Distributed methods, questions of suitable intent information**
- **Short Term CR (minutes)**
  - **Distributed methods, interface with TCAS**



Main Issues

- **Choice of suitable CR maneuvers**
- **Priority rules (if needed),**
- **Coordination of CR maneuvers between conflicting aircraft,**
- **TP uncertainty handling**
- **Conflict of multiple aircraft (clustering)**
- **Optimization (selection) criteria**

Two parallel approaches:

Conventional

Vs.

Theoretical (formal)

Based on the expert assessment and subsequently validated – used in the both design cycles.

Based on the modelling of the complex hybrid system and subsequent analysis of the critical observability.

Conclusions

Honeywell

iFLY objectives

- Assess maximum en-route traffic to be accommodated by self separation
- Develop en-route high traffic demand Self Separation concept (A3).
- Develop complementary ATM ground support concept (A4) which further increases capacity of self separation.

Web site: http://iFLY.nlr.nl

Coordinator: Henk Blom (NLR)

Currently within first design cycle (A3) – High-level ConOps delivered.

Thank You!