National Aerospace Laboratory NLR
The Netherlands

iFly

Safety, Complexity and Responsibility based design and validation of highly automated ATM

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Background

- Free Flight has been “invented” as a potential solution for high density airspace
- During recent years ATM community research trend is to direct self separation research to situations of less dense airspace (e.g. MFF, ASSTAR)
- iFly aims to develop a step change in this trend through a systematic exploitation and development of advanced mathematical techniques

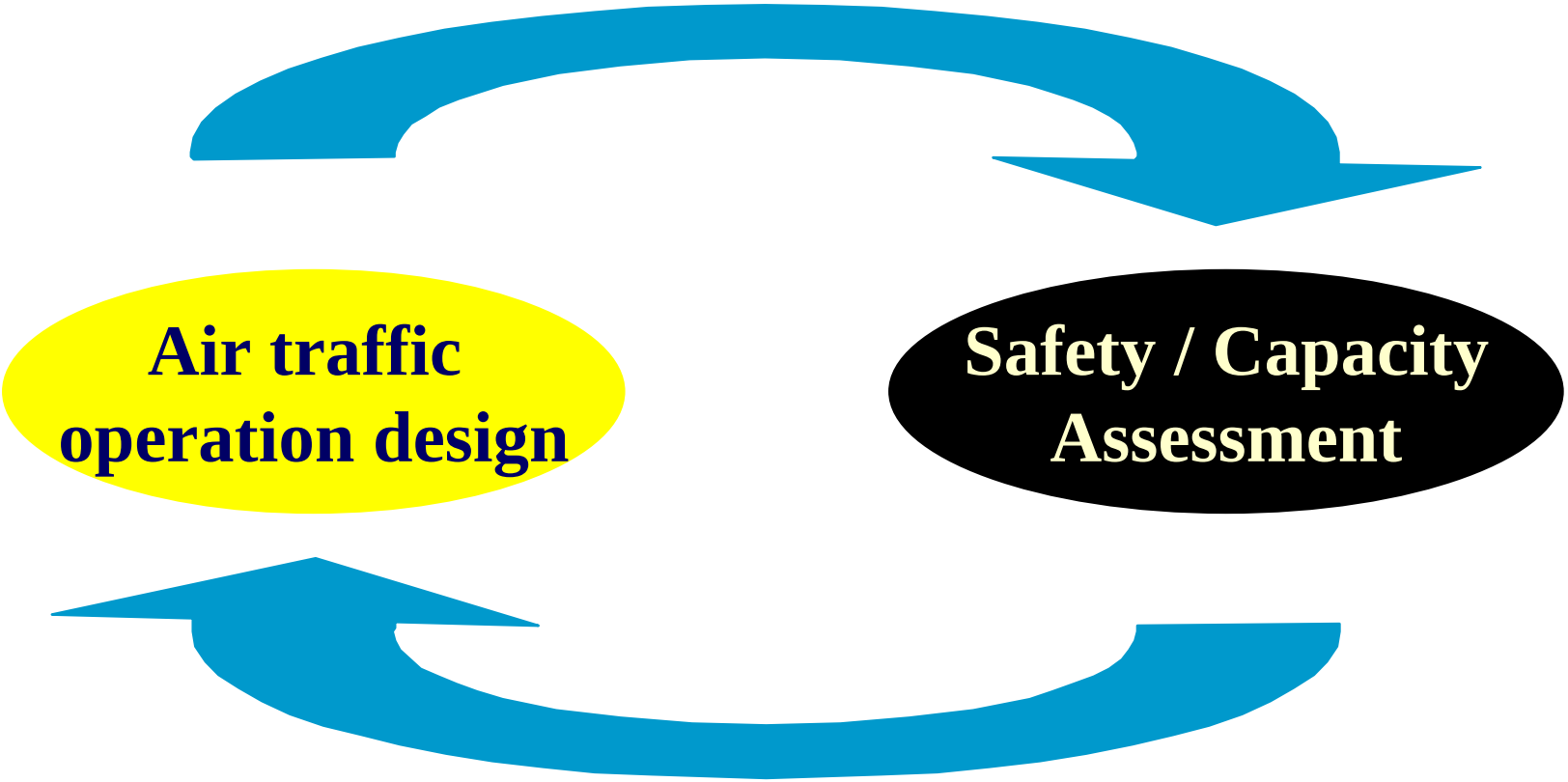
iFly

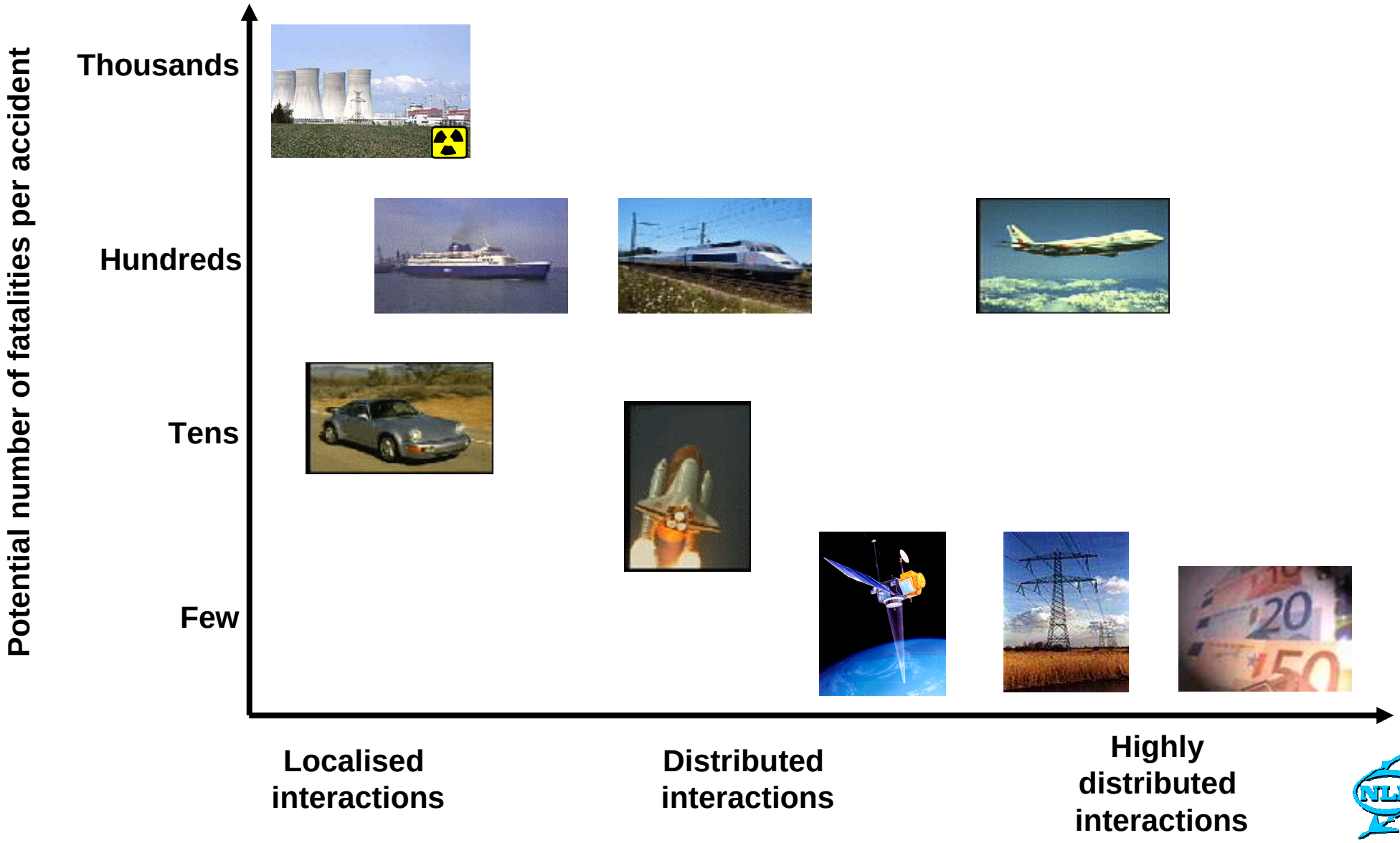
- 4+ Year innovative ATM project (2007-2011) within EC DG-TREN
- Objective: development of an advanced airborne self separation ATM operational concept the design of which takes into account:
  - Safety targets
  - Human responsibilities
  - Complexity is well understood
- Builds on theoretical results of HYBRIDGE project for EC DG-INFSO
  - Novel methods in rare event modelling and estimation
  - Novel methods in conflict modelling and resolution
- 18 Partners, 11 of which are from HYBRIDGE
  - Total effort: ~ 45 person-years
  - Budget: 5.2 MEuro (3.3 MEuro by EC)
  - NLR is coordinator

iFly participants

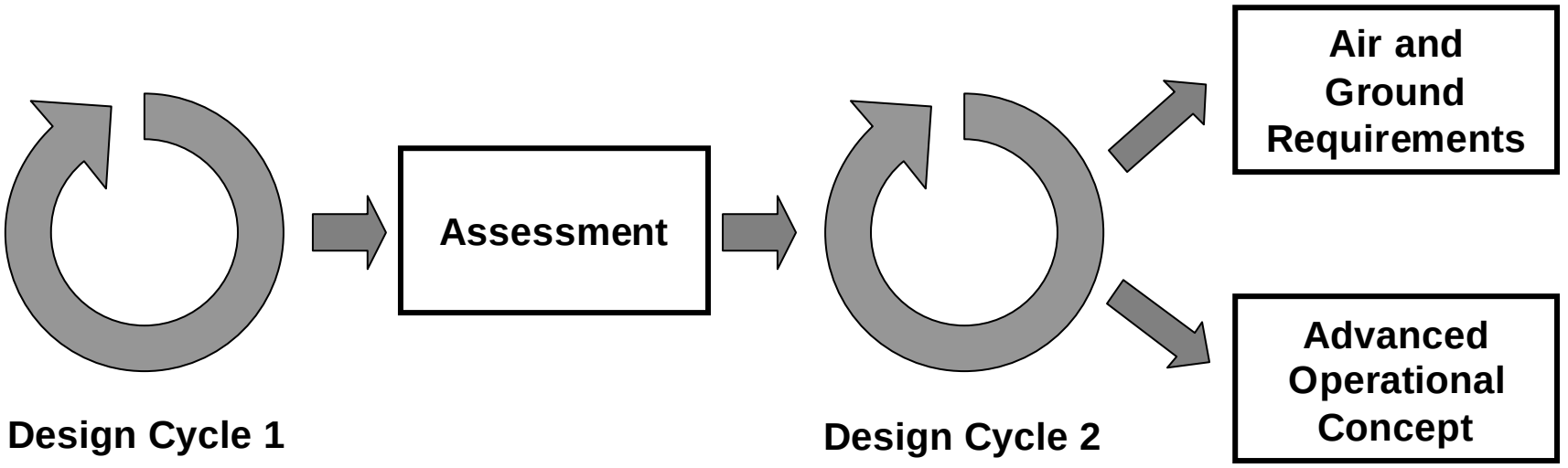
1. NLR (NL)
2. Honeywell (CZ)
3. ISDEFE (ES)
4. Univ. of Tartu (EE)
5. Athens U. Economics & Business (GR)
6. ETH Zurich (CH)
7. L'Aquila University (IT)
8. Politecnico di Milano (IT)
9. Cambridge Univ. (UK)
10. NTU Athens (GR)
11. Twente Univ. (NL)
12. ENAC (FR)
13. Dedale (FR)
14. NATS En Route (UK)
15. INRIA (FR)
16. Eurocontrol Experimental Centre (F)
17. DSNA-DTI-SDER (FR)
18. Leicester Univ. (UK)

Safety feedback based design




Potential number of fatalities per accident
Thousands
Hundreds
Tens
Few
Localised interactions
Distributed interactions
Highly distributed interactions

iFLY work structure



First Design Cycle

- **Objective:** To design an Autonomous Aircraft Advanced (A3) en-route concept that safely accommodates an as high as possible en route traffic demand, and taking into account pilot responsibilities

- **Inputs:**
  - Existing airborne self separation designs (MFF, ASSTAR)
  - Initial collision risk assessment using HYBRIDGE results
  - Advanced conflict management and resolution methods (from HYBRIDGE and other projects)

- **Period:** First and second year

Assessment Cycle

- Objectives:
  - To further improve the novel methods in rare event modelling and simulation;
  - To assess the safety, the capacity and economy of the advanced autonomous airborne (A3) concept of the first design cycle

- Inputs:
  - HYBRIDGE rare event modelling and simulation methods
  - A3 concept from first design cycle

- Period:
  - Novel methods: First and second year
  - Initial assessment: Third year
  - Feedback and Consolidation: Fourth year

Innovative methods

- Objectives: Develop innovative, architecture-free methods towards key issues that have to be addressed by an advanced operational concept:
  - Method to model and predict complexity of air traffic
  - Model and evaluate the problem of maintaining multi-agent Situation Awareness and to avoid cognitive dissonance
  - Develop conflict resolution algorithms for which it is formally possible to guarantee their performance

- Inputs:
  - HYBRIDGE novel methods in conflict modelling and resolution

- Period:
  - Novel methods: First and second year
  - Interaction with second design cycle: Third year
  - Consolidation: Fourth year

Second Design Cycle

- Objective:
  - To refine the A3 en-route concept with the goal of safely accommodating a factor three to six increase in en-route traffic demand
  - To identify the applicable airborne requirements

- Inputs:
  - A3 concept from first design cycle
  - Analysis of Human responsibilitities (separate WP within iFly)
  - Initial risk assessment and feedback from Assessment cycle
  - Innovative results on conflict management and resolution

- Period: Third and Fourth year

Expected results of relevance to SESAR

- Autonomous Aircraft Advanced (A3) ConOps
- Human Factors of A3 ConOps
- Safety/Capacity of A3 ConOps
- Cost-benefit of A3 ConOps
- Predict traffic complexity
- Maintaining multi-agent SA
- Guaranteed conflict resolution
- Vision how A3 ConOps suits SESAR
- Airborne requirements
- Overall Validation Plan

Thank You !