



Priority Rules in a Distributed Air Traffic Management

Petr Cášek & Silvie Luisa Brázdilová
April 14, 2010

Air Transport & Operations Symposium 2010



Honeywell

Future Air Traffic Management (ATM)

Honeywell

Key Elements envisioned for future ATM:

Enhanced ATM Strategic Phase

Through implementation of Trajectory Based Operations

Information Sharing Process

Enabled by System Wide Information Management (SWIM) system

New Separation Modes

Allowing partial or full delegation of responsibility for separation tasks to flight crew



Distributed ATM

New Separation Modes – Distributed ATM

Honeywell

In comparison with the centralized ATM, the distributed control system brings some specific issues:

- ✓ How to incorporate the global strategic aspects?
- ✓ How to avoid excessive maneuvering of single aircraft?
- ✓ How to avoid maneuvering of excessive number of aircraft?
- ✓ How to coordinate simultaneous maneuvering of multiple aircraft?

Priority Rules

Operational Rules



iFly – Highly Automated Air Traffic Management

Honeywell

iFly Purposes:

Develop highly **automated ATM design for en-route traffic** based on **autonomous aircraft concept**

- ✦ Assess the highest level of en-route traffic demand in which equipped aircraft can safely self separate
- ✦ Develop the airborne system requirements that must be met to ensure the safe 2025+ operations
- ✦ Cost – Effectiveness Analysis

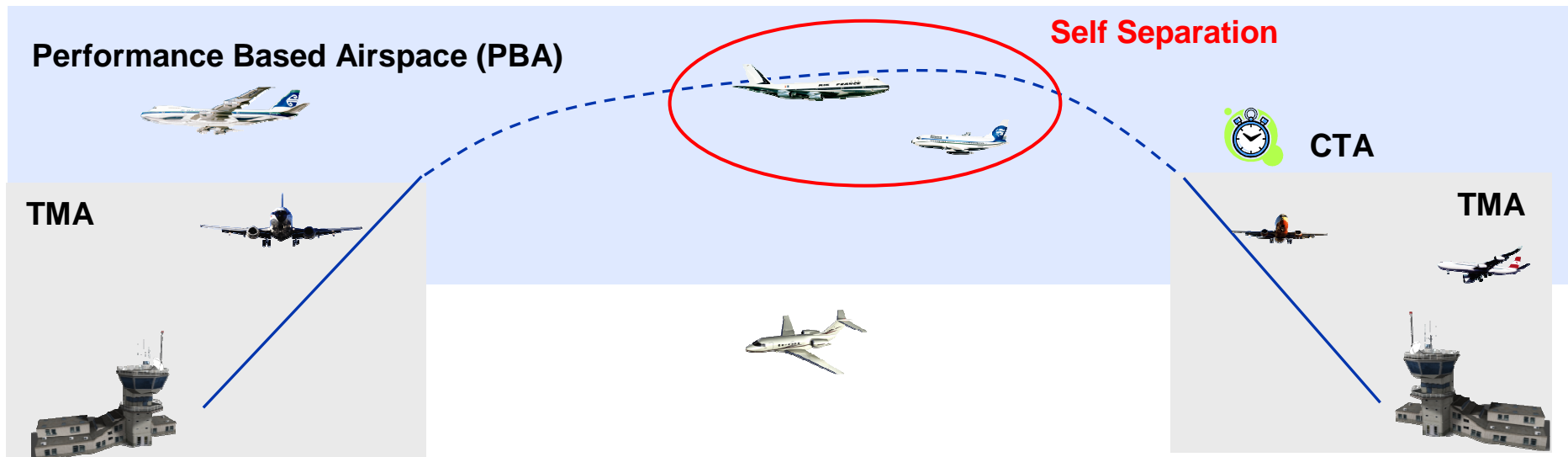


Consortium:

- ✦ 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 

Selected Elements of iFly ConOps

Honeywell



- ✓ **Two levels separation management process:**
 - ✓ Mid-term Conflict Resolution: Priority rules, new full-length trajectory generated
 - ✓ Short-term Conflict Resolution: Implicit Coordination
- ✓ **No explicit coordination (specific communication) among conflicting aircraft**
- ✓ **Priority and category of operations broadcasted as an aircraft state characteristic**
- ✓ **Updated trajectories information (RBTs) available via ground information sharing support (SWIM).**

Priority Number

FREER Approach (onboard evaluation):

- **Maneuverability**
- **Availability (flexibility according to the navigation constraints)**
- **Distance to predicted Loss of Separation**



Proposed Concept – Priority number determined by a centralized (ground) application based on flight trajectories (RBTs) available from SWIM:

- **Geometrical maneuverability**
- **Availability (flexibility according to the navigation constraints)**
- **Global strategic aspects**

Resolution of Pairwise Conflicts

Effectiveness and robustness of the priority-driven ATM solution should be ensured through two step mitigation processes:

- Strategic aspects are incorporated directly in the priority number (centralized application).
- Prevention of the failure of onboard tactical separation tasks is envisioned through:
 - Onboard detection of areas with high air traffic complexity or,
 - Onboard detection of predicted reduction of own maneuverability.

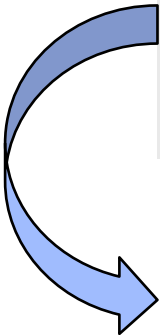


If (despite mitigations) the lower priority a/c is not able to find a solution, the conflict will be solved cooperatively through short-term CR (with implicit coordination).

Coordination of Maneuvering (multiple a/c)

Trajectory Change Initiation:

- A pair-wise conflict with an aircraft with higher priority number (not in change mode),
- Conflict with more than one aircraft,
- Passing through an area with high air traffic complexity.



Change Mode

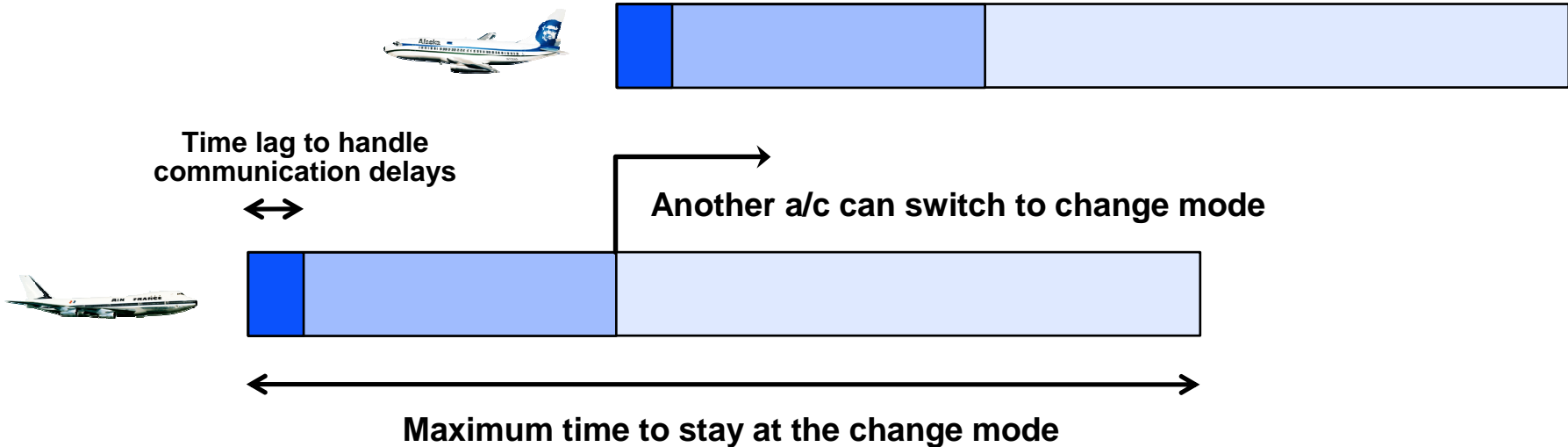
Broadcast



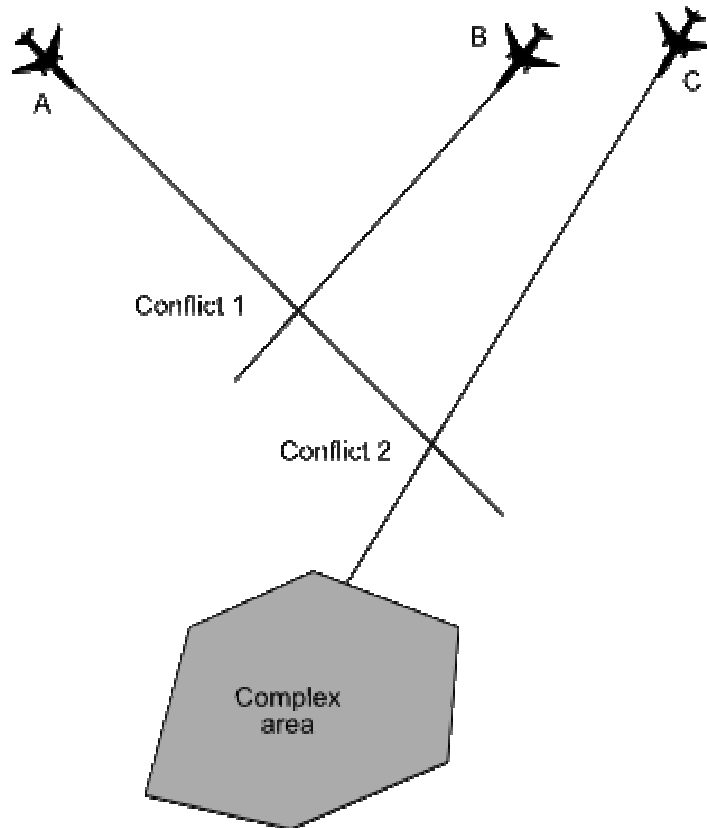
Flag + Time stamp

Operational Rules

First Come First Served principle



Illustrative Example of Application



- Aircraft B will check the priority with respect to aircraft A.
- Aircraft A and C will aim to maneuver.

The true concept validation still to be done!

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

Coordinator: Henk Blom (NLR)

A3 Concept of Operations documents:

- High level A3 available at the web site
- A3 ConOps will follow soon (final draft under review)

Acknowledgements:

The iFly WP1 team for the fruitful and pleasant teamwork on the iFly ConOps (starting point of this work).

Thank You!

Honeywell