Priority Rules in a Distributed Air Traffic Management

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Future Air Traffic Management (ATM)

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
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?
iFly – Highly Automated Air Traffic Management

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

- Performance Based Airspace (PBA)
- Self Separation
- CTA
- TMA

✓ 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.

Operational Rules
First Come First Served principle

Maximum time to stay at the change mode

Another a/c can switch to change mode

Time lag to handle communication delays
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!
iFly Information

Web site: [http://iFLY.nlr.nl](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)

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