WP1: A^3 Concept of Operations -– Overview

Petr Cásek

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WP1: A^3 Concept of Operations

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WP1 Goal:

Develop highly **automated ATM design for en-route traffic** based on **autonomous aircraft concept (ASAS Self Separation).**

WP1 Structure:

- ✓ WP1.1: A^3 High-level ConOps
- ✓ WP1.2: A^3 Airline Strategy Concept
- ✓ WP1.3: A^3 ConOps

Main Elements:

- Concept Enablers:
  - Communications
  - Information sharing
- Autonomous Flight Rules
  - Mid Term CR based on Priority Rules
  - Short Term CR based on Implicit Coordination
- Priority Rules guidelines
- A possible high-level airborne system design
- Human factors aspects

A3 ConOps Team

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iFly WP1 Authors:

- Frank Bussink (NLR)
- Ignacio Echegoyen (former Isdefe)
- Petr Cásek (Honeywell)
- Gustavo Cuevas (Isdefe)
- Aavo Luuk (University of Tartu)
- Claudia Keinrath (Honeywell)
- Rosa Weber (Honeywell)
- José García García (Isdefe)

iFly Partners and Reviewers contributing with their feedback

iFly A3 ConOps has also benefitted from NASA's pro-bono involvement:

- NASA's advanced airborne self separation ConOps and research
- Active iFly participation by NASA Langley ATM Research Team
  - David Wing, Maria Consiglio
  - Frank Bussink, previously at LaRc on loan from NLR

Scope of Self Separation in iFly

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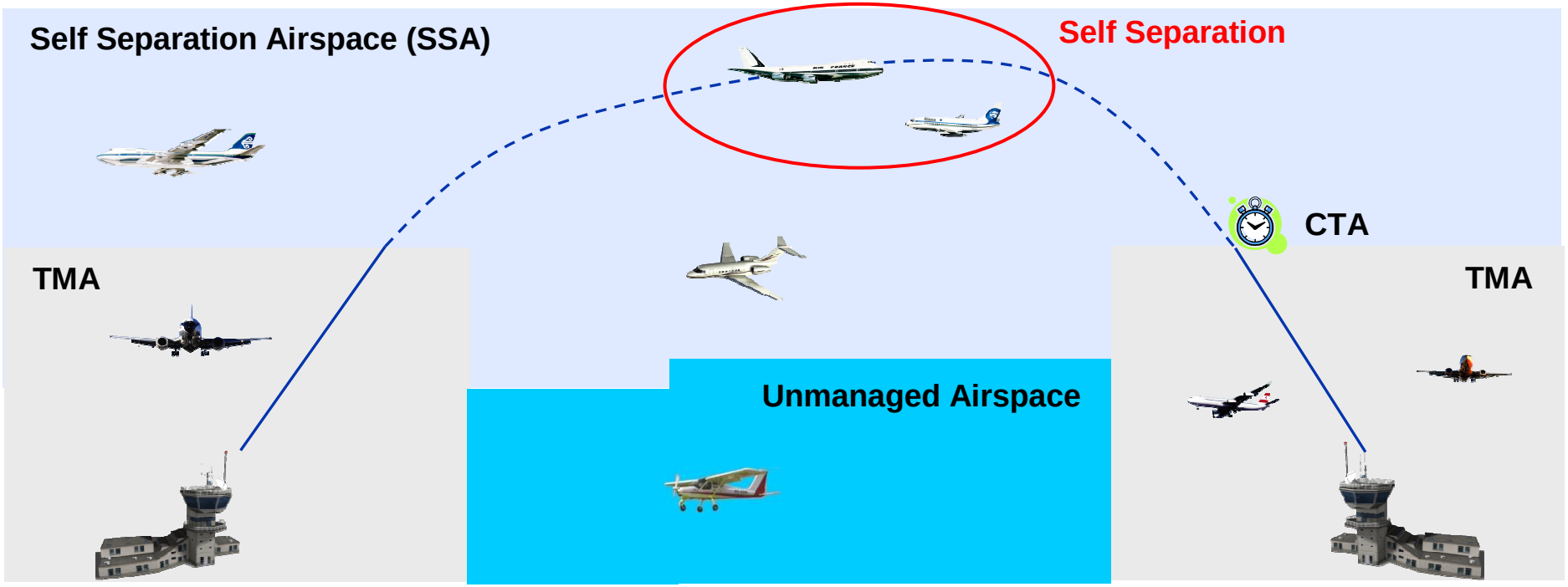

iFly's Scope:

- ✓ En-route phase of the flight
- ✓ All aircraft are equipped to self separate
- ✓ No ATC involvement
- ✓ Ground information sharing support (SWIM) available

Autonomous Aircraft Concept Traits

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Requirement

→ Airborne Separation Management

Opportunity

→ Onboard Trajectory Management

Key Enabler

Situation Awareness (Information availability)

↓

Information Sharing Process

↙ Reliable

↓ Continuous

↘ Effective

Data Link Communications (Traffic Data)

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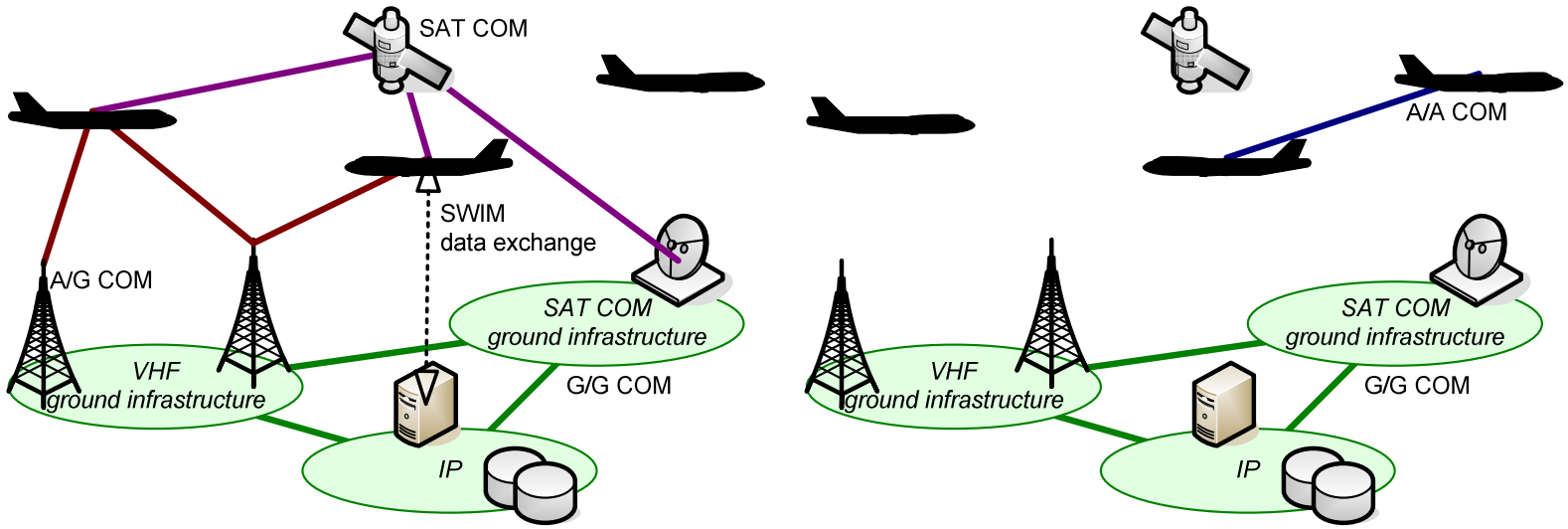
Reception of data broadcasted by other aircraft



Querying ground infrastructure (e.g., SWIM)

Direct querying another aircraft

Information Sharing Support

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Information Sharing Process

Level 1: Air–Air Broadcast, State only

- Air–Air data link range
- CD further limited by accuracy of state-based TP
- No information back up

Level 2: Air–Air Broadcast, State + Intent

- Air–Air data link range
- No information back up

Level 3: Air–Air Broadcast + SWIM support, State + Intent

- Range defined by the area of interest (in principle)
- CD limited by the range of available intent information
- Information back up (point-to-point communication, SWIM)

SM Limitations

iFly considers Level 3, but performance and safety assessment may be performed for multiple levels.

Information Sharing – Situation Awareness

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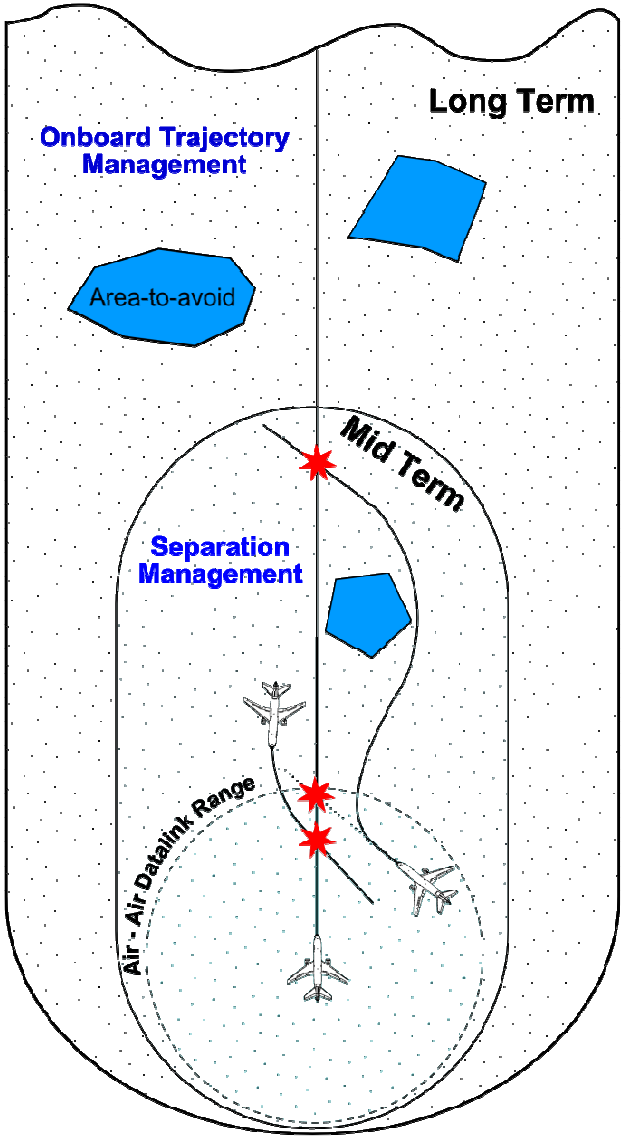

Areas of interest:

- Long Term Awareness Zone(LTAZ)
  - relevant for Trajectory Management (optimization)
- Mid Term Awareness Zone(MTAZ)
  - used for Separation Management
- Air–Air Data link Range
  - additional state-based Conflict Detection

SWIM and Envisioned Functionality

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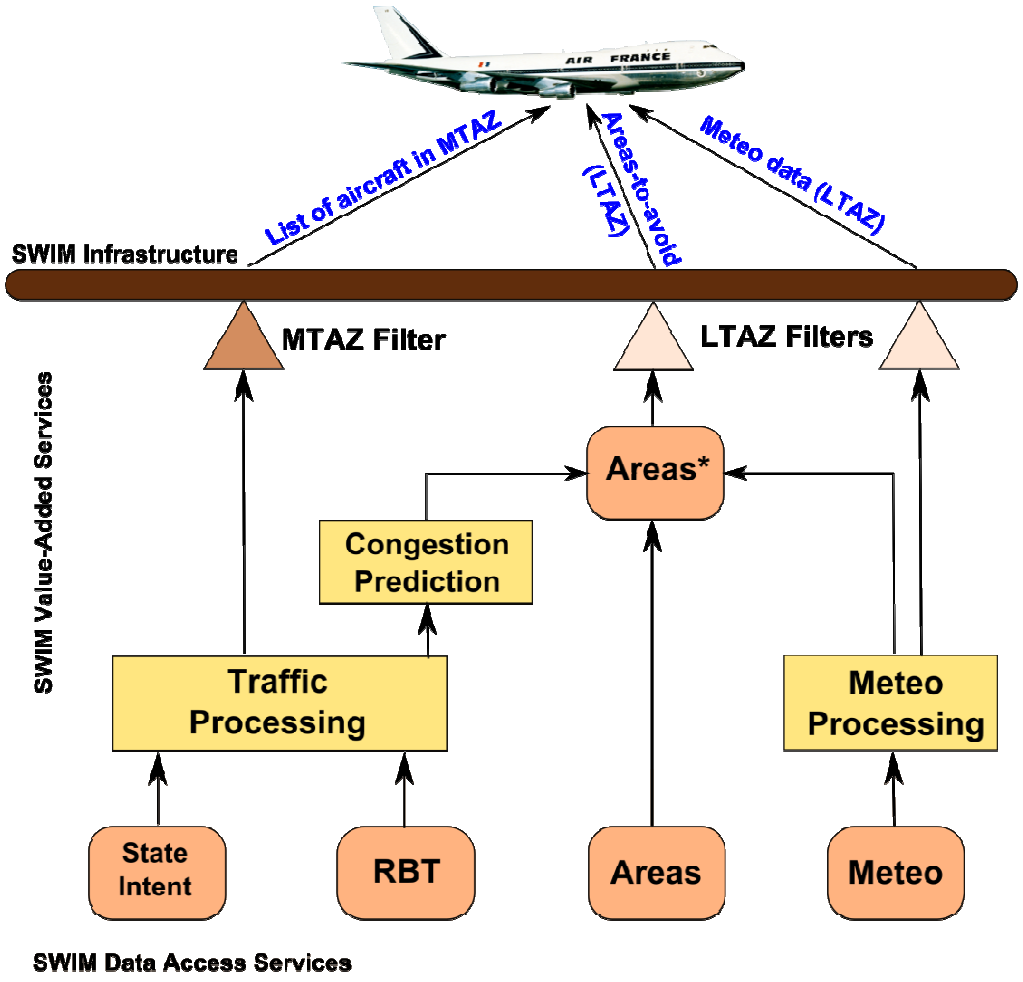

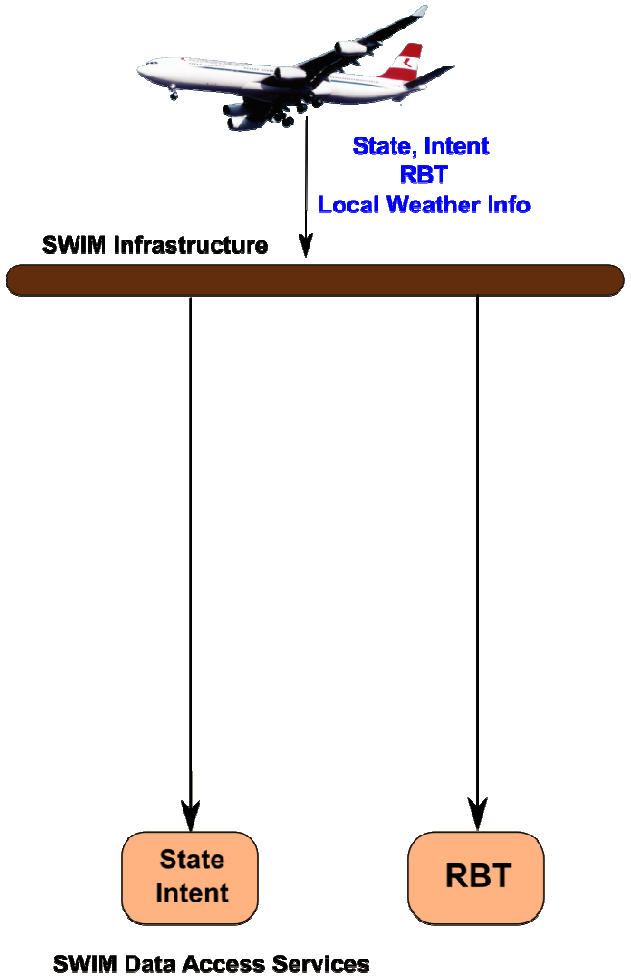

Possible A^3 Airborne System Architecture

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Information Management

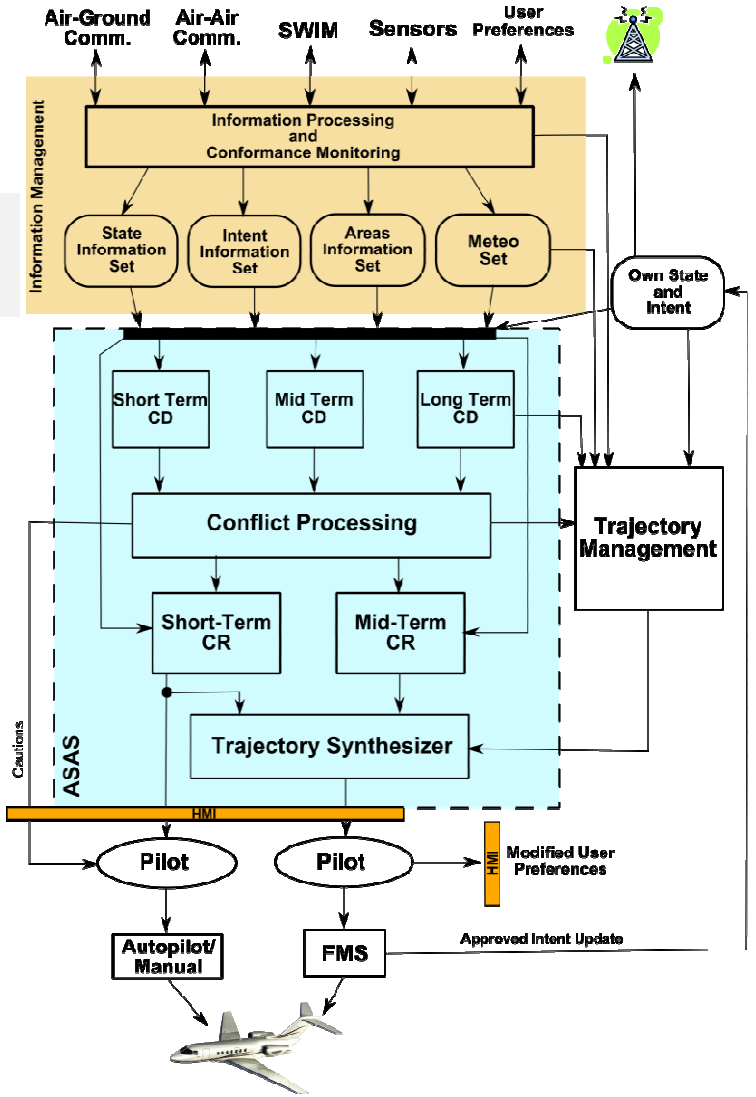
- Shields communications details
- Collect and process required data

Separation & Trajectory Management

- Situation Assessment
- Resolution Advisories

Human Machine Interface

- Situation Awareness
- Flight changes advisories



Onboard Information Management

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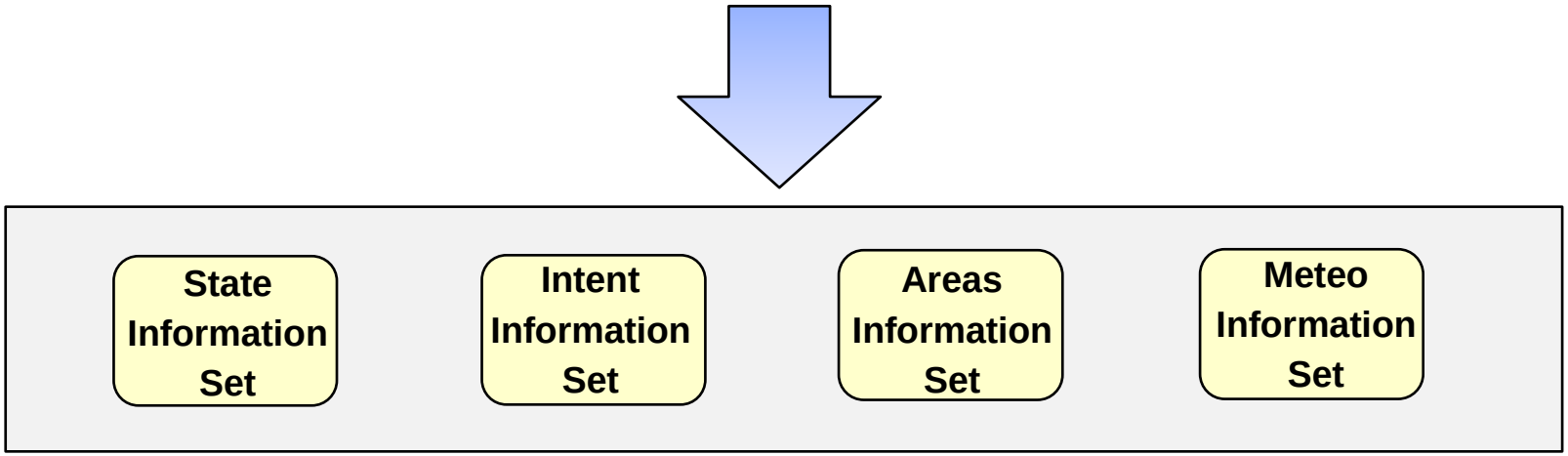
- ✓ Process all incoming broadcasted data
- ✓ Process the list of MTAZ traffic
- ✓ Query aircraft or SWIM for missing information
- ✓ Process areas-to-avoid, uploaded meteo data and data from sensors (weather radar, EGPWS)
- ✓ Monitor the conformance of aircraft to the intent
- ✓ Data fusion to determine the most probable trajectories of aircraft



CD&R And Trajectory Management

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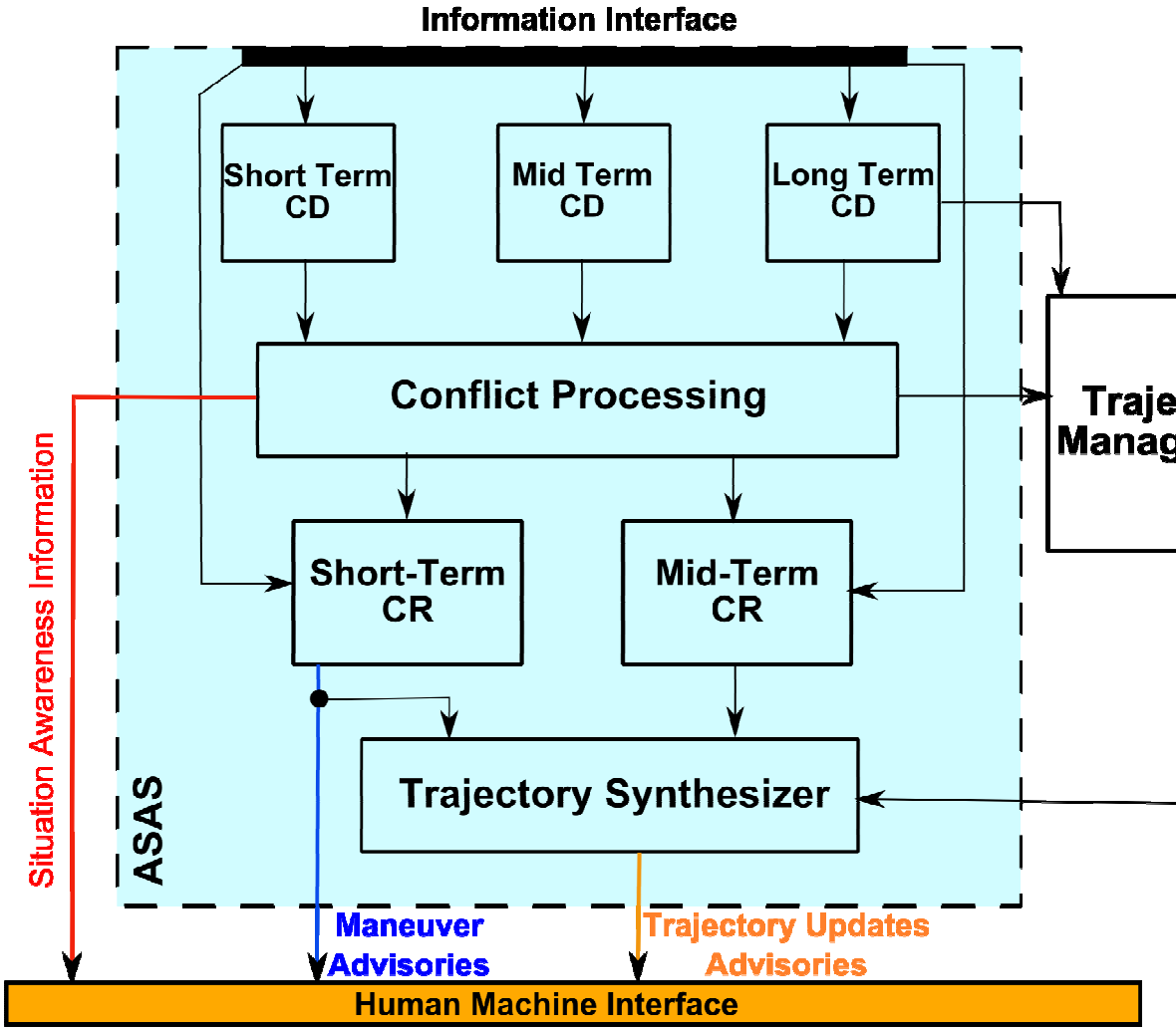

Mid Term Conflict:

1. Predicted LoS
2. Potential CR risk (complex situation)
   - ❑ Complexity, or
   - ❑ Maneuvering flexibility

Short Term Conflict:

- ❑ State-based predicted LoS

Long Term Conflict:

- ❑ Predicted LoS with Areas-to-avoid

HMI Airborne System Requirements

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- Provide aircrew with automation and decision support tools to ensure planned trajectory is clear of traffic, weather and restricted airspace
  - Integrated ownship and surveillance (ADS-B/C) data visualization
  - Real-time traffic, flow management and airspace hazard data;
  - Complementary (visual/aural) conflict alerting and multiple resolution maneuvering options

BUT…

Critical to the aircrew

- HMI must be designed to allow for a quick and easy data input/understanding, which is tailored to users needs
- Appropriate level of automation
- Appropriate level of information
  - Situation awareness needs of ATM & aircrew

A³ ConOps – Dissemination

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Presentations of A³ Concept of Operations:

- ✓***iFly: ASAS Self Separation – Airborne Perspective*;** Presentation at ASAS-TN Workshop in Rome 2008, (Petr Casek and Rosa Weber).

- ✓***Airborne System for Self Separation in Trajectory-Base Airspace*;** paper + presentation at 7th Eurocontrol Innovative ATM Research Workshop, EEC Bretigny 2008 (Petr Casek and Claudia Keinrath).

Thank You!

Any Questions…

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