The MIDCAS project

Johan Pellebergs
Saab Aeronautics

MIDCAS

- EDA is the contracting agency for the MIDCAS project on behalf of the contributing members states:
  - **Sweden (lead)**
  - **Germany**
  - **France**
  - **Italy**
  - **Spain**

European Defense Agency

- Approx 50 MEuro budget – biggest single project within EDA
- Contract signed at the Paris Air Show, June 2009 with an industry consortium of 13 partners from the 5 nations
- Project started 15 Sep 2009 and will run for 4 years

MIDCAS mission statement

"The MIDCAS mission is to demonstrate the baseline of solutions for the UAS Midair Collision Avoidance Function (including separation), acceptable by the manned aviation community and being compatible with UAS operations in non-segregated airspace by 2015"

MIDCAS scope has been defined with due consideration for the views of the main European stakeholders: EASA, EUROCONTROL, EUROCAE WG73

MIDCAS main objectives

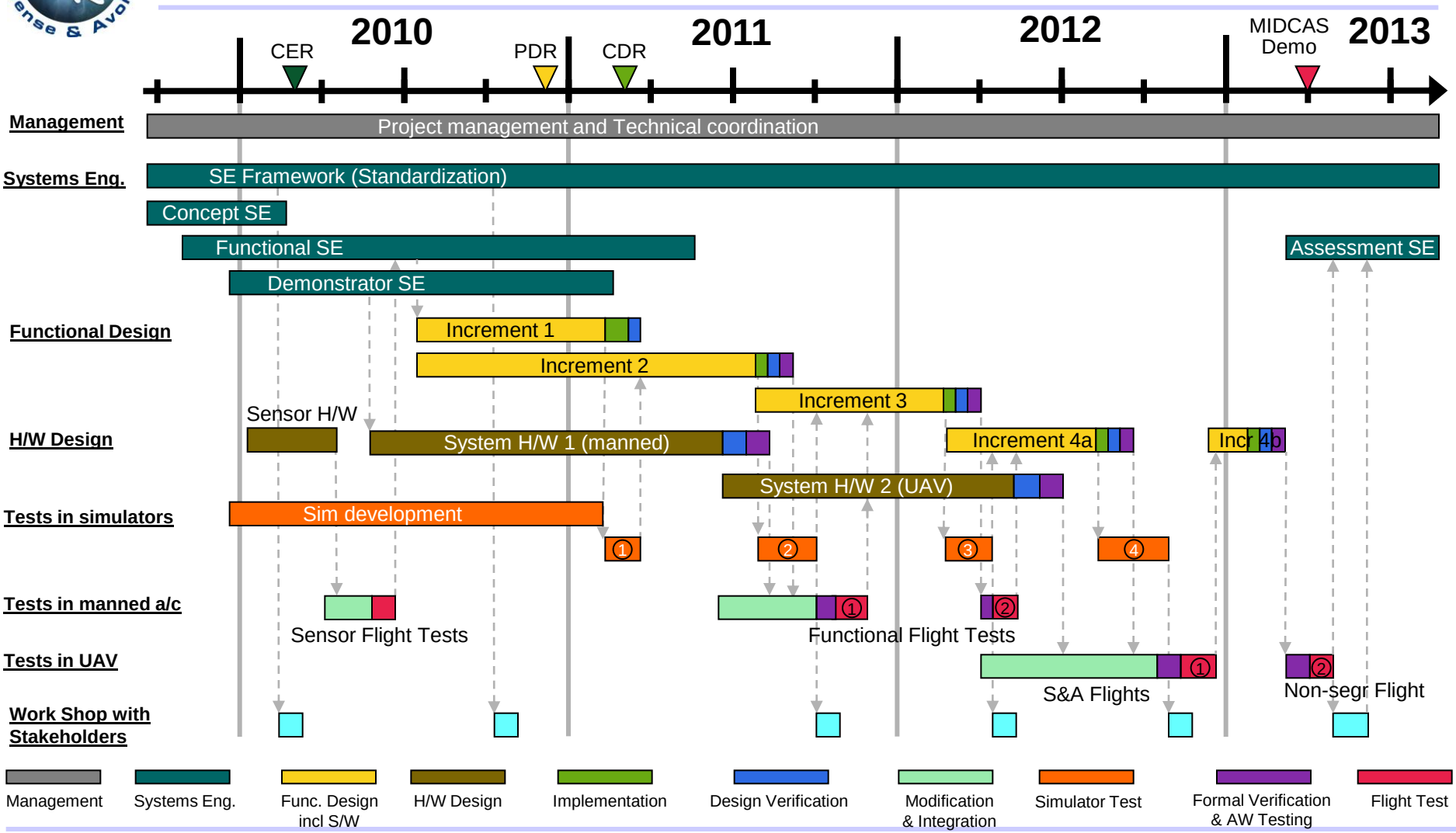
The MIDCAS project is designed with focus on 3 main tracks with high level of interaction and interdependency:

- Progress on Standards for S&A
- Design of a generic S&A function to be tested in simulations
- Design of a S&A demonstrator to be tested in manned and UAS flight

Work packages

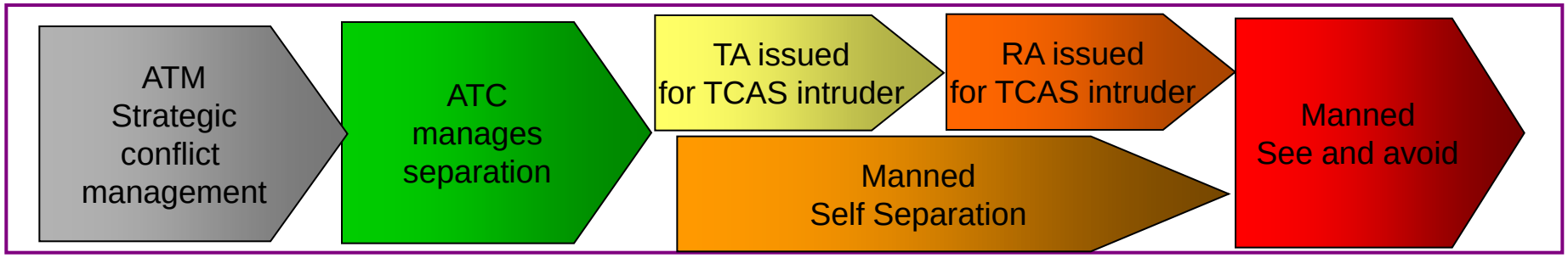
WP1	Project Management & technical coordination
WP2	MIDCAS function system engineering
WP3	Overall sense function definition
WP4	Non cooperative Intruders Sense function definition
WP5	Cooperative intruders sense function definition
WP6	Avoid function definition
WP7	Sense & Avoid Validation on Simulator
WP8	Development of the S&A demonstrator
WP9	Validation on manned testbed A/C
WP10	Adaptation of the UAS and Midcas demonstrator integration
WP11	UAV flight demonstration

MIDCAS Schedule



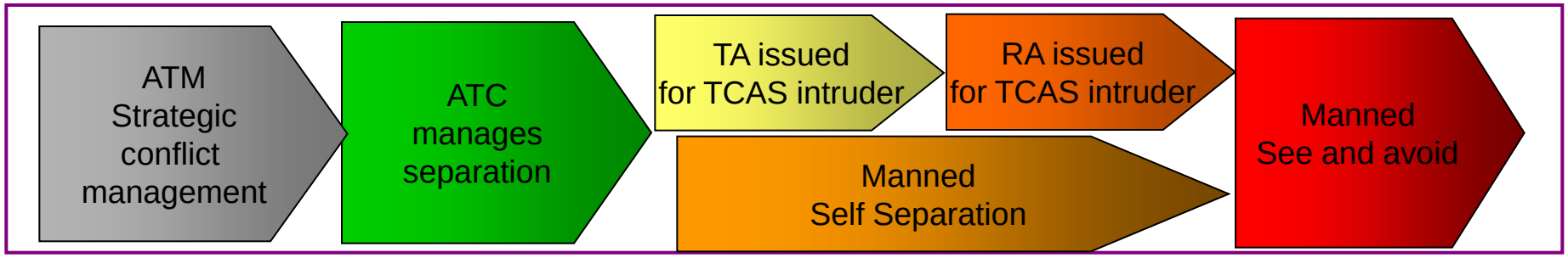
Safety layers

Existing safety layers (manned aviation)



Safety layers

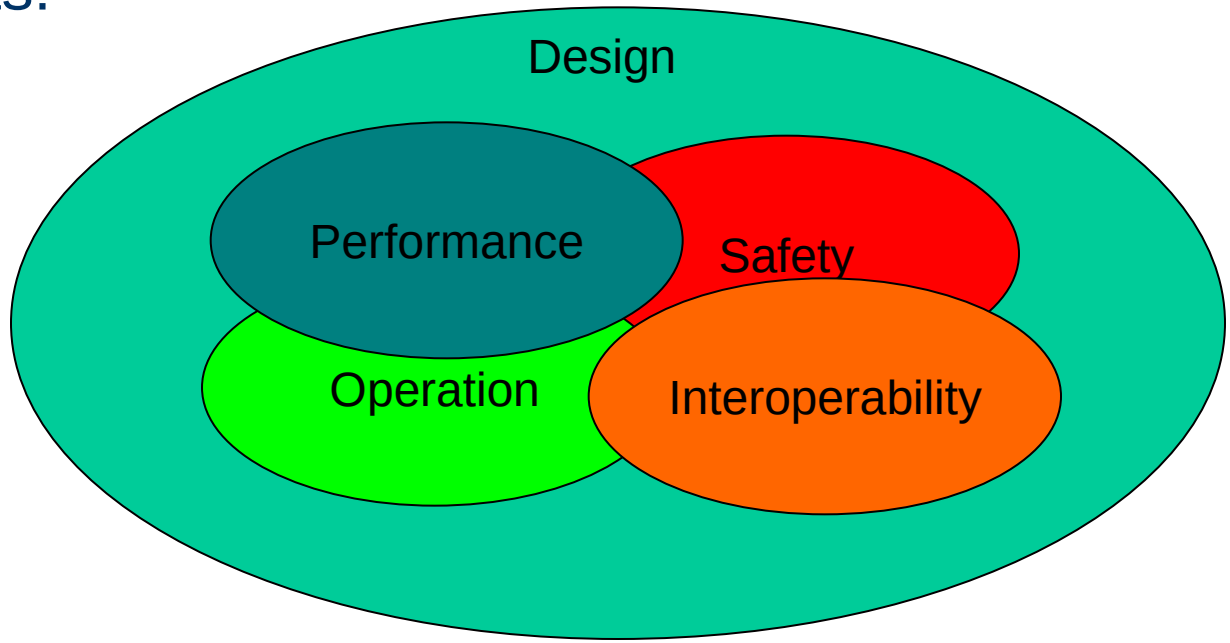
Existing safety layers (manned aviation)



Introduced by MIDCAS

Overall design consideration

The MIDCAS architecture is designed considering 4 main aspects:



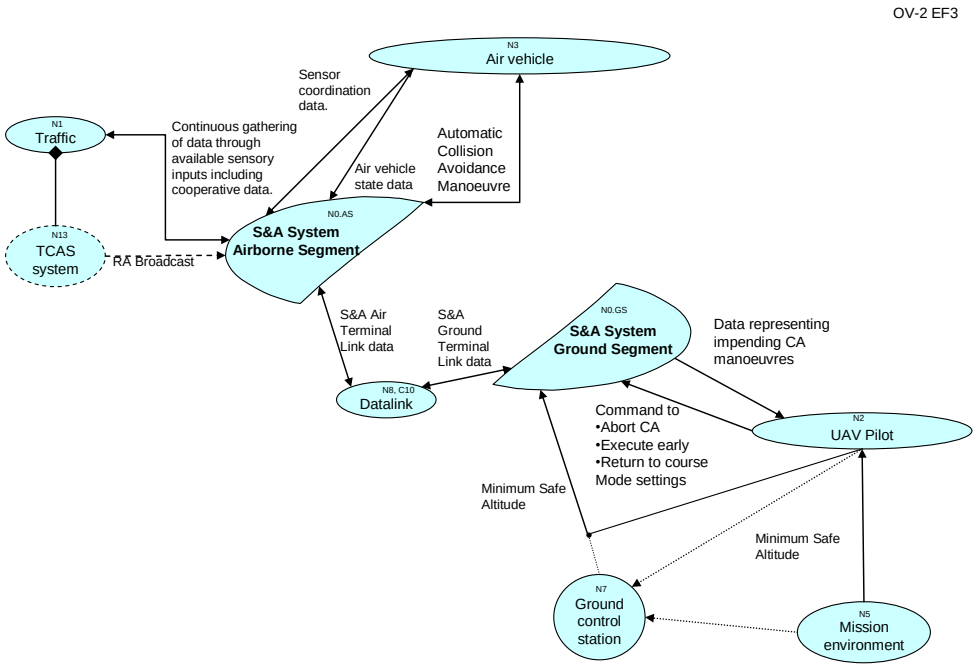
Keeping in mind that the design has to be:

- Acceptable
- Feasible

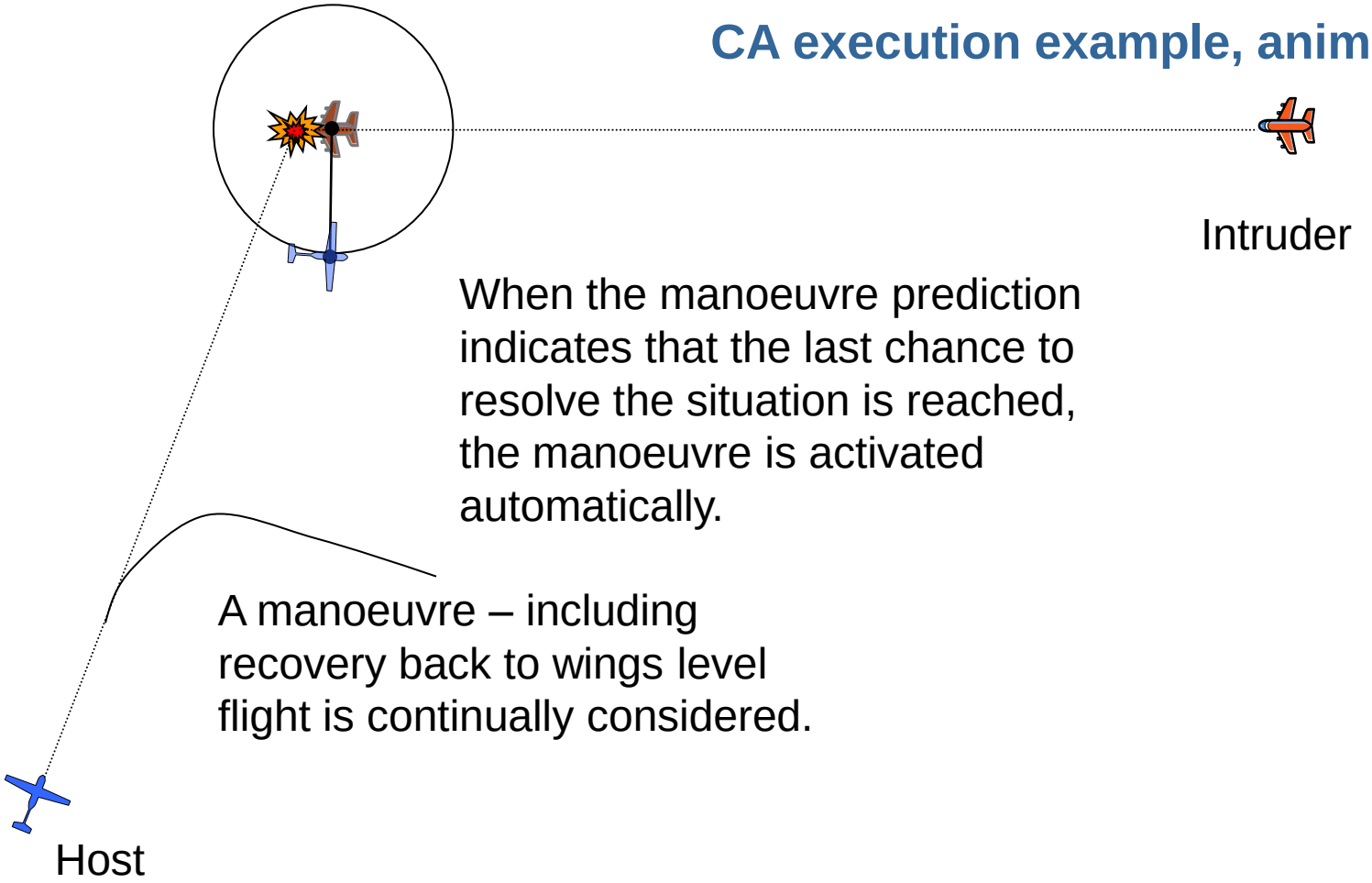
Main S&A Functions

- Provide Situational Awareness (SA)
- Provide Traffic Avoidance (TrA)
- Provide Collision Avoidance (CA)

External Function 3: Provide Collision Avoidance



CA execution example, animation



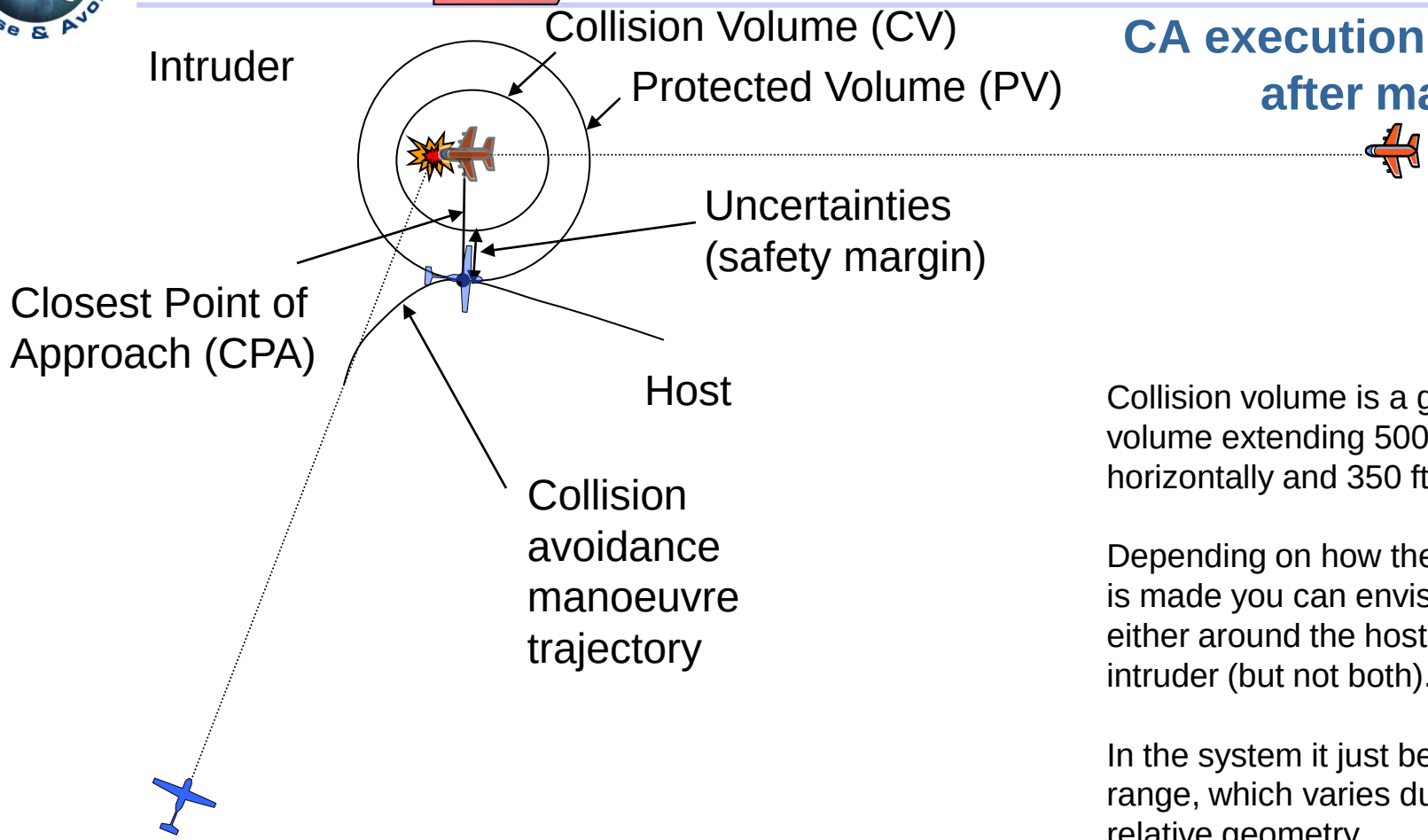
When the manoeuvre prediction indicates that the last chance to resolve the situation is reached, the manoeuvre is activated automatically.

A manoeuvre – including recovery back to wings level flight is continually considered.

Case 2: Non TCAS intruder-Sit. in class A to E

S&A Collision Avoidance / Perfo. Design

CA execution example after manoeuvre

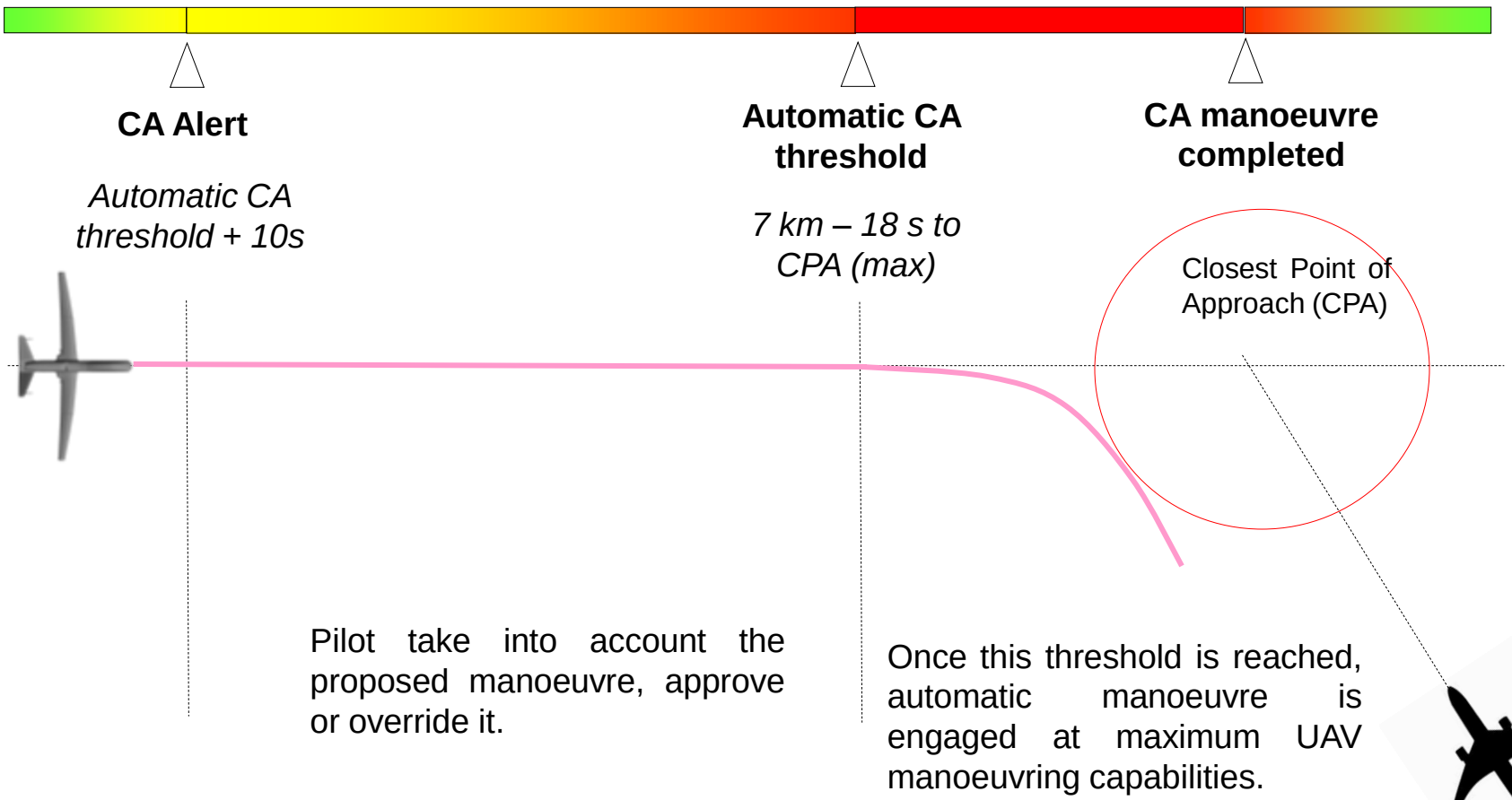


Collision volume is a given volume extending 500 ft horizontally and 350 ft vertically.

Depending on how the analysis is made you can envision it either around the host or the intruder (but not both).

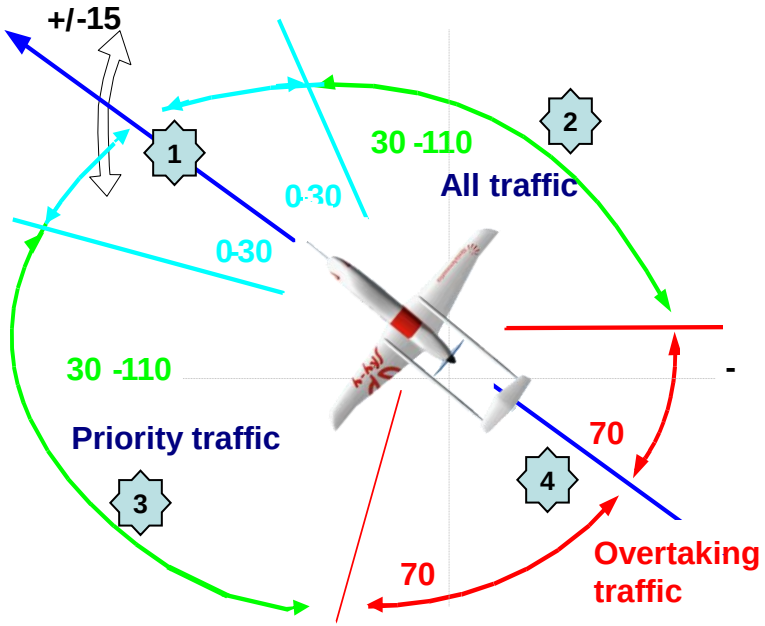
In the system it just becomes a range, which varies due to the relative geometry.

Collision avoidance timeline



Operational capabilities – ICAO ROA

ROA compliance



Sectors of interest

1	Intruder head-on or approximately, or intruder crossing ahead or being overtaken
2	All intruders converging from the right sector have the priority
3	Intruder converging from left sector : the UAV has the right-of-way, except for priority intruders
4	Overtaking intruders : the UAV has the right-of-way, the intruder has to comply with ROA

Traffic Avoidance assistance :

The direction of the manoeuvre is biased to take own right of ways Rules of the Air into account.

Collision Avoidance :

The direction of the manoeuvre is weighted to the right for head-on cases, and behind the intruder for beam cases coming from the right. The CA capability does not consider own right-of-way

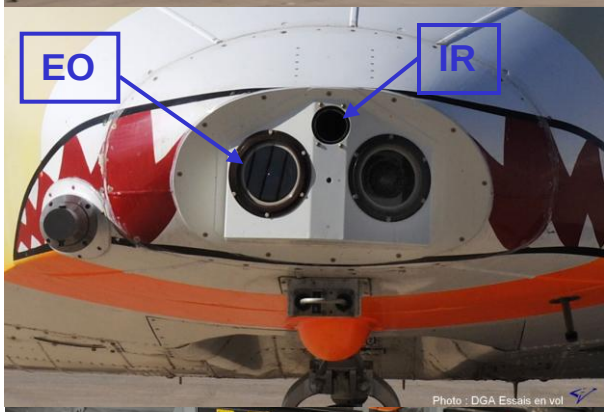
Sensor flight tests

An initial sensor flight test campaign has been performed with the purpose to gather data to be used for:

- development of image processing algorithms
- sensor models for simulation

Two different types of sensors have been integrated into the nose of a CASA C-212 test aircraft

- two visible band (EO) cameras
- one infrared (IR) camera



Flight test demonstrations

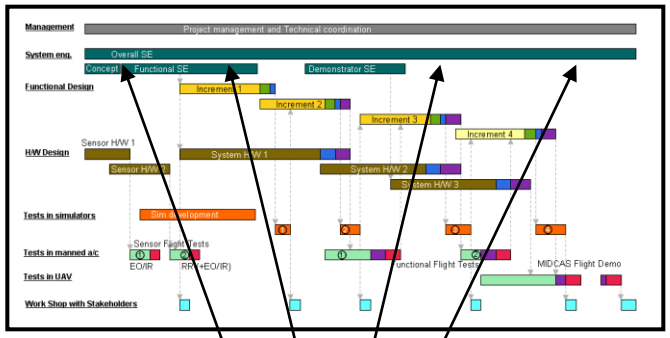
S&A design to be evaluated in:

- 2 Manned aircraft flight test campaigns
- 2 UAS flight test campaigns

CASA C-212

Alenia Sky-Y

MIDCAS support to Civil aviation standards



MIDCAS

Main stakeholders
CAAs
pilots associations
Airlines,
Aerospace Industry…

EUROCAE

Ops rules, regs, stds

AMC for ESARRs

Tech standards,
MASPS, MOPS

ED docs for ETSO

EUROCONTROL

EASA TYPE-CERTIF

ICAO

coordination

RTCA

Federal Aviation Administration

SAAB · AleniaAeronautica A Finmeccanica Company · CIRA · DIEHL BGT Defence · DLR · CASSIDIAN AN EADS COMPANY · ESG · indra · SAFRAN Sagem · SELEX Communications A Finmeccanica Company · SELEX GALILEO A Finmeccanica Company · SELEX Sistemi Integrati A Finmeccanica Company · THALES

Standardization process

- Generic Design work provides information to be used for standardization support
- Information is used to define Working papers that are presented in different stakeholder and standardization forums
  - EUROCAE WG73
  - Stakeholder workshops: 6 arranged over the project duration
  - Stakeholder Advisory Group
  - Study Notes presented in ICAO UAS study group
  - Information available on www.midcas.org

Feedback from stakeholders is incorporated in MIDCAS continued work

MIDCAS Stakeholder Workshops

Six dedicated workshops aims at informing and getting feedback from the major aviation stakeholders about MIDCAS project progress (www.midcas.org)

- **WS 1** General presentation of the project: objectives, methodology and time schedule (16 February 2010)
- **WS 2** Midair collision avoidance CONOPS and MIDCAS system operational capabilities (5 October 2010)
- **WS 3 Preliminary design: Operational, Performance, Interoperability and Safety aspects (23 Feb 2012)**
- **WS 4** Safety methodology and simulation capabilities, system integration and interface features with the UAS including HMI aspects
- **WS 5** Presentation of the overall results of safety and performance studies based on simulations results
- **WS 6** Presentation of UAS flight tests results and general conclusions of the project

Key issues and challenges

- **TCAS compatibility**; definition
- **Safety objective breakdown;** contributors and allocation
- **How to handle different UAV types;** slow vs fast, maneuverability
- **Sensors;** types and performances
- **Rules of Air;** interpretation
- **Field of view for Sensors**; safe, acceptable, feasible
- **Transition** Traffic Avoidance -> Collision Avoidance concept.
- **Effect of future ATM;** NEXTGEN/SESAR, ADS-B based
- **Standard;** High level requirements or pseudo code

MIDCAS main outcome

Main outcome of the MIDCAS project with respect to the 3 main tracks:

- Progress on Standards for S&A
  - Support the establishment of standards that enables design of S&A systems
  - Targets air space classes A-G, initial focus on A-C in line with WG 73
  - Challenge to arrive at reasonable performance and safety requirements
- Design of a generic S&A function to be tested in simulations
  - Covers self separation, collision avoidance and situation awareness
  - TCAS compatible
  - Feasible for different types of UAS
  - Possible to evolve over time as technology progresses
  - Designed to TRL 6
- Design of a S&A demonstrator to be tested in manned and UAS flight
  - Perform relevant demonstrations in flight
  - Targets final demonstration with UAS in non segregated air space
  - Pushes positions of authorities approving flights