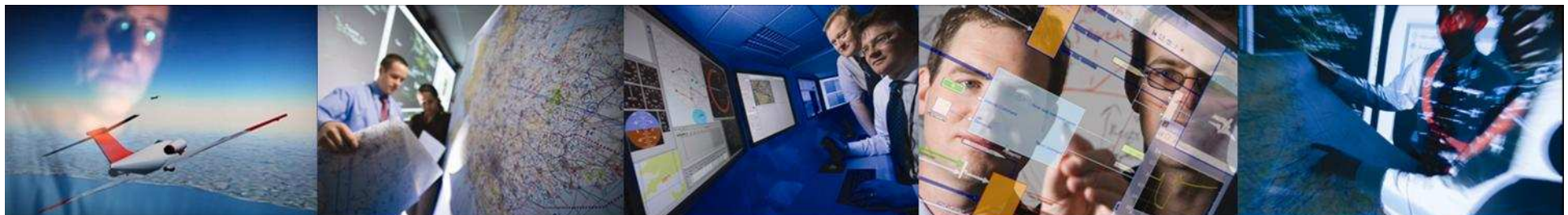




Opening the airspace for UAS

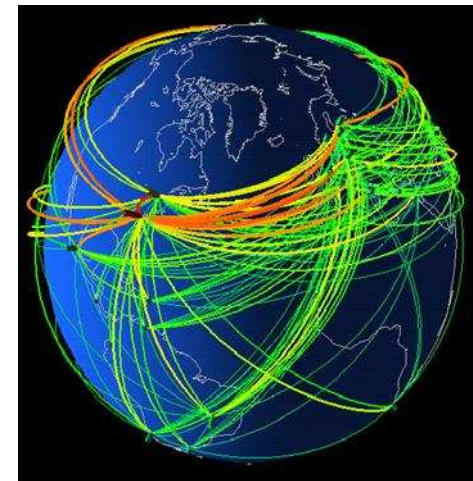
**Lambert Dopping-Hepenstal, FEng
Aero Engineering 2010**

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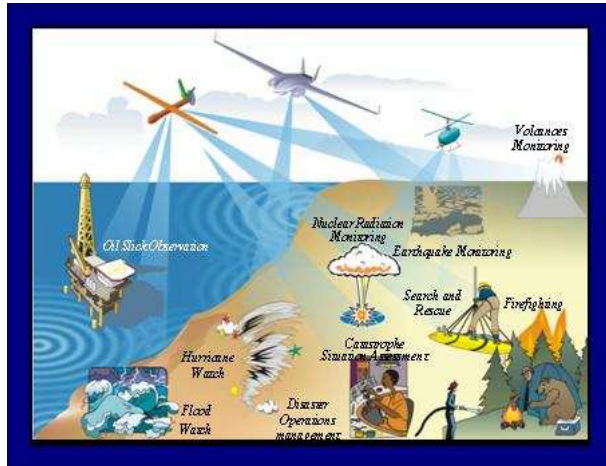


The airspace integration challenge

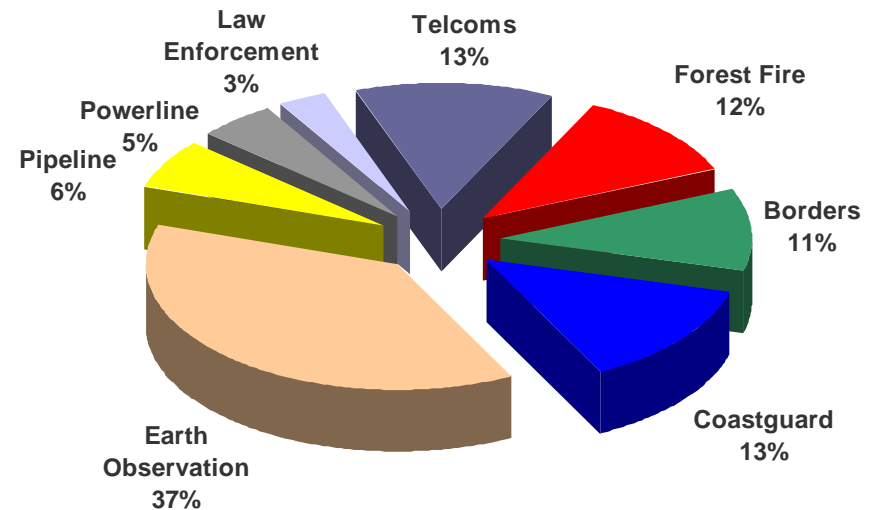
- **Regulations for manned flight have matured over the past 100 years**
- Implicit assumption that pilot is on-board
- No agreed interpretation on standards and regulations for unmanned systems
- **Regulatory authorities have provided guidance**
 - Transparency
 - Equivalence
 - No less safe than manned aviation
- **Catch 22 situation**
 - Regulators require example system to certify
 - Industry require regulations to specify requirements
- **Global access to airspace initiatives**
- **Public perception**



UAV Civil Market



- Potential to address many applications in the civil sector.
- Service-oriented solutions could become the norm.
- Unmanned to Manned Autonomy Technology potential



Who is involved?

A programme, jointly funded by industry and the public sector

➤ **TSB**

➤ **Regions**

- Welsh Assembly Govt
- Scottish Enterprise
- SEEDA
- SWRDA
- NWDA

➤ **Industry**

- Agent Oriented Software
- BAE Systems
- Cobham
- EADS Cassidian Systems
- QinetiQ
- Rolls-Royce
- Thales

➤ **Universities**

- Bath
- Bristol
- Cranfield
- Loughborough
- Sheffield
- Strathclyde

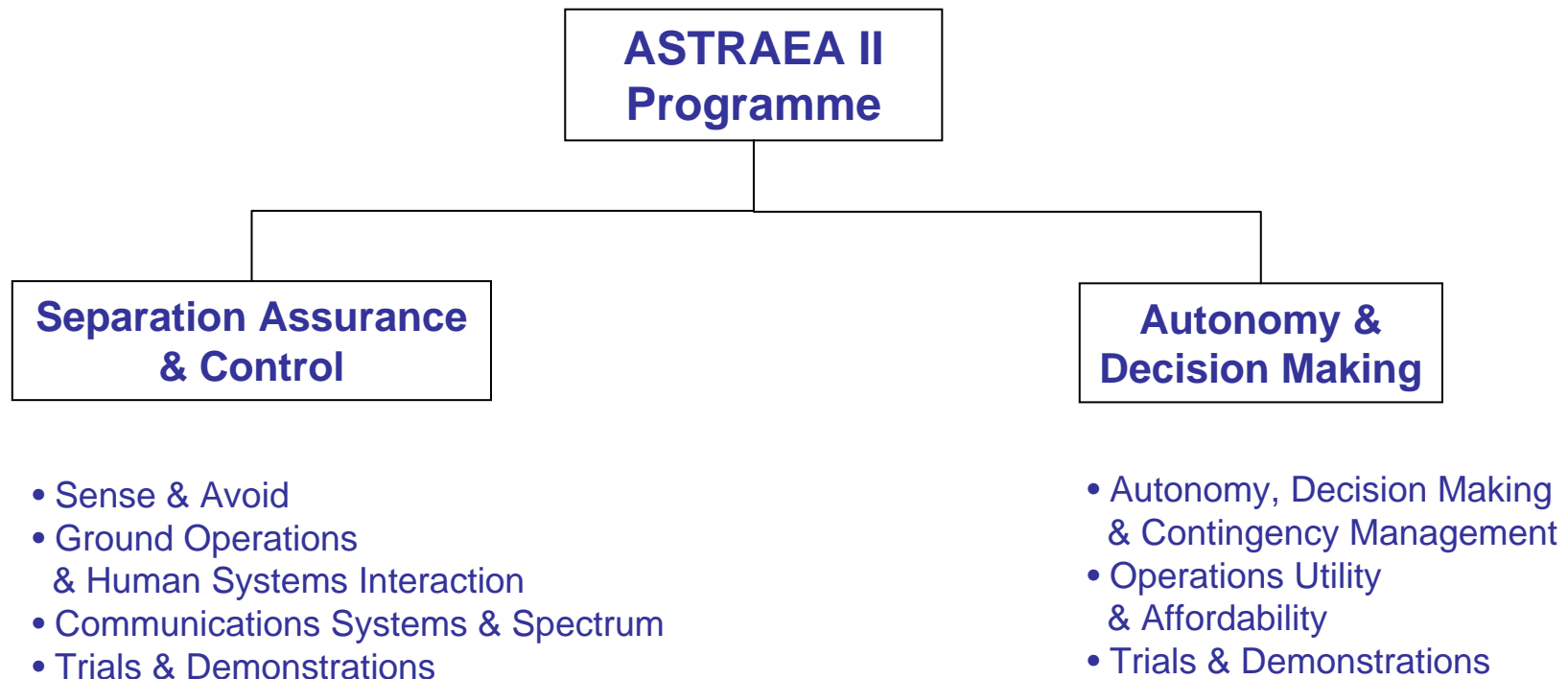
➤ **UK Civil Aviation Authority**

➤ **Subcontract SMEs and Universities**

Programme Construct



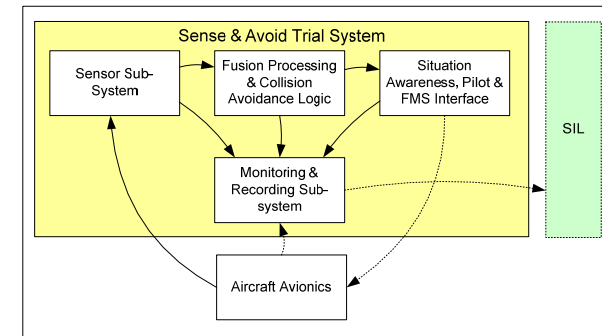
January 2009 – March 2013



Sense & Avoid



- To enable UAVs to **sense** (using visual, radar, co-operative transponder or other advanced technologies) **all other air traffic in the airspace or ground based obstacles**
- To determine whether **any air traffic poses a potential conflict**
- To provide the UAV pilot with **data to determine any course or altitude change to avoid intruders or to autonomously manoeuvre the UAV to eliminate the conflict**
- Develop **technology** that enables UAVs to avoid collision with other aircraft in situations where a loss of separation occurs
- Develop a clear **path to certification** through comprehensive regulatory engagement
- **Demonstrate** and explore technology solutions and operating standards to the stakeholder community in both synthetic and real world environments
- **Build public confidence** and develop a complete and robust safety case leading to an increased demand for UAS solutions in the civil domain

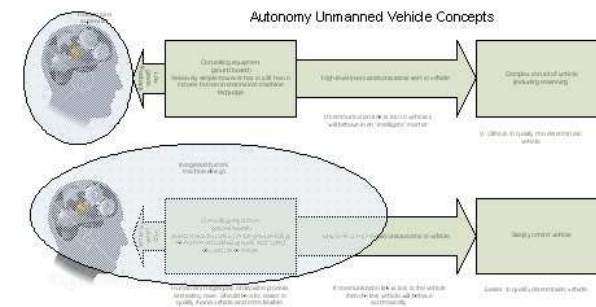
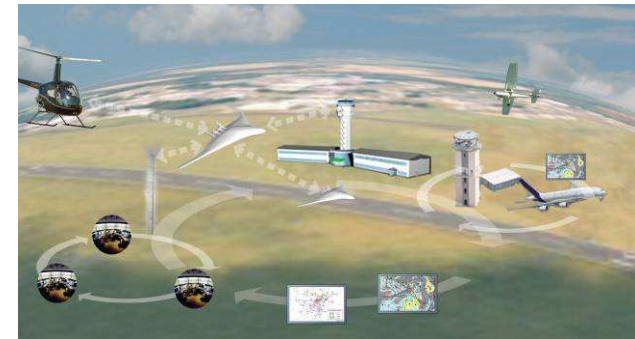


Ground Operation & Human Systems Interaction



- Identify the **ground operational environment** required for a UAS, including:
 - Tools required by the **operator** and the information that needs to be provided to allow **informed decisions** to be made
 - The required **interaction with ATC** and other authorities
 - The restrictions placed on the **ground operating environment by the regulatory authorities**, eg safety, security and certification requirements

- Identify how to fully **integrate the human into the autonomous system**, including:
 - Issues of **system trust** and maintaining operator awareness
 - Innovative HSI solutions
 - Numbers of operators, their **roles and skill levels**
 - Novel solutions to meet **training** needs

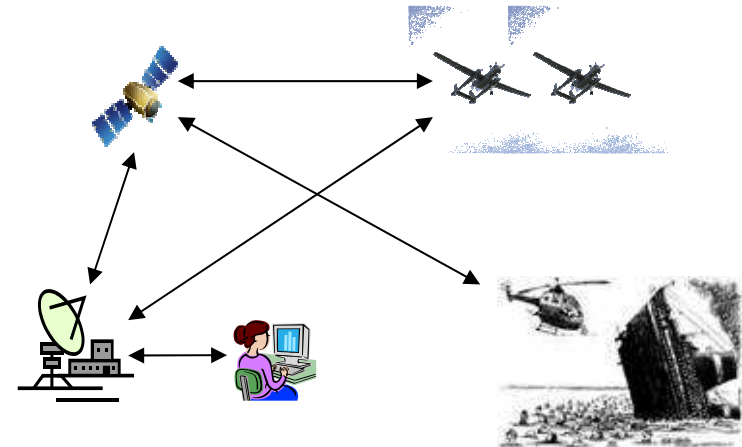


Communications Systems & Spectrum



- Determine how the future systems will **communicate both with the ground and other airborne assets** to provide safe flight and human in the loop capabilities in a civil environment.
 - Develop and demonstrate the **architecture** that allows the Human in the loop to maintain communications with the UAV both Line of Sight (LOS) and a Beyond Line of Sight (BLOS) situations.
 - To augment the capabilities of the UAV in its ability to **cooperate with other air assets** in normal and exceptional circumstances.
 - To ensure that the **Operator has the ability to intervene**, make decisions and take control if necessary thus maintaining public confidence
 - To enable **higher UAV density** through cooperation and mutual understanding of individual air vehicle intentions.

WRC-2012



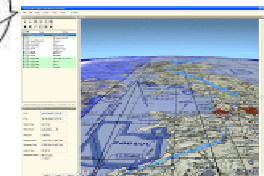
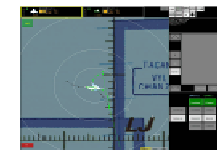
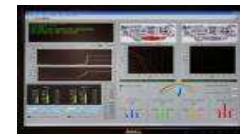
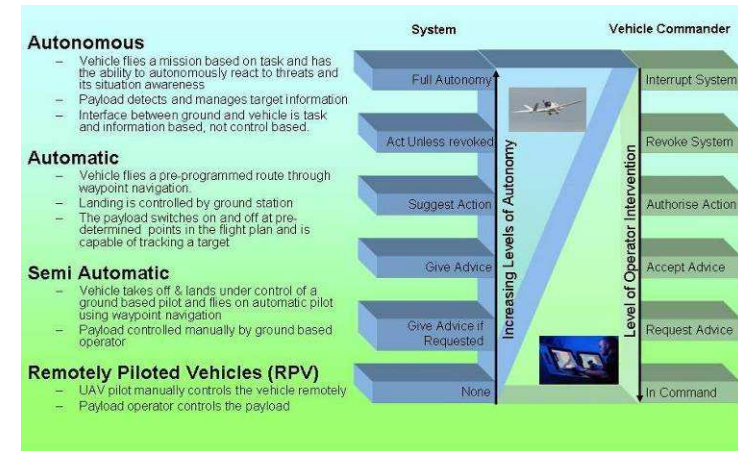
Autonomy & Decision Making

- Determine how the **decision making system** allows safe autonomous operations

- To **augment the capabilities of the remote operator** so that the UAV behaves in a sensible and safe fashion in the presence of normal and exceptional circumstances.

- To **reduce the workload of the remote operator** so he/she can focus on the top level mission goals while the UAVs perform the tactical tasks.

- To enable a **higher UAV to operator ratio** so that the full potential economic benefit can be realised.

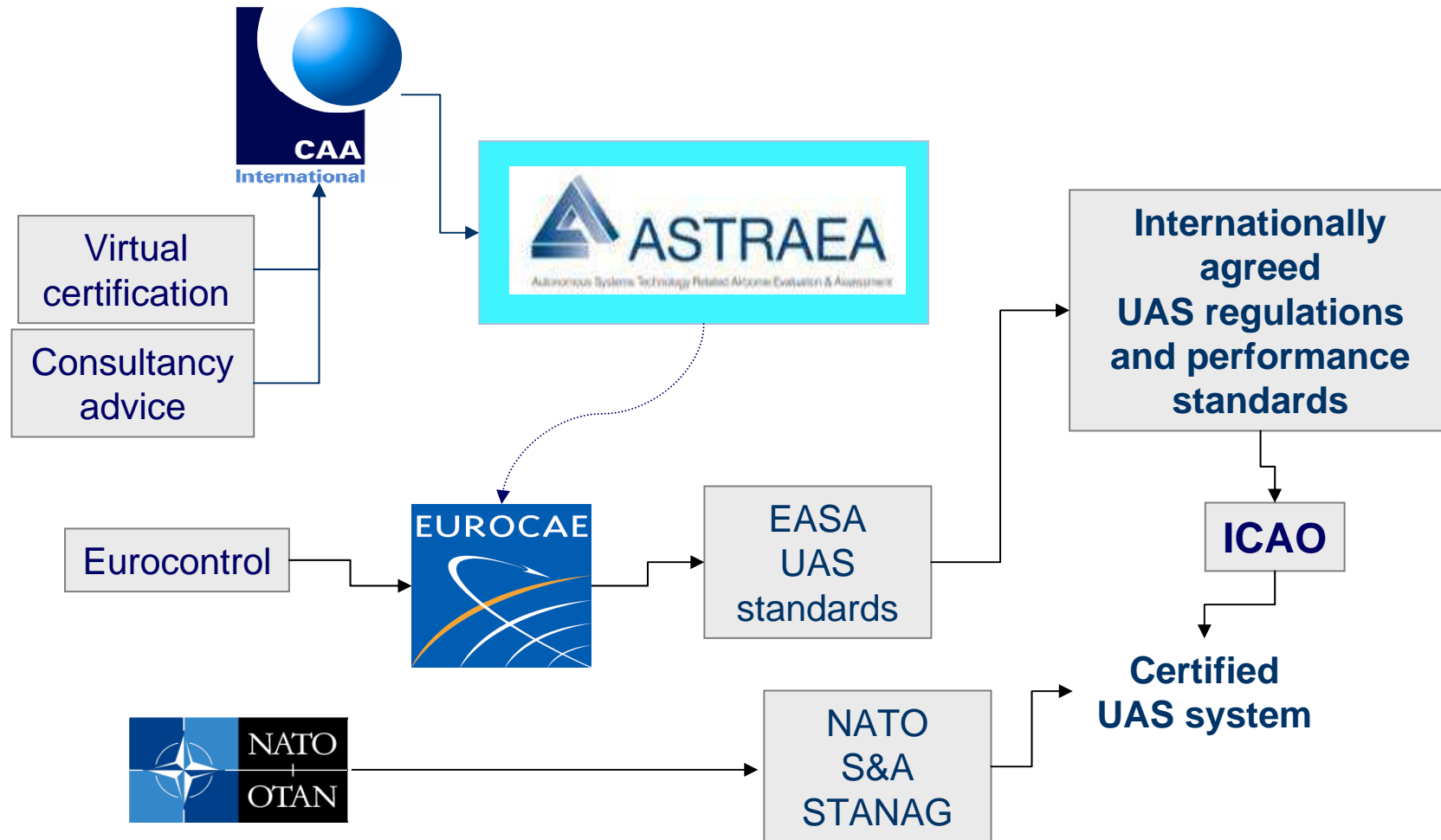


Demonstrations

- Synthetic Environments
- Hardware in the Loop
- Surrogate Aircraft

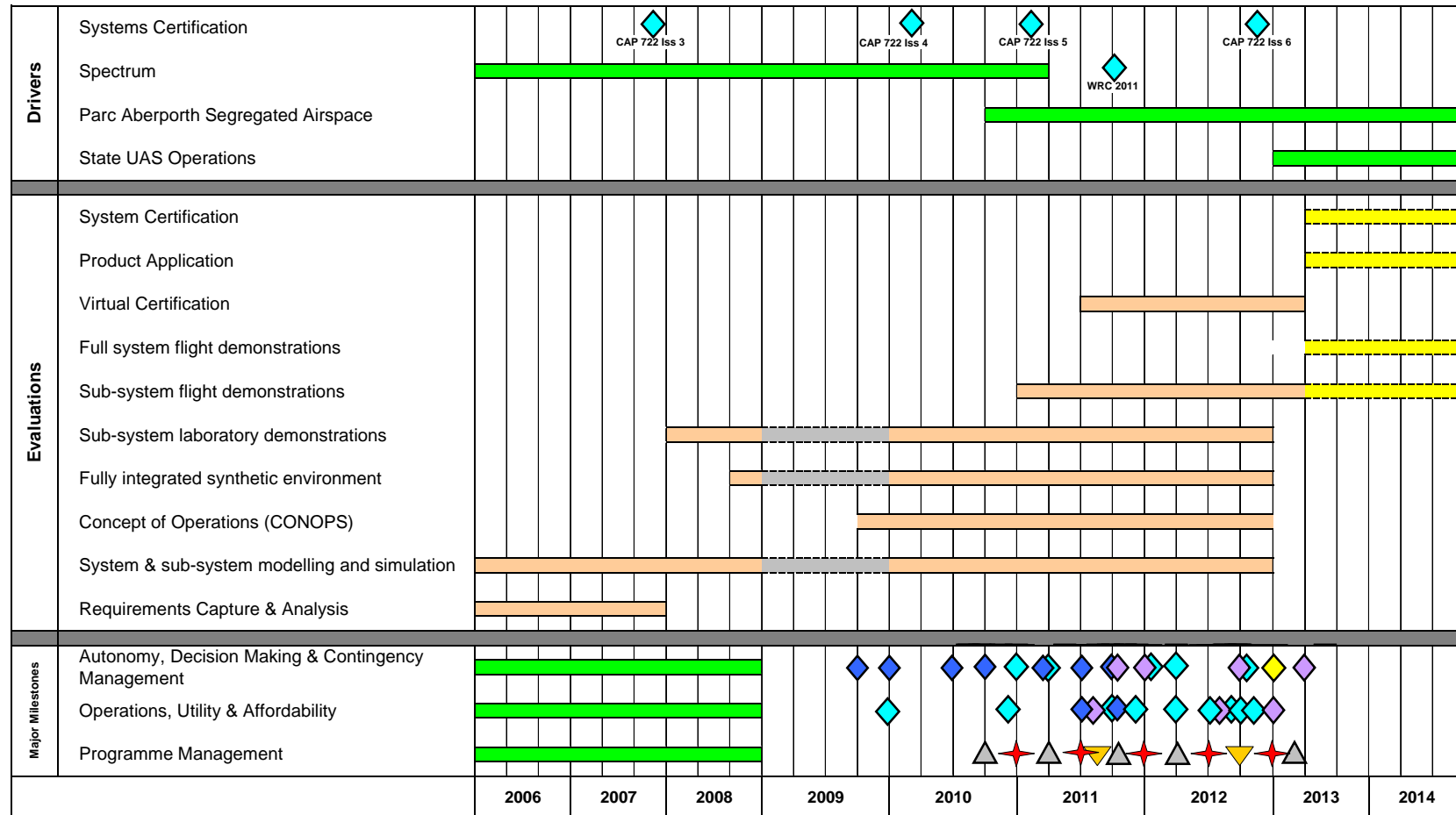


Stakeholder Engagement

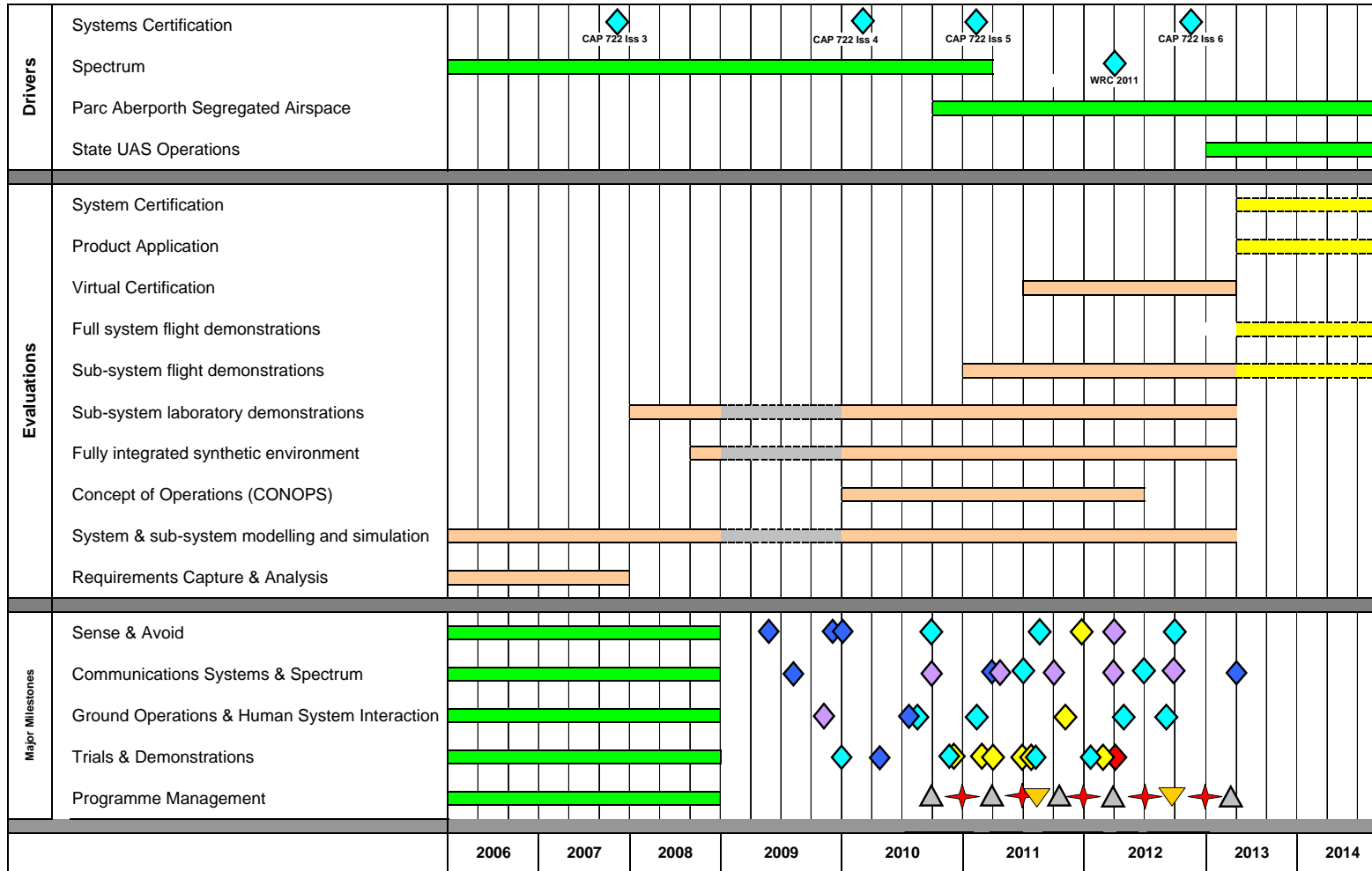


ASTRAEA – a route to UK, European and International certification

Autonomy & Decision Making Roadmap



Separation Assurance & Control Roadmap





Conclusions

Limited flight clearances are currently being offered for UAS operations in a number of countries, however, the ASTRAEA projects are addressing all technical aspects of certification which are necessary to ultimately achieve full access to airspace, even in the crowded skies and high population density of the UK.

Going Forward Together



AOS Autonomous
Decision-Making
Software

BAE SYSTEMS

COBHAM

CASSIDIAN
AN EADS COMPANY

QinetiQ

Rolls-Royce

THALES

www.ASTRAEA.aero

