The Quarterly Bulletin of the CEAS

COUNCIL OF EUROPEAN AEROSPACE SOCIETIES

3AF AIAE AIDAA AAAR CzAeS DGLR FTF HAES NVvL PSAA RAeS SVFW TsAGI

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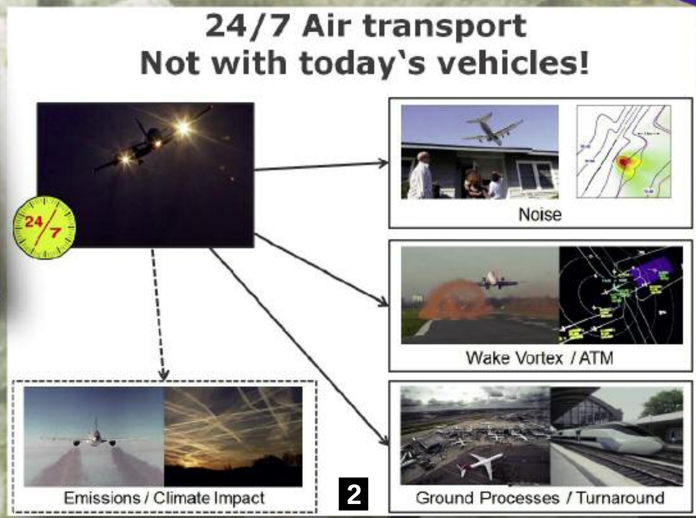

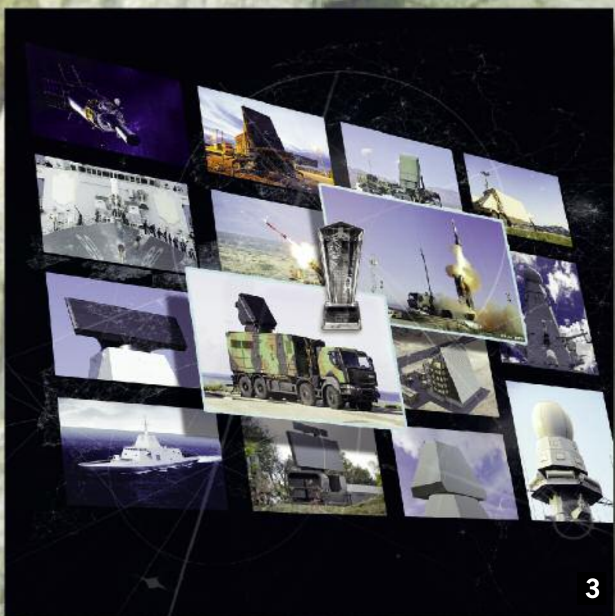

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CEAS

WHAT IS THE CEAS ?

The Council of European Aerospace Societies (CEAS) is an International Non-Profit Association, with the aim to develop a framework within which the major Aerospace Societies in Europe can work together.
It presently comprises thirteen Full Member Societies: 3AF (France), AIAE (Spain), AIDAA (Italy), AAAR (Romania), CzAeS (Czech republic), DGLR (Germany), FTF (Sweden), HAES (Greece), NVvL (Netherlands), PSAA (Poland), RAeS (United Kingdom), SVFW (Switzerland), TsAGI (Russia); and four Corporate Members: ESA, EUROAVIA, LAETA (Portugal) and VKI (Belgium).
Following its establishment as a legal entity conferred under Belgium Law, this association began its operations on January 1st, 2007.
Its basic mission is to add value at a European level to the wide range of services provided by the constituent Member Societies, allowing for greater dialogue between the latter and the European institutions, governments, aerospace and defence industries and academia.
The CEAS is governed by a Board of Trustees, with representatives of each of the Member Societies.

Its Head Office is located in Belgium:
c/o DLR – Rue du Trône 98 – 1050 Brussels.
www.ceas.org

WHAT DOES CEAS OFFER YOU ?

Knowledge transfer:
- A well-found structure for Technical Committees

High-Level European Conferences:
- Technical pan-European events dealing with specific disciplines and the broader technical aspects
- The CEAS European Air and Space Conferences: every two years, a Technical oriented Conference, and alternating every two years also, a Public Policy & Strategy oriented Conference

Publications:
- Position/Discussion papers on key issues
- CEAS Aeronautical Journal
- CEAS Space Journal
- CEAS Quarterly Bulletin
- Aerospace Events Calendar – www.aerospace-events.eu

Relationships at a European Level:
- European Commission
- European Parliament
- ASD (AeroSpace and Defence Industries Association of Europe), EASA (European Aviation Safety Agency), EDA (European Defence Agency), ESA (European Space Agency), EUROCONTROL
- Other European organisations

European Professional Recognition:
- Directory of European Professionals

Honours and Awards:
- Annual CEAS Gold Medal to recognize outstanding achievement
- Medals in technical areas to recognize achievement
- Distinguished Service Award

Young Professional Aerospace Forum

Sponsoring

THE CEAS MANAGEMENT BOARD

It is structured as follows:

- General Functions: President, Director General, Finance, External Relations & Publications, Awards and Membership.

- Two Technical Branches:
  – Aeronautics Branch
  – Space Branch

Each of these two Branches, composed of specialized Technical Committees, is placed under the authority of a dedicated Chairman.

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EDITORIAL

THE CEAS TOWARDS NOTORIETY

Jean-Pierre Sanfourche
Editor-in-Chief,
CEAS Quarterly Bulletin

The management team of the CEAS is multiplying the efforts with the ambition to make of this Association an organisation highly considered by the European Aerospace Institutions, Industry and Academia. Among these efforts are the organisation of the next biennial CEAS Conference, the Memorandum of Understanding with the EASN and the one with the EREA.

Aerospace Europe 2017 Conference

This event, organised by the Aeronautics and Astronautics of Romania (AAAR), will take place in Bucharest on 16-20 October 2017. It will be the 6th CEAS Air & Space Conference, but for the first time, it will be supported by a number of European specialized aerospace science and technology research associations: ECCOMAS (European Community on Computational Methods in Applied Sciences), EUROMECH (European Mechanics Society), EUROTURBO (European Turbomachinery Society) and ERCOFTAC (European Research Community on Flow Turbulence Air Combustion). Furthermore, it will offer Clean Sky and SESAR project partners a platform to share the results of their works while Aerospace Academia dedicated sessions will be managed by the EASN, association with which we have just signed a Memorandum of Understanding.
So, the objective is that this CEAS Air & Space Conference 2017 is in fact the first "AEROSPACE EUROPE" Conference. It is the reason why all necessary efforts are being be made to achieve a glaring success.

Memorandum of Understanding has been signed between CEAS and EASN

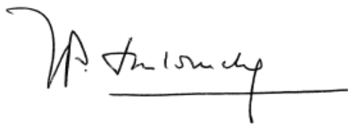
This MoU between CEAS and EASN (European Aeronautics Science Network) signed on 16 March is intended to serve of development of a close cooperation between both Associations with a view to exchanging information, coordinating conference and workshop organisations, to jointly supporting education and training of students in aeronautics and to encouraging scientist and research engineers to publish in the CEAS Aeronautical Journal as well as in the EASN supported Journals.

Memorandum of Understanding between CEAS and EREA

This MoU between CEAS and EREA (European Research Establishments in Aeronautics) which has been signed in September 2015 clearly constitutes for CEAS a winning card, making easier its access to the knowledge of aeronautics research and technology development projects conducted by the Excellence Centres of Europe and allowing get its support for conferences and workshops. Besides the CEAS Aeronautical Journal should be one of the best adapted magazines to publish researchers work results.

Towards notoriety

Having established solid links with many important organisations and being well considered by the European Commission, the CEAS has further strengthened its position as the number one Aerospace Association of the EU. This achievement is the fair reward of the excellent collaborative and entrepreneurial spirit which prevails within the management team.



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CEAS PRESIDENT'S MESSAGE


Fred Abbink, CEAS President

Security and Safety

On the morning of March 22 three terrorist attacks took the lives of 32 victims and of the 3 suicide bombers. Over 300 persons were injured. Two of the bombing attacks took place at Brussels Airport in Zaventem. The airport was immediately closed and it took more than a month before it was back to its full capacity. The air transport sector is looking for lessons learnt on how to reduce the terrorist-caused risks while in the meantime maintaining the airport capacity.

An item of growing concern to the air transport sector is the increasing use of Unmanned Aerial Systems. The number of incidents is increasing and the risk of an airline accident is growing. EASA has established a task force to study the risk of collisions of UAS and aircraft. The EASA task force will:

- Review all relevant occurrences including the occurrences collected by the European Member States;
- Analyse the existing studies on the subject of impact between drones and aircraft;
- Study the vulnerabilities of aircraft (windshields, engines, and airframe) taking into account the different categories of aircraft (large aeroplanes, general aviation, and helicopters) and their associated design and operational requirements;
- Consider the possibility to do further research and perform actual tests (for example on windshields).

Aeronautical Research, Technology Development Test and Evaluation

In the USA and Europe large steps are being made towards the development and demonstrations of new technologies that will allow more environmentally friendly and more cost effective aircraft.

In the USA NASA announced a 10-year American Aviation Plan to accelerate aviation energy efficiency, advanced propulsion system transformation and enable major improvements in aviation safety and mobility. The 10-year NASA programme includes a series of new experimental aircraft or "X-plane and technology demonstrations. The budget for the 10-year American Aviation Plan from 2017-2026 is over 10 billion US Dollars. As part of the X-plane concept NASA has provided Lockheed Martin in February with a 20 million US Dollar contract for the preliminary design of a "low boom" supersonic jet.

In Europe Clean Sky 2 is getting in full swing. Clean Sky 2 will run from 2014 till 2024. It is focused towards the speeding up of technology demonstrators for new environmentally friendly technologies for next generation aviation as well as to strengthen European international aviation competitiveness. The budget of Clean Sky 2 is 4 billion Euros. The EU contributes 1.8 billion from the Horizon 2020 Programme budget. The industrial partners contribute 2.2 billion Euros.

Clean Sky 2 will complement the various national programmes as e.g. the German Luftfahrt Forschungsprogramm (LuFo) and the French Conseil pour la Recherche Aéronautique (CORAC) programme.

CleanSky Forum in Brussels

On April 4, in Brussels the CleanSky Forum took place. This Forum was used by CEAS to provide visibility of CEAS and of the CEAS 2017 Air and Space Conference. The latest CEAS Bulletin and a leaflet of the CEAS 2017 conference were distributed amongst the Forum participants.

Hybrid Electric Propulsion

Electric propulsion shows great promises to make aircraft more environmentally friendly.

The first man-carrying electric flights were made already in 1973. The fast development of battery technology allowed great steps to be made in aviation too.

In December 2009 the Swiss Solar Challenger 1 conducted its first flight. In July 2010 it flew an entire diurnal solar cycle, including 9 hours of night flying.

Its successor the Solar Challenger 2 started to circumnavigate the globe in 2015. The largest leg (from Japan to Hawaii) was executed in July 2015.

In July 2011 the Slovenian ultra-light aircraft manufacturer Pipistrel unveiled its Taurus G4 dual fuselage, four seat, single engine experimental aircraft that demonstrated the equivalent of 400 passenger miles per gallon efficiency. The aircraft carries around 500 kg of Lithium polymer batteries. The G4 first flew on 12 August 2011 and won the NASA Green Flight Challenge on 3 October 2011. Pipistrel and Siemens have partnered to design and build a four seat hybrid-electrical aircraft under their Hypstar programme

In July 2014 the Airbus Group demonstrated the Airbus E-Fan at the Farnborough Airshow.

The E-Fan has a crew of one and place for one passenger, a cruising speed of around 160 km/hr and an endurance of around one hour. It is powered by a set of Lion batteries with a total mass of around 165 kg and a capacity of around 30 KWh. In 2017 a 60 kWh version E-Fan 2.0 is foreseen, with two-hour endurance.

And Airbus proposes a hybrid-electric E-Fan 4.0 that will fly around 2019 with a kerosene fueled generator will

charge the batteries during flight and increase the endurance from 2 to 3.5 hours.
On April 7 Airbus Group and Siemens signed a collaboration agreement in the field of hybrid electric propulsion. Airbus and Siemens plan to develop prototypes for propulsion systems with power classes from a few 100 kilowatts up to 10 and more megawatts, i.e. for short local trips with aircraft with less than 100 seats, helicopters or UAVs up to short and medium range aircraft. Siemens predicts that by 2035 hybrid electric aircraft will be in use for 60-100 passenger commercial aircraft.
NASA also has a large hybrid-electric aircraft programme, starting with its Scalable Convergent Electric Propulsion Technology (SCEPTOR) project, the Leading Edge Asynchronous Propellers Technology (LEAPTech) project and its NX-3 future passenger aircraft prototype.

Space launchers

In the USA on April 8, May 6 and May 27 successful landings of the SpaceX Falcon 9 launchers on a seaborne platform took place: a great step towards reusable launchers resulting in significant cost reductions. SpaceX claims that from 2017 the cost of a launch could be reduced by 30%. This is a tall order for the European Space industry to meet.

Birthday celebrations of CEAS Member Societies

In 2016 three CEAS Member Societies are celebrating anniversary lustra. The Royal Aeronautical Society (**RAeS**) has celebrated the great event of its 150th anniversary with a Gala Banquet in Guildhall, London on May 18.
The Netherlands Society of Aeronautical Engineers **NVvL** will celebrate its 75th anniversary with a one day symposium in the National Military Museum in Soesterberg on November 22.
And the Aeronautics and Astronautics Association of Romania **AAAR** will celebrate its 10th anniversary.
CEAS congratulates the three Member Societies with these anniversaries.

Boeing 100-year anniversary

On July 15 1916 the Boeing Company was founded by William Boeing in Seattle, USA.
In the 100 years Boeing became one of the largest global aircraft manufacturers with around 160.000 employees, the second-largest defense contractor in the world and the largest exporter in the USA.
CEAS congratulates Boeing with its centennial anniversary

Farewell reception of Dr Constantinos Stavrinidis

On March 17 Dr Constantinos Stavrinidis held his Farewell Reception at ESTEC in Noordwijk, The Netherlands. As president of CEAS I got the opportunity to address Dr Stavrinidis and the audience.
Dr Stavrinidis has been actively contributing to CEAS and its development since 2002. Since 2011 he was the chief editor of the CEAS Space Journal, a refereed CEAS Journal, appearing quarterly.

On the left, Constantinos Stavrinidis. On the right, Giorgio Saccocia, currently acting as Head of Mechanical Engineering Department, ESTEC.

He was the face of the CEAS Space activities and played an essential role in CEAS, its space-related publications and in the organization of the biennial CEAS Conferences since 2007.
CEAS expressed its gratitude to Dr Stavrinides by presenting him the CEAS Distinguished Service Award.

34th CEAS Board of Trustees meeting in Barcelona

On March 15 and 16 in Barcelona, Spain the 34th CEAS Board of Trustees meeting took place.
Highlight of this meeting was the signing of a Memorandum of Understanding between EASN and CEAS. Furthermore the status of the nominations for the CEAS Gold Award 2017, of the EU Project ECAero 2 and the CEAS 2017 Air and Space Conference were discussed. With respect to ECaero 2 and its important delivery of a joint CEAS-EUCASS Air and Space Conference it had to be concluded that 2017 was too soon for such a joint event. The CEAS 2017 Air and Space Conference will take place in Bucharest from 16th to 20th of October 2017 and it will be organised by the Romanian CEAS Member Society AAAR. Within ECAero2 it will be investigated if the CEAS 2017 Air and Space Conference can be the first Aerospace Europe Conference with as much support and cooperation of the ECAero 2 partners and from the EU.


Left to right: Annelies Abbink, Christophe Hermans, Mercedes Oliver Herrero and Cornelia Hillenherms

35th CEAS Board of Trustees meeting in St-Petersburg

On June 9 in St Petersburg, Russia the 35th CEAS Board of Trustees meeting took place.
From the four excellent nominations for the **CEAS Gold Award 2017** the CEAS Awards subcommittee selected the nomination for Eric Dautriat. The CEAS Board of Trustees accepted this proposal.
Furthermore it decided to provide the **CEAS Technical Award** to the 'BlueCopter 'Demonstrator Project Team.
The EU Project ECAero 2 and the CEAS 2017 Air and Space Conference were discussed. The potential of support of the RAeS to the CEAS 2017 Conference was discussed in the context of the ECAero 2 project. It was decided to investigate how CEAS can support the EU PERSEUS project.
Finally it was decided to entrust professor Keith Hayward with the project to write a book on the **25 years of the CEAS** to be published in 2017.
Finally the organisation of the communication with the CEAS MoU partners and Corporate Members was decided.

Fred Abbink
CEAS President

Left to right: Mrs Lundahl, Sergey Chernyshev, Tatjana Chernyshev, Leonardo Lecce, Mrs Lecce

Left to right: Darja Belova (TsAGI secr Sergey), Fred and Annelies Abbink

CEAS AWARD 2017

Personality Awarded: Eric Dautriat

Citation

Eric Dautriat has contributed in an exemplary, outstanding way to the French space community and to the European aeronautics technology development and demonstration, essential for the progress of the environmental sustainability and competitiveness of the European aeronautical industry.

Justification

After a successful career in space launchers with CNES (France) in close relationship with ESA, Eric Dautriat became in 2009 the Executive Director for the EU Joint Undertaking Clean Sky and later Clean Sky 2.
In this function he managed the 1.6 billion Euro Clean Sky Public Private Partnership programme between the European Commission and the European Aeronautics industry. Clean Sky encompassed 6 Large Integrated Technology Demonstrators (ITDs): Green Regional Aircraft, Smart Fixed Wing Aircraft, Green Rotorcraft, Sustainable and Green Engines, Systems for Green Operations and Eco-Design. Complementing these 6 ITDs a Technology Evaluator assessed the environmental improvements provided by the new technologies. From 2015 on Clean Sky will be succeeded by 4 billion Euro Clean Sky 2 Public Private Partnership programme.

Clean Sky 2 is Europe's foremost European aeronautical research programme. It is aimed to be a main contributor to the ambitious European Commission's Flight Path 2050 goals set by the Advisory Council for Aeronautics Research in Europe (ACARE).

Eric Dautriat provided vision and leadership in an exemplary way to the industrial leaders of the ITDs, the contributing Small and Medium Enterprises, Universities and Research Establishments. He provided the essential interface between the Clean Sky Joint Undertaking (CSJU) Governing Board, made up of representatives from the industry, the Commission and the European Nations. He managed the team of Clean Sky Joint Undertaking (CSJU) Project Officers and the Scientific and Technology Advisory Board (STAB) members in an excellent, visionary and pragmatic way that resulted in a large spectrum of new technology demonstrations, essential to the environmental sustainability and competitiveness of the European Aeronautical Industry.

Curriculum Vitae of Eric Dautriat

- Born in Bar-Le-Duc, France, 1955
- **1977** Graduated as Engineer from Ecole Centrale de Lyon.
- **1978-1984** Mechanical Engineer (Advanced Projects) Snecma, Melun Villaroche, France.
- **1985-1988** Centre National d'Etudes Spatiales (CNES), French Delegate to the Ariane Programme Board and the Scientific Programme Board of ESA.
- **1988-2003** CNES Launchers Directorate, Deputy Manager Ariane 4 Complementary Programmes, Manager Advanced Programmes, Project Manager of Ariane 5 Solid Rocket Booster and Director of Launchers.
- **1997-2003** In charge of Ariane 5 developments by delegation of ESA and of National R&T Activities.
- **2003-2008** Quality VP of Snecma (Safran Group).
- **2007-2009** Quality VP of Safran Group.
- **2009-2016** Executive Director of Clean Sky Joint Undertaking (CSJU), European Commission, Brussels.

Eric Dautriat is Chevalier de la Légion d'Honneur.

THE CEAS TECHNICAL AWARD

The CEAS Technical Awards have been created in order to recognise outstanding contributions, by individuals or teams, to the advancement of aerospace technology in Europe. The Technical Awards take the form of a scrolland are presented annually, by the President of CEAS or his representative, on the occasion of either the European Aerospace Conference or the appropriate CEAS Forum. The decision on the recipient of the Award is made by, and is at the sole discretion of, the CEAS Council upon recommendations put forward by the CEAS Specialist Groups.

The CEAS Technical Award 2016 is attributed to the Bluecopter Demonstrator

BLUECOPTER DEMONSTRATOR – ECO-EFFICIENT HELICOPTER DESIGN

Represented by:
Marius Bebesel, Airbus Helicopters, Head of Bluecopter Demonstrator (ETRD);
Team: Christian Wehle, Sebastian Günther, Thorsten Koenemann, Martin Weidenthaler, Martin Gambs, Alessandro D'Alascio, Sascha Schneider.

THE BLUECOPTER DEMONSTRATOR

The "Bluecopter Demonstrator" has been developed to prove the feasibility of a future eco-friendly friendly helicopter concept and to demonstrate "green" technologies in-flight. The main objectives are:

- Significant reduction in CO_2 Emission and Fuel Consumption up to 40%;
- Noise Reduction of around 10 EPNdB below the ICAO noise certification limits;
- Development of "transversal" technologies allowing for serial applications to all helicopter classes.

A major contribution to the improved efficiency and acoustic emission of the Bluecopter Demonstrator is provided by the newly developed rotor system. It includes an innovative five-bladed bearingless main rotor with increased diameter, new twist distribution and low tip speed design. Moreover it features an advanced Fenestron with an optimized blade and stator design.

Several measures were applied to reduce the drag of the aircraft. They include faring's for the main rotor and landing skids, a special design of the aft-body and a low-drag empennage including a "T-Tail" horizontal stabilizer.

An dedicated power management has been adopted in order to meet the ambitious CO_2 emission targets. It consist of an intelligent control system allowing to shut-off one engine for the parts of the mission were one engine delivers sufficient power.

Additional features like the active fin rudder and the "acoustic liner" for the Fenestron shroud have been applied to further improve the acoustic footprint of the demonstrator.

The Bluecopter has been successfully flight tested in 2014 and 2015 and achieved the set targets in terms of CO_2 emission and acoustic footprint.

The Bluecopter Demonstrator has been presented in the frame of the 2015 European Rotorcraft Forum and has been honored with the "Ian Cheeseman Best Paper Award".

The development of several Bluecopter technologies has been partially funded by the European Community's Seventh Framework Program (FP/2007-2013) for the Clean Sky Joint Technology Initiative (e.g. Reduction of airframe drag) and by the German Luftfahrtforschungsprogramm (LuFo) IV (e.g. Main Rotor developed in the frame of the ECO-HC, IKOROZ/LOCAR research projects).

THE BLUECOPTER DEMONSTRATOR - Top Benefits

The combination of all technologies including rotor systems, reduced drag and power management leads to a reduction of up to 40% in CO_2 emission and fuel consumption. This is a strong competitive advantage as this features are unequaled by competitors.

World champion in terms of acoustic footprint: around 10 EPNdB below ICAO certification limits. This is a strong competitive advantage as this features are unequaled by competitors.

Bluecopter technologies can be applied across Airbus Helicopters' product line reducing the environmental impact and increasing the competitiveness of the entire fleet.

THE BLUECOPTER DEMONSTRATOR - References

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8] Jacobs E.W. and Pollack M.J., "High Performance and Low Noise Characteristics of the Sikorsky S-76D™ Helicopter", 69th AHS, May 2013, Phoenix, Arizona.

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Curriculum Vitae

Dr. Marius Bebesel, Airbus Helicopters

Dr. Marius Bebesel has studied Physics at the Technical University of Munich. He performed his Diploma Thesis and the PhD at the former Daimler-Benz Aerospace Research Center on the topic "Active Structural Acoustic Control". Marius Bebesel started his professional career in April 1998 at Airbus Helicopters (former Eurocopter). After different functions in General Engineering and Military programs he worked more than 7 years as a Program Manager for Research and Innovation. Since 2011, Marius Bebesel is the Head of the Bluecopter Demonstrator Project being in charge of developing and validating in-flight eco-efficient technologies for future Helicopters.

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CEAS-EASN MEMORANDUM OF UNDERSTANDING

Between The Council of European Aerospace Societies (hereinafter referred to as CEAS) and The European Aeronautics Science Network Association - 98 Rue du Trône 1050 Bruxelles – Belgium (hereinafter referred to as EASN)

Preamble

The "Council of European Aerospace Societies" (hereinafter CEAS) existing under the Belgium Law, having its registered office at 98 Rue du Trône, 1050, Bruxelles, Belgium, represented by its president Fred Abbink,
and
the "EUROPEAN AERONAUTICS SCIENCE NETWORK» (hereinafter EASN), established and existing as a non-forprofit Association (AISBL) under the laws of Belgium, having its registered office at 98 Rue du Trône, 1050, Bruxelles, Belgium, represented by its chairman Prof. Spiros Pantelakis.
Both hereinafter referred to as the "Parties", have agreed to establish the Memorandum of Understanding (MoU) between them based on the interest of both Parties to intensify the cooperation in aeronautical science and technology.

PURPOSE

This MoU is intended to serve for the development of a mutually beneficial scientific, technological and organizational cooperation between the Parties in aeronautical activities, promotion of developments in aeronautics and popularizing the achievements and research in all areas of aeronautics.

SCOPE OF COOPERATION

Cooperation under this MoU may include, but not be limited to the following fields of aeronautical research and industrial applications:
(1) Mutual exchange of information about future activities in aeronautics
(2) Mutual exploitation of newsletters, bulletins and other means of reaching the respective communities for publishing news of interest to the European Aerospace community
(3) Coordination of activities and development of streamlined policies with respect to important issues and challenges raised by European Commission, such as the framework programmes, and other European bodies such as the Joint Technology Initiatives.
(4) Coordination, mutual support and encouragement of cross-attendance to the scientific conferences and events of the two Parties (CEAS Air & Space conference and EASN Workshops and conferences) as well as cooperation concerning the publication the respective scientific papers.
(5) Joint organization of conferences and workshops on specific topics of mutual interest
(6) Joint organisation and promotion of students events to support aducation and training of students in aeronautics


The CEAS-EASN MoU's signing ceremony, Barcelona, 6 March 2016. On the left, CEAS President Fred Abbink; on the right, Zdobyslaw Goraj, Vice Chairman of EASN, representing Spiros Pantelakis, Chairman of EASN.

(7) Joint participation in Specific Coordination and Support Actions in the frame of national and international funding schemes and programmes;
(8) Encouraging of scientists to publish the outcome of their research in the CEAS Aeronautical and Space Journals and in the EASN supported journals.
Other cooperation areas may be defined jointly by the Parties and will be notified as an amendment to this MoU.
Nothing contained herein shall obligate one party to cooperate with each other exclusively but shall be understood as a mutual understanding to collaborate.
Both Parties will nominate their representatives being responsible for contacts and smooth realization of this MoU and its specific issues.

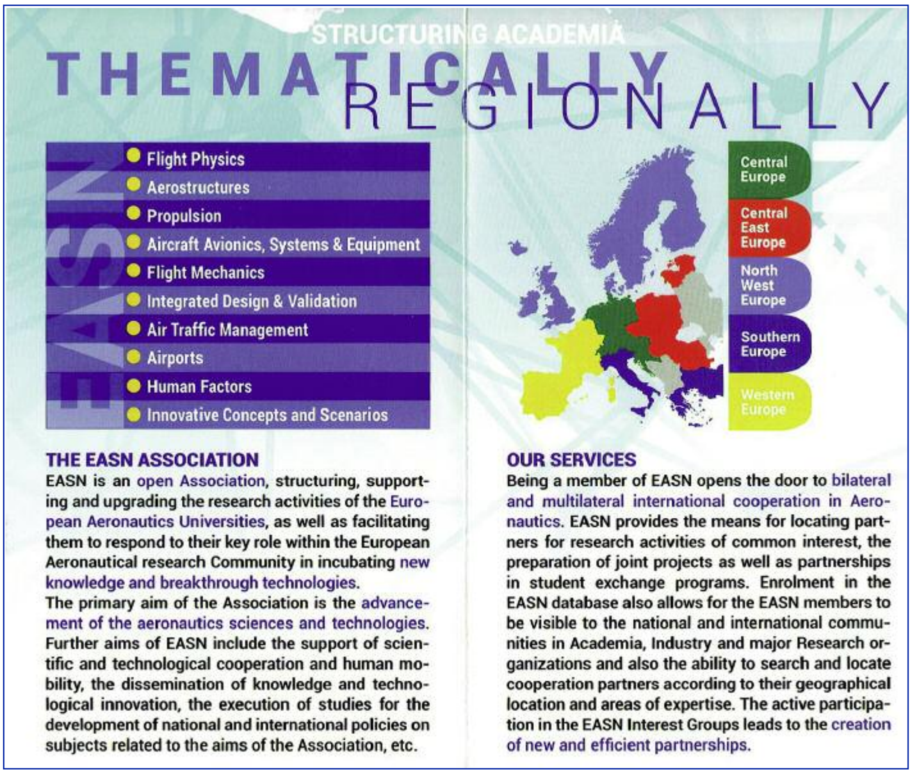
FINANCING

Cooperation on the basis of this MoU shall not involve the exchange of funds unless otherwise mutually agreed by the Parties in writing prior to the start of the activities.

CONFIDENTIALITY

(1) All related information and data obtained within the scope of the MoU communicated between the Parties and marked as being confidential is confidential information vis-a-vis third parties. It can only be communicated to third parties with the prior written consent of the Party having generated such information. It is only open for use within "CEAS" and "EASN".
(2) These paragraphs are also applicable on reports being produced by "CEAS" or "EASN" within the scope of research cooperation mentioned above and using confidential information of the other Party.

Entry into force, duration and termination of the Memorandum of Understanding



(1) This MoU will enter into force on the date of its signature by both Parties and shall remain in force for an initial period of ten years. It shall be tacitly extended for successive periods of three years. Each Party may terminate the MoU upon six months' written notice to the other Party prior to the interruption of the MoU.
(2) The implementation of this MoU, or any supplemental agreements or work plans, will be made in accordance with the articles of this MoU and shall be agreed upon and entered into force as either independent contract or separate agreement signed by both Parties.
(3) Amendments to this MoU may be made at any time, but must be confirmed in writing by both Parties.
In witness whereof the undersigned, duly authorized thereto, have signed the present Memorandum of Understanding in two original copies in English language all the two original copies being equally authentic.

For CEAS
Fred Abbink,
CEAS President

For EASN
Spiros Pantelakis,
EASN Chairman

ABOUT THE CEAS AERONAUTICAL AND SPACE JOURNALS

Dr.-Ing. Cornelia Hillenherms

Scientific Publications by CEAS: The CEAS Aeronautical Journal & the CEAS Space Journal

The CEAS Aeronautical Journal and the CEAS Space Journal were created under the umbrella of CEAS to provide an appropriate platform for excellent scientific publications. The German Aerospace Center (DLR) and the European Space Agency (ESA) support the Journals.
The CEAS Aeronautical Journal is dedicated to publishing high-quality research papers on new developments and outstanding results in all areas of aeronautics-related science and technology, such as flight physics, aerodynamics, propulsion, structures and materials, flight mechanics, aeroelasticity, aeroacoustics, air transport system, and air traffic management. Reports on new developments in design and manufacturing of aircraft, rotorcraft, engines, missiles and unmanned aerial vehicles are also welcome. The journal is intentionally open to basic research as well as applied science and technology, and it supports the transfer of scientific progress into innovation. Regular features include original research articles and review papers.
The CEAS Space Journal is devoted to publishing new developments and results in all areas of space-related science and technology, including important spin-off capabilities and applications as well as ground-based support systems and manufacturing advancements. Also of interest are (invited) in-depth reviews of the status of development in specific areas of relevance to space and descriptions of the potential way forward. Typical disciplines of

interest include mission design and space systems, satellite communications, physical fluid dynamics, aerothermodynamics, environmental control and life support systems, guidance, navigation and control, mechanisms, propulsion, power, robotics, structures, materials, testing and thermal issues.

As such the journals disseminate knowledge, promote aerospace research particularly in Europe, e.g. from current EU framework programmes, and foster the transfer of knowledge into practice.

In 2015, authors from 16 / 15 different (also non-European) countries have submitted 88 / 65 manuscripts to the CEAS Aeronautical / Space Journal. Four issues of each journal with a total of 43 / 32 articles have been published. At present, the journals are indexed in, among others, SCOPUS, Google Scholar, EI-Compendex, SCImago, OCLC, Summon by ProQuest.

Journal subscription rate for members of CEAS member societies: 60 €/year (excl. VAT).
http://link.springer.com/journal/13272 &
http://link.springer.com/journal/12567
(Journals' Homepages)
https://www.editorialmanager.com/canj &
https://www.editorialmanager.com/ceas (Paper Submission)

Here below is a summary of the articles published at CEAS Journals (and links to their respective web pages). Please, note that the Space and Aeronautical second Journal Issues of this year have been recently published.

CEAS Aeronautical Journal: Description and Full list

- **Volume 1** (September 2011, 6 articles): CEAS-Aeronautical-Vol1
- **Volume 2** (December 2011, 29 articles): CEAS-Aeronautical-Vol2
- **Volume 3**, Iss 1 (April 2012, 9 articles): CEAS-Aeronautical-Vol3 Iss 1
- **Volume 3**, Iss 2-4 (December 2012, 4 articles): CEAS-Aeronautical-Vol3 Iss 2-4
- **Volume 4**, Iss 1 (April 2013, 14 articles): CEAS-Aeronautical-Vol4 Iss 1
- **Volume 4**, Iss 2 (June 2013, 6 articles): CEAS-Aeronautical-Vol4 Iss 2
- **Volume 4**, Iss 3 (September 2013, 8 articles): CEAS-Aeronautical-Vol4 Iss 3
- **Volume 4,** Iss 4 (December 2013, 8 articles): CEAS-Aeronautical-Vol4 Iss 4
- **Volume 5**, Iss 1 (March 2014, 8 articles): CEAS-Aeronautical-Vol5 Iss 1
- **Volume 5**, Iss 2 (June 2014, 8 articles): CEAS-Aeronautical-Vol5 Iss 2
- **Volume 5**, Iss 3 (September 2014, 11 articles): CEAS-Aeronautical-Vol5 Iss 3
- **Volume 5**, Iss 4 (December 2014, 11 articles): CEAS-Aeronautical-Vol5 Iss 4
- **Volume 6**, Iss 1 (March 2015, 13 articles): CEAS-Aeronautical-Vol6 Iss 1
- **Volume 6**, Iss 2 (June 2015, 13 articles): CEAS-Aeronautical-Vol6 Iss 2
- **Volume 6**, Iss 3 (September 2015, 9 articles): CEAS-Aeronautical-Vol6 Iss 3
- **Volume 6**, Iss 4 (December 2015, 10 articles): CEAS-Aeronautical-Vol6 Iss 4
- **Volume 7**, Iss 1 (March 2016, 11 articles): CEAS-Aeronautical-Vol7 Iss 1
- **Volume 7**, Iss 2 NEW (June 2016, 12 articles): CEAS-Aeronautical-Vol7 Iss 2

CEAS Space Journal: Description and Full list

- **Volume 1** (September 2011, 9 articles): CEAS-Space-Vol1
- **Volume 2** (December 2011, 10 articles): CEAS-Space-Vol2
- **Volume 3**, Iss 1-2 (June 2012, 6 articles): CEAS-Space-Vol3 Iss 1-2
- **Volume 3**, Iss 3-4 (December 2012, 2 articles): CEAS-Space-Vol3 Iss 3-4
- **Volume 4**, Iss 1-4 (June 2013, 6 articles): CEAS-Space-Vol4 Iss1-4
- **Volume 5**, Iss 1-2 (September 2013, 6 articles): CEAS-Space-Vol5 Iss1-2
- **Volume 5**, Iss 3-4 (December 2013, 13 articles): CEAS-Space-Vol5 Iss3-4
- **Volume 6**, Iss 1 (March 2014, 7 articles): CEAS-Space-Vol6
- **Volume 6**, Iss 2 (June 2014, 4 articles): CEAS-Space-Vol6 Iss2
- **Volume 6**, Iss 3-4 (December 2014, 3 articles): CEAS-Space-Vol6 Iss3
- **Volume 7**, Iss 1 (March 2015, 6 articles): CEAS-Space-Vol7 Iss1
- **Volume 7**, Iss 2 (June 2015, 16 articles): CEAS-Space-Vol7 Iss2 See open access articles
- **Volume 7**, Iss 3 (September 2015, 6 articles): CEAS-Space-Vol7 Iss3
- **Volume 7**, Iss 4 (December 2015, 6 articles): CEAS-Space-Vol7 Iss4
- **Volume 8**, Iss 1 (March 2016, 7 articles): CEAS-Space-Vol8 Iss1
- **Volume 8**, Iss 2 NEW (June 2016, 6 articles): CEAS-Space-Vol8 Iss2

Aerospace Europe 2017 Conference

(6th CEAS Air & Space Conference)

Organized by AAAR - The Aeronautics and Astronautics Association of Romania on behalf of CEAS
PARLIAMENT of ROMANIA, 16th-20th October 2017
with the contribution of ECCOMAS, EUROMECH, EUROTURBO, ERFCOTAC, ACARE, EREA, EDA, EASA, EUROCONTROL, EASN

The Aerospace Europe CEAS 2017 Conference brings together academic, research, industry and operator representatives for a fruitful date exchange of the latest ideas and developments in European aeronautics and aerospace.

The Council of European Aerospace societies CEAS comprises the European national aerospace societies, and one Russian research institute involved in every aspect of aeronautics and space, including academia, research, industry, operators and MRO organizations. The aim for the Aerospace Europe 2017 Conference is to create a unique opportunity for knowledge dissemination in aeronautics where east meets west.

The conference is supported by the EU E-Caero2 project and its partner societies ECCOMAS, EUROMECH, EUROTURBO and ERFCOTAC, that will organize special sessions in their field of expertise. Aerospace Europe will furthermore offer the 2 major EU Joint Technology Initiatives CleanSky and SESAR project partners a platform for sharing their research and development results. Academic research and its application potential will be presented in dedicated sessions under responsibility by EASN.

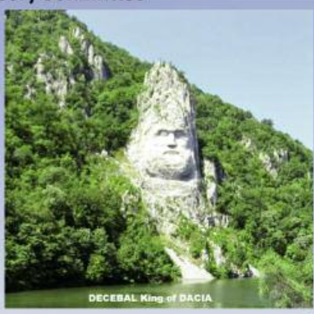
The Aerospace Europe Program Committee, with major support of all member societies, local organizers, EREA, EDA, EASA, EUROCONTROL and EASN will safeguard the scientific and technical quality of papers to be presented by reviewing applications.

For all those involved in the aeronautical or space fields, we therefore wish to invite you to be our guests at the conference.

The principal channels for the publication of selected high quality papers are the two journals reviewed according to Springer's procedures: CEAS Aeronautical Journal and CEAS Space Journal. Selected conference papers will be published in the CEAS Journals as well as in the Aeronautical Journal of the Royal Aeronautical Society.

First Call for Papers has been published and it includes all the details of the conference on the web site: **www.ceas2017.org**

Aerospace Europe Advisory Committee



Local coorganizers:

COMOTI ROMANIAN RESEARCH & DEVELOPMENT INSTITUTE FOR GAS TURBINES

rosa

INCAS - NATIONAL INSTITUTE FOR AEROSPACE RESEARCH "ELIE CARAFOLI"

CEAS 2017 CONFERENCE

Organization Committee

It is composed of AAAR members: Dr Valentin Silivestru, President – Prof. Ion Fuiorea, Local Organizing Responsible – Prof. Virgil Stanciu, Academia Responsible - Dr Jeni Popescu, Committee Secretariat – Dr Cleopatra Cuciumita – Dr Valeriu Vilag – Dr Bogdan Gherman – Dr Valeriu Dragan.

Programme Committee

- Christophe Hermans , NVvL, NLR/DNW
- Luis Braga da Costa Campos, OE/LAETE, Instituto Superior Técnico Lisbon
- Eike Stumpf, DGLR, RWTH Aachen
- Helmut Toebben, DGLR, German Aerospace Centre (DLR)
- Christian Breitsamter, DGLR, TU Munich
- Gianfranco La Rocca, NVvL, TU Delft
- Pierre Bescond, 3AF
- Zdobyslaw Goraj, PSAA, Institute of Aviation, Warsaw
- Tomasz Goetzendorf-grabowski, PSAA, Warsaw University of Technology
- Nina Voevodenko, TsAGI, Moscow
- Ion Fuiorea, AAAR, COMOTI
- Valentin Silivestru, AAAR, COMOTI
- Virgil Stanciu, AAAR, Faculty of Aerospace Engineering Bucharest
- Tomas Melin, FTF, Linköping University
- Constantin Rotaru, AAAR, Henri Coanda Academy
- Octavian Pleter, AAAR, Faculty of Aerospace Engineering Bucharest
- Petrisor Parvu, same as above
- Florin Frunzulica, same as above
- Laurentiu Moraru, same as above
- Cristina Pavel, same as above
- Mircea Boscoianu, Henri Coanda Academy

The main CEAS2017 Conference Thematics

The conference aims to challenge new visions and trends both in aeronautics and space sciences & technologies according to its general theme: European Aerospace: Quo Vadis? All major areas consisting in the aerospace development matrix will be considered:

- Physics of flight, structures (theoretical, simulation, experimental and testing);
- Propulsion;
- Manufacturing & materials (including MRO);
- Guidance, control and ATO;
- Education and training (including licensing).

Topics

Topic areas to be covered by the PC are to a maximum extent aligned with the International Council of the Aeronautical Sciences (ICAS) approach for Aeronautics and the International Astronautical Federation(IAF) approach for space. Main topics to be dealt with are: **For Aeronautics:** Aeroacoustics – Aeroelasticity & Structural Dynamics – Air Transport Operations - Aircraft/Spacecraft Design – Aircraft Systems – Challenges of Environment - Flight Physics – Future Education and Training Needs – Guidance, Navigation and Control (GNC) - Integrated Logistics – Manufacturing Technologies – Propulsion – Remotely Piloted Aircraft Systems (RPAS) – Rotorcraft – Safety and Security - Structures and Materials – For Space: Advanced Manufacturing for Space Applications – Aerothermodynamics - Clean Space - Environmental Control & Life Support in Space ECLS – GNC – Mechanisms – Mission Design and Space Systems – Power – Robotics – Space Propulsion – Satellite Communications – Structures – Thermal.

Conference important milestones

The selection process will address to the extended abstracts of at least one full page (minimum 600 words) that can be uploaded on the platform via conference web site from the 20th of June 2016 until the 15th of October 2016, inclusively. Until the 20th of December 2016 the selected abstracts will be notified and the authors will be invited to submit the full 8 to 10-page papers following the same procedure until the 1st of July 2017.

The main milestones are:

- 20 June 2016 – The abstract uploading session was open
- 20 June to 15 October 2016 - Abstract uploading session
- 15 October 2016 – Deadline for abstract uploading session
- 16 October to 9 December 2016 - Abstract review and acceptance session
- 20 December 2016 - Abstract review results communication and full paper uploading invitation
- 1st of July 2017 - Deadline for full paper uploading session
- 15 July 2017 – Early bid registration deadline
- 16 – 20 October 2017 Aerospace Europe Conference

The **duly submitted papers** and presented at the conference will be integrally published in the conference proceedings. The session chairpersons will recommend the papers to be published as scientific articles, which will be edited according to Springer requirements, reviewed and published with respect to their thematic in:

- **CEAS Aeronautical Journal.**
- **CEAS Space Journal.**
- **The Aeronautical Journal edited by the Royal Aeronautical Society.**

Commercial papers will be rejected.

> *Note: The complete and final information will be published in the next CEAS Quarterly Bulletin (issue 3-2016 - date of distribution 1st of October). Besides the Web Site is from now permanently updated and can be regularly consulted: www.ceas2017.org*

AERONAUTICS AND ASTRONAUTICS ASSOCIATION OF ROMANIA

The Aeronautics and Astronautics Association of Romania (AAAR) springs into existence as a natural process emanant from an outstanding tradition marked by illustrious Romanian pioneers in aeronautics and space fields as: Hermann OBERTH, Traian VUIA, Henry COAND , Ellie CARAFOLI, Aurel VLAICU.


Hermann OBERTH


Traian VUIA


Henry COANDĂ


Ellie CARAFOLI


Aurel VLAICU

The Aeronautics and Astronautics Association of Romania has been founded in 2006 by a group of aeronautics and astronautics enthusiast professionals, aiming at promoting the field of aerospace related activities. The main domains that the members belong and represent inside the association can be mentioned as:

- Academic;
- Research;
- Industry;
- Operators;
- Air Traffic Management;
- Maintenance, Repair Overhaul;
- Aeronautic National Authority.

The purpose of the Association is to reunite individuals and institutions interested in aeronautics and space, for professional, para-professional reasons or personal reasons. The actual number of AAAR members is over one hundred.

Since 2011 the Aeronautics and Astronautics Association of Romania is a full member of the Council of European Aerospace Societies CEAS.

The Association promotes the collaboration to other associations and foundations with similar goals, and seeks to attract investments and funding from Romania and from abroad.

The Aeronautics and Astronautics Association of Romania (AAAR) has the following objectives:

- To foster frequent contacts between its members, either of similar specialization, or activating in different fields;
- To develop a significant, in the broad sense, information source for aeronautics and astronautics, including scientific updates;
- To present and promote the aeronautics and astronautics related fields to authorities and the general public, to the benefit of the members;
- To provide a platform for the members to express their opinions and to advertise their work;
- To represent the members with respect to other scientific and technical associations and federations;
- To enhance the member's professional, scientific and technical reputation;
- To provide consulting for aeronautics and astronautics documentation elaboration;
- To organize and support conferences, symposia, seminars and other professional development activities in the field of aeronautics and astronautics;
- To publish journals, magazines, news bulletins and other informative publications and to foster mass-media cooperation to support and disseminate aeronautics and astronautics related ideas;
- To organize and manage fairs and exhibitions or other promotional activities in the field of aeronautics and astronautics;
- To enable the collaboration with other associations and foundations, with industrial partners and economic agents, with internal and international bodies, with similar European and world associations, either directly, or through their representatives in Romania.

ABOUT THE AAAR

AAAR organizes different professional events addressing both to its members and different partners from the country and abroad:

- The biennial International Conference NEW CHALLENGES IN AEROSPACE SCIENCES:
  - NCAS 1st edition, November 07-08, 2013;
  - NCAS 2nd edition, November 05-06, 2015.

- Promoting Aerospace Engineering Education. One of the main accomplishments of AAAR was closing the gap between the Faculty of Aerospace Engineering of University Politehnica of Bucharest and the aerospace industry:
  - Encouraging university- industry partnerships and the creation of new curricula, better suited to the expected future needs of the employers. AAAR members were instrumental in forging the accord signed in 2008 between the University Politehnica of Bucharest and the national air navigation services provider ROMATSA. Based on this 12 years partnership accord, two new and pragmatic programs of studies

NCAS 2nd edition, November 05-06, 2015

were created: Air Navigation Bachelor of Aerospace Engineering (4 Years) and Air Transport Engineering Master of Aerospace Engineering (2 Years);

– Convergence between the curricula and the syllabus of the academic education of aerospace engineers with the EASA Part-66 requirements for the maintenance personnel.

- AAAR policy on education led to the introduction for the first time in Romania of university courses such as Aeronautical Safety, Aeronautical Information and Exchange of Aeronautical Data, Air Traffic Management, Environmental Aviation, Aviation Noise.

- Involvement in the Volcanic Ash Crisis of 2010. Members of AAAR were involved in the ICAO EUR-NAT VATF (International Civil Organization Europe and North Atlantic Volcanic Ash Task Force), Paris, May 2010, and ICAO International Volcanic Ash Task Force IVATF, Montreal, 2011-2012. The research results of the AAAR members were relevant in defining the volcanic ash impact problem on aeronautical safety as a four-dimensional problem (concentration, time of exposure, particle size distribution, air breathing flow) instead of a two-dimensional problem (concentration - time of exposure), the theory that prevailed at the time. The results were used by EURCONTROL to issue a white paper on the impact of volcanic ash on air traffic management.

- Air Navigation Convention AAAR members were involved in the creation and the support for the annual Air Navigation Convention. The first edition was held in Bucharest, in March 2010, and the latest in March 2016. Air Navigation Convention is an international conference, with participation of aviation professionals from many countries: Romania, United Kingdom, United States, France, Belgium, Netherlands, Spain, Portugal, Germany, Austria, and Switzerland. Prestigious organizations have been represented at almost every annual session: ICAO, EUROCONTROL, Romanian Air Navigation Services Provider ROMATSA, Romanian national flag carrier Tarom, the Civil Aviation Authority of Romania, Aloft Group, Imperial College of London, Centre for Transport Studies.

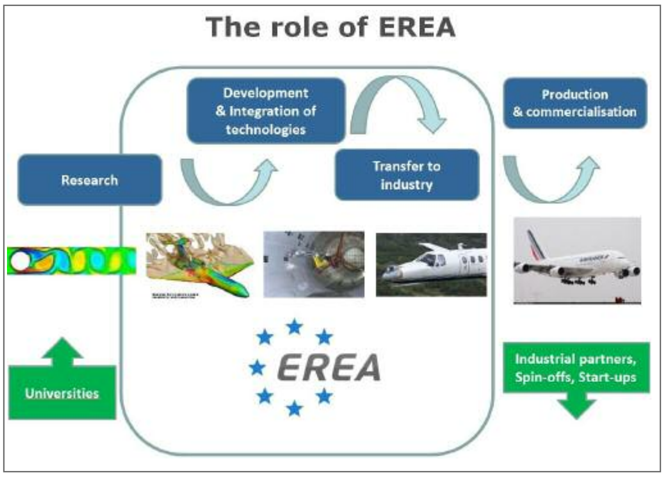
FUTURE SKY PREPARING FOR THE FUTURE OF AVIATION

Jean-Pierre Sanfourche[1]

ABOUT THE EREA

EREA, the association of European Research Establishments in Aeronautics, is a non-profit organisation whose members are Europe's most outstanding research centres in the field of aeronautics and air transport. These organisations joined EREA in order to:

- Promote and represent joint interests;
- Intensify cooperation in the field of civil and military aeronautics and space-related research;
- Improve and intensify cooperation with third parties in the field of aviation;
- Facilitate integrated management of joint research activities, thus contributing to Europe's role as a global player in aeronautics.



PRESENT EREA MEMBERS

12 Full Members: CEIIA (Portugal) – CIRA (Italy) – DLR (Germany) – FOI (Sweden) – ILOT (Poland) – INCAS (Romania) – INTA (Spain) – NLR (The Netherlands) – ONERA (France) – VKI (Belgium) – VZLU (Czech Republic) – CSEM (Switzerland).

Associate Members, Affiliate Member & Strategic Partner: AIT (Austria) – AFIT (Military Aeronautics Research Centre of Poland) – TsAGI (Russia).

ABOUT THE FUTURE SKY PROGRAMME

Future Sky's overall goal is "**Twenty-Four/Seven**". This concept describes the full airside mobility, 24 hours a day, 7 days a week, resilient against any impacts e.g. from disruptive events like extreme weather conditions, in line with the goals laid by Flightpath 2050.

Although Future Sky finds its origins in the alignment of the research programmes of the national research Establishments, industry and university are explicitly invited to join it.

The European Commission will be involved not only through the funding mechanisms for Future Sky under Horizon 2020, but also in giving guidance for the next set-up and management of the Joint Research Initiative (JRI).

COLLABORATION OF NATIONAL RESEARCH ESTABLISHMENTS

The national research establishments that have gathered in EREA are all committed to contribute to Future Sky. For each joint research programme, the national research establishments will draft of roadmap for the next 5 to 7 years. The research establishments will map out which areas of a certain research theme are covered by their institutional research programme and where they see opportunities for sharing results and joint planning. The roadmap will also identify certain research gaps that are not or insufficiently covered by the national research programmes. These gaps will be tackled in a new European research project in which the research establishments will actively seek to collaborate with universities and industry.

The aim of Future Sky is to enhance collaboration between establishments and to involve the aviation research community as a whole to prepare for a competitive European aviation industry in 2050.

HOW FUTURE SKY CONTRIBUTES TO FLIGHTPATH 2050?

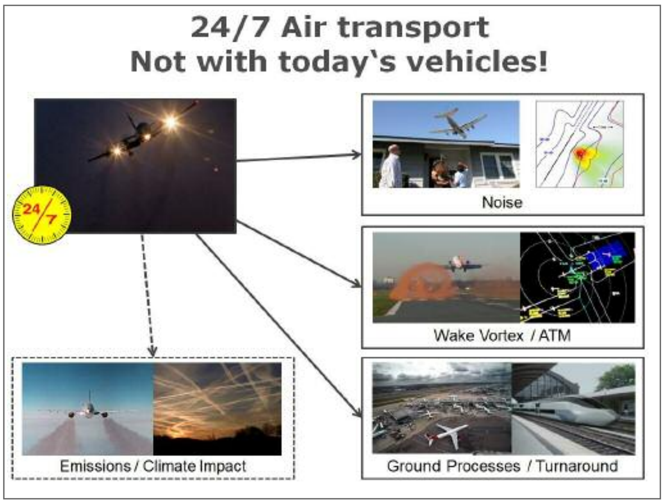
It is necessary to condense what a Future Sky should be and to define a common long-term goal.

Based on ACARE and national strategies, 24/7 air transport:

- Combines the most far reaching goals of Flightpath 2050, striving for a substantial increase in performance, safety, competitiveness and acceptance;
- Is a synonym for maximum mobility and maximum modal embedment with minimum impact on the environment.

In order to fulfil Flightpath 2050 goals, European aviation research needs to target the complete Air Transport System (ATS) and to apply a full life cycle engineering approach, covering the full Research & Innovation (R&I) chain. The ACARE-SRIA envisages putting in place attractive and efficient research instruments, which ensure continuity between research or promising breakthrough concepts, their validation by focused RTD (Research and Technology Development) actions and finally their demonstration in an integrated environment.

Furthermore Flightpath 2050 and the ACARE-SRIA are proposing to establish multidisciplinary clusters of excellence for Research & Innovation to achieve common technology goals (outcome of common strategy to address issues). They ensure that the appropriate organisations are tackling activities at the appropriate level in the innovation chain. For demonstration activities on system level the well-known JTI concept led by industry has been proved to be successful.



Future Sky will combine the power and the capacities of the research establishments in EREA into multidisciplinary clusters of excellence proposed by Flightpath 2050 in order to ensure appropriate mid- and long-term research on lower TRLs (Technology Readiness Levels) complementing the industrial lead demonstration activities on higher TRLs.

Future Sky will address the 24/7 Air Transport System (ATS) as outlined in Flightpath 2050.

Four 24/7 Enablers – the four pillars of JRI, so-called TSE, under Future Sky, will be started one by one every two years: TS1, TS2, TS3 and TS4.

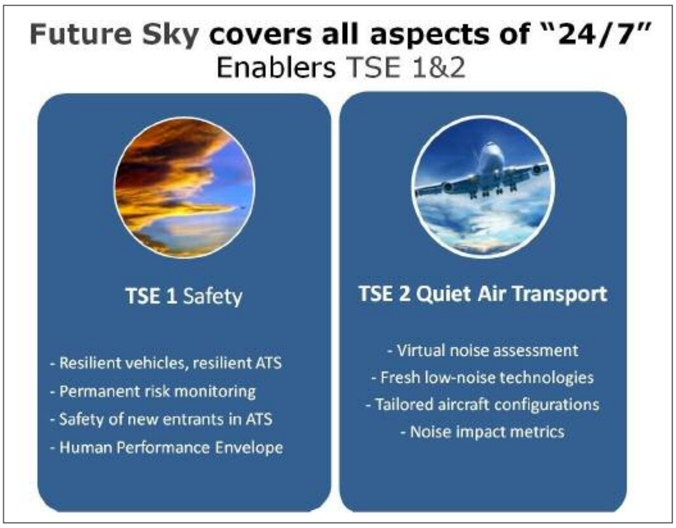
TS1 - Safety

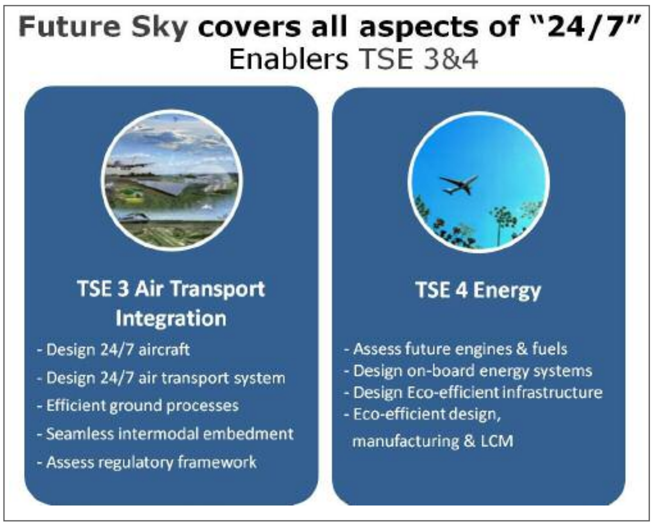
EREA takes responsibility to provide the research and validation needed to guarantee in the short term safety rules, regulations, measures and standards, and in the long term to fulfil the Flightpath 2050 goals in safety.

TS2 - Quiet Air Transport

Quiet operating air transport vehicle, serviceable from small airfields, make use of ultra-quiet or hybrid-electrical engines, use flow control for maximum lift on short runways, allow fast boarding, fuelling, catering.

TS3 - Air Transport Integration





The Air Transport System ATS aspects shall be addressed by this Joint Research Programme. A special focus will be on the insertion of UAVs in the civil ATS; this JRI shall define the base to fulfil the corresponding goal of Flightpath 2050.

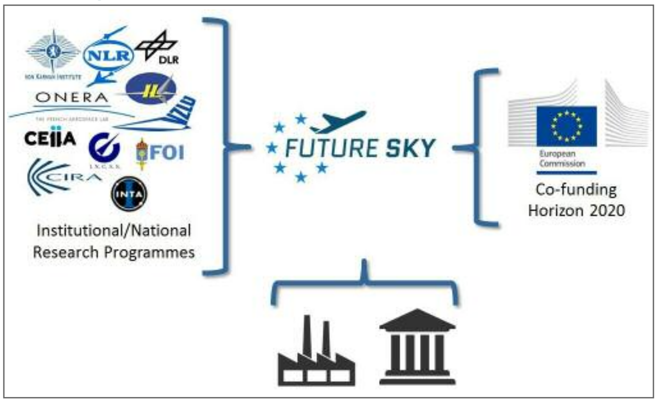
TS4 – Energy

As a consequence to TS2 and TS3 asking for new energy concepts, TS4 will address the energy system on-board and on-ground.

Only with four elements, the whole 24/7 goal can be gained, and the complete impact of aviation to the environment can be analysed.

>It is foreseen that Future Sky will be a part of the EC's programme for Research & Innovation Horizon 2020. For each Joint Research Programme or "TSE" in which the research establishments will coordinate their institutional programmes and at the same time set up open research projects to fill the gaps of research roadmap, a European contribution of about 25 Million Euro is foreseen.

Funding and Participants



About Future Sky Safety

Addressing the priorities of the ACARE Strategic Research Agenda and EASA's European Aviation Safety Plan, with an overall 40 M€ budget (25 M€ EU), nine technical projects are already running covering four themes: (1) new protections against accidents; (2) strengthening the capability to manage risks; (3) building ultra-resilient systems and operators; (4) building ultra-resilient vehicles.

How to Join Future Sky?

Although Future Sky is an initiative of EREA, the Joint Research Initiative is aiming to go well over the boundaries of EREA members: a contribution from all the aviation research stakeholders is needed to achieve the ambitious goals of the programme. Apart from the coordination of national institutional research programmes, each Joint Research Programmes will define research projects open to all. On: www.futuresky.eu

you will find the latest information on Future Sky, its research programmes and contact information.

[1]Paper written by J.-P. Sanfourche on the basis of the EREA presentation at Aerodays 2015 (London, October 2015) given by Paul Eijssen (NLR).

CLEAN SKY/AIRBUS FLIGHT LAB TAKES OFF

03/06/2016

The first flight of the Airbus Flight Lab (A320 MSN1) took place on 3 June.

The aircraft features a number of innovative electrical technologies developed within Clean Sky's SGO Systems for Green operations (SGO) platform, including the Electrical Environmental Control System (Liebherr), Electrical Power Centre (Airbus/Thales), Scoop Inlet with acoustic and anti-ice systems (Sandit consortium/Airbus) and the Primary In-Flight Icing Detection System (Zodiac).

The flight test campaign will evaluate robustness, performance and integration of these technologies over the aircraft operating envelope. Preliminary results are promising.

J.-P. S. From information provided by Cleansky JU.

Clean Sky 2 high-speed compound helicopter demonstrator making good progress

It has been an exciting year so far for Airbus Helicopter's high-speed compound helicopter demonstrator 'LifeRCraft', which is being developed under Clean Sky 2. The pre-design phase, involving all core partners, has now been completed, and recently a mock-up of the break-through airframe design was tested in a windtunnel at an Airbus facility. These tests confirmed the viability of the chosen design in terms of efficiency, sustainability and performance, and a preliminary review of the overall design is expected to take place before the end of 2016. The ultimate objective of the demonstrator is to meet future requirements for increased speed, better cost-efficiency, and reductions of emissions and noise footprint. Flight tests are expected to start in 2019.

"We are honoured to be carrying out this project on behalf of the Clean Sky Joint Undertaking and the large number of European companies who are taking part in the development. Our ambition is to become the benchmark of the rotorcraft industry, and as such we are willing to drive a bold vision for the future of helicopter transportation," said Jean-Brice Dumont, Airbus Helicopters Chief Technical Officer. He underlined the importance of the demonstrator in finding the best balance between cost-efficiency, sustainability and mission performance, and the aim to pave the way for future applications such as emergency missions by breaking the cost barrier usually associated with increased speed and range.

Ron van Manen, Clean Sky 2 Programme Manager, highlighted that "The LifeRCraft Demonstrator project in Clean Sky 2 will pull together capabilities from across the European Research Area, addressing technology gaps in systems, structures and overall design and demonstrating the viability of a compound rotorcraft design that can bring a fundamentally new combination of payload / range / speed to the aviation market.

In particular where a rapid response or a key range requirement exists (such as in disaster relief, medical evacuation or search & rescue) this aircraft concept can bring important benefits to the public and open new market opportunities that will strengthen Europe's already formidable competitive position in the vertical life aviation sector."

J.-P. S. From information provided by Cleansky JU.

SESAR partners validate low-noise landing procedures

SESAR members and partners, Deutsche Lufthansa AG, DFS Deutsche Flugsicherung GmbH and Fraport AG, are jointly beginning tests of new satellite-based approach procedures at Frankfurt Airport. The aim of these tests is to prove the advantages of curved and steeper approach procedures in the vicinity of airports. The trial period begins in May and will run until August. The tests are part of the Augmented Approaches to Land (AAL) SESAR demonstration project.

Under real conditions, the "required navigation performance to instrument approach (RNP to xLS)" procedure will be tested in Frankfurt. These satellite-based curved approaches guide the aircraft very accurately on both precision approach systems that are available at Frankfurt Airport: The instrument landing system (ILS), which has been proven for decades, and the new system of the future ground-based augmentation system (GBAS). In future the new procedure should help to enable flying in curves in the vicinity of the airport to become more accurate and to further increase aircraft flight track adherence. The lateral course of the new approach procedures are strongly orientated to the low-noise segmented approach procedures known for years. The new feature is that for the first time the north-west runway will be connected to this procedure. Additionally, the suitability of the procedure in an environment of high traffic density will be investigated at Frankfurt Airport. During test flights the criteria "flight track adherence" and "noise emission" will be especially intensively observed and subsequently evaluated. Besides Bremen and Zurich, Frankfurt is the only European airport to this new procedure during testing. All three airports have the new GBAS satellite-based precision landing system.

Lufthansa will use aircraft models A380, B747-8 as well as three upgraded GBAS-capable A319 for the tests. In addition in a few days a test aircraft from the company

Honeywell will fly the new routes. The corresponding flight procedures for the test were developed by the DFS Deutsche Flugsicherung GmbH and have already been submitted to the Aircraft Noise Commission. Throughout the entire duration of the tests Fraport will supervise the approach procedures with fixed and mobile flight noise monitoring stations and will subsequently evaluate the data.

With the start of the tests of the new procedures by Fraport, DFS and Lufthansa, the international pioneering role of Frankfurt Airport in research and further development of active noise protection will once again be underlined. The partners involved hope to make an important contribution to greater efficiency and to quieter landing and take-off procedures with this investigation.

Co-funded by the SESAR Joint Undertaking, the AAL project brings together the following companies: NetJets Europe, EBAA, Lufthansa, Swiss, Honeywell Aerospace and Elbit Systems, DFS Deutsche Flugsicherung GmbH, ANS CR, Skyguide with support from DLR and Airbus Pro Sky and DSNA, Dassault Aviation, Airbus, Perigueux, Bergerac, Bordeaux, Ostrava and Bremen airports and large airports (Frankfurt and Zurich Airports).

J.-P. S. From information provided by SESAR JU

INTEGRATED ANTI-MISSILE AIR DEFENCE (IAMD) IN EUROPE: COMPLEXITY AND CONSENSUS ?

Luc DINI, Co Chairman of the 3AF Conference on Missile Defence

GENERAL BACKGROUND

Air defence and anti-ballistic missile defence have been the subjects of programmes and debates within NATO for more than 10 years. They regularly bring about adjustments to the evolution of the strategic context of threats. The reality of air threats and of short range ballistic missiles is today indisputably present in Europe's exterior zones and still at the door of NATO territories. There must be a consensus. While NATO is equipped with air defense command systems which can be extended to anti-missile defense, research into a consensus on integrated air & anti-missile defense seems probable. It is attainable if there are equal and measured contributions from the USA and Europe, with participation from European industry in programmes that Europe has already invested in. In a context of a budgetary discipline but also of security risks, Transatlantic and European industry can and must provide solutions for the evolution of command systems and reinforced interoperability of defence systems. For example, concepts of networking sensors and weapons systems could be envisaged in the short term as a factor of improvement of the interoperability between systems but also cooperation between the industries.

PERCEPTION OF THREATS AND PRIORITY BALANCE BETWEEN THEATRE AND TERRITORY DEFENCE

In view of the generalization of air and missile threats Europeans must put their differences aside in order to find a consensus on an integrated anti-missile air defence (IAMD) all whilst preserving the sovereignty of airspaces and of national territories. At the same time, the command and control of the air component of NATO allows for the conducting of coordinated air operations interfacing with national air control systems (ARS).

How do you defend yourself when facing threats which we call 'Air-Breathing Propulsion or Air-Breathing' as well as ballistic threats, which together form, what we call in Missile Defence Jargon, 'a dual threat'? Furthermore, how do you preserve or even reinforce the balance between collective and national contributions to NATO and the role played by the European industry, all whilst facing budgetary pressures which weigh on European defence budgets? How do you assure that an integrated NATO command with a consultative process between nations for the planning and the rules of engagement of long range weapons systems against threats which fly over Europe? These are the many challenges to take up!

The development of the ALTBMD (Active Layered Ballistic Missile Defence) defence architecture and of Theatre anti-Missile Defence in NATO, started gradually in 2005, with the first Theatre operational capacity called 'INCA' an INitial CApacity which was declared operational in 2011, then a capacity for an Interim Ballistic Missile Territory Defence (IBMD) declared operational in 2012 (Chicago Summit). Its objective is the gradual integration of an anti-missile defense architecture composed of various layers of defence (high and low altitude) for protecting troops in operation as well as sites of vital importance against a dual threat on exterior theatres of operation. This dual threat is made up of intermediate range ballistic missiles (range of up to 3000 km) and 'Air-Breathing' air threats such as cruise missiles or fighter planes.

ABOUT ANTI-ICBM DEFENCE

Nevertheless, since the start of the 2000s studies on defence of territories and of population have equally been pushed by NATO in order to fight against an emerging ballistic threat, the long range ICBM type missile. Although there is an aim for potential spreading in certain countries, this ICBM threat was not seen as a priority in Europe, whereas it is considered more probable in the USA. To this end, the USA have deployed a ground anti-missile system 'GMDS' to counter this threat, based mainly on the long range Ground Based Interceptors (GBI) and anti-'IBCM' across 2 American sites. Without a global consensus, either on the spectrum of the threat or the priorities in terms of costs and budget, there has not been a willingness to invest in a defence system which is judged to be very expensive for anti-'ICBM' defence of Europe. The '3rd anti-missile site in Europe' project, supposed to complement the 2 American sites, was an example of this difference in the assessment of priorities in terms of threats and the manner of protection. Also, the American project was almost uniquely focused on the protection of the American continent by a third advanced site in Europe, whereas the coverage of Europe remains partial in terms of ICBMs, considered as a non-priority threat by Europeans, then finally by the USA. The project was therefore abandoned in 2009.

THE EPAA PROJECT

The political approach has changed radically with the regional defence project 'European Phased Adaptive Approach' (EPAA) proposed by the Obama administration. This was a new start for the cooperation on anti-missile defence in Europe based on the high altitude layer of the ALTBMD; thus a synergy appeared possible between the

American systems - Aegis Frigate fitted with SM3 missiles, made also in a land version, Aegis 'ashore' - (Figure 1), the NATO and American Command Centres and the European IAMD (integrated anti-missile and air defence) systems. The EPAA also confirmed the deployment of American ground based anti-ballistic missile defense systems combined with high altitude systems (Aegis ashore missile SM3) and dual low altitude such as the Patriot (Figure 2), American or European (German and Dutch) systems or the French-Italian SAMP/T (Figure 3). In effect, it is important to ensure the defence of sites against more conventional or short range ballistic threats which target the most exposed Alliance Zones. For example, the SAMP/T was designed at the start, with its Arabel Fire-Control radar and the Aster 30 missile, for a 360° protection against cruise missiles and sea-skimmer missiles, including an equivalent naval version - SAAM system and PAAMS - (Figure 4). The EPAA project also allowed initially for delaying the situation with the Russians on the question of territorial anti-missile defence, while cooperation already existed between Russia and NATO on the interoperability of theatre anti-missile systems.

Figure 1: The Aegis system.

Figure 1.1: Radar SPY-1 of the Aegis system which operates in S band.

Figure 1.2: Radar AN-TPY2 of the Thaad in X band.

The 'AEGIS' is a combat system mounted on American destroyers which allows for the implementation of the exo-atmospheric SM3 missile with the AN-TPY2, conceived as a firing control radar of the Thaad system, which is dedicated to anti-ballistic missile, but also used in an alert radar mode in an advanced position (FBR), in order to allow a pursuit of ballistic missiles and allow for an engagement of the SM3 missile in a 'launch on remote' or 'engagement on remote' mode before the tracking of the assailant missile by the SPY 1 Fire control radar of the AEGIS.

Figure 2: The Patriot system.

Figure 2.1: Fire Control radar of the Patriot system.

Figure 2.2: Command & Control shelter of the system.

The Patriot system is a system of medium range low altitude ground based air and antimissile defense, conceived mainly for the fight against short range ballistic missiles. Existing since the 80s, it is now in a PAC3 version, equipped with sectorial multi-function radar in C band (possibly with lateral antennae) and must be equipped with an improved missile called MSE. The PATRIOT system is 100% American, provided by Raytheon and Lockheed Martin.

Figure 3: The ground SAMP/T system and the naval versions.

Figure 3.1: Multi-Function Radar Arabel (Firing Unit)
Figure 3.2: Module of engagement (Firing Unit)
Figure 3.3: Module launcher
Figure 3.4: Firing of the Aster from a module launcher
Figure 3.5: Technology Pioneer Award awarded to the SAMP/T and the teams that contributed to the ATBM coordinated between the DGA Missile Test Launching Centre (Biscarrosse, France) and NATO.

The French-Italian weapons system SAMP/T (Surface-Air Moyenne Portée/Terrestre), by conception totally dual, responds simultaneously to conventional air threats and short range ballistic threats. The principles of SAMP/T are notably the defense of a 360° zone, its mobility and its aero-transportability in exterior theatres of operation. From conception to realisation 100% European, it is developed and produced by THALES (responsible for the Firing

Figure 3: The ground SAMP/T system and the naval versions.

Unit) and by MBDA (responsible for the Aster missile and the launchers) through the EUROSAM consortium, in cooperation with France and Italy. The SAMP/T system is in service in these two countries, providing a national contribution to the NATO anti-ballistic missile programme.

A SAMP/T battery comprises a firing control unit (Arabel multi-function radar) (Figure 3.1) and an engagement's module (Figure 3.2) and 3 to 4 launchers (Figure 3.3) armed with 8 Aster 30 B1 (Figure 3.4). The SAMP/T is in operational service in the French and Italian Air Forces. It was fired in 2013 with direct impact against a SCUD target coordinating with NATO via 'Liaison 16': a success for which it received the Technology Pioneer Award of 2015 (See Figure 3.5 and the dedicated article in the 3AF letter 17). The SAMP/T equipped with the Aster 30 B1 missile responds to the need of current and future anti-air missions which continue to evolve. At the end of 2015 a contract was formed between EUROSAM, Thales and MBDA for the development of the SAMP/T B1NT armed with the Aster 30 B1NT (equipped with a Ka band seeker for more precision) and a new firing unit to improve the performance and adaptation of the system to new operational constraints, one of which being the ballistic threat at a range of 1000km.

The SAMP/T is armed with a 360° capacity against supersonic diving and skimming missiles resulting in the conception of medium range ground to air family at the time ground and naval (see figure 4.1) benefiting from a high performing firing capacity against very fast targets including ballistics.

Figure 4: Other European Naval and Ground systems.

Figure 4.1: SAAM system with the MFR Arabel radar (band X) equipped onto the CDG aircraft and the Sawari frigates.
Figure 4.2: LRR / S1850 radar (Smart-l family in L band); an air surveillance radar on the Horizon frigates (Franco-Italian), T45 (UK), but also German, Danish and Dutch frigates…
Figure 4.3: MFR EMPAR radar of the French and Italian Horizon frigates (PAAMS System) in C band.
Figure 4.4: MFR SAMPSON radar of the T45 frigates in S band.
Figure 4.5: MFR Herakles radar (Figure 4.5a) in S band on the FREMM French frigates participating in maritime IAMD tests At Sea Demo 2015 (Figure 4.5b) for a detection mission and autonomous antiballistic missile pursuit compatible with its air defence mission.
Figure 4.6: X band MFCR radar of the demonstrator of the MEADS system, destined for the future German TLVS system.

The naval versions of the medium range weapons systems equipped with Aster missiles are adapted to different missions and naval platforms for France, Italy and Great Britain and non-European marines (KSA, Morrocco, Singapore). The systems are all armed with Aster 15 and/or Aster 30 missiles with the SAAM firing unit (Aircraft Carrier Charles de Gaulle (FR), Frigate Sawari2 (KSA) with the multifunction Arabel radar in band X (Figure 4.1), PAAMS for the Horizon Frigates (FR,IT) with surveillance radars LRR S1850/(of the smart-L in L band) (Figure 4.2), the MFR EMPAR radar in band C (Figure 4.3), and T45 with the S1850 radar and the MFR SAMPSON radar in band S (Figure 4.4). The FREMM frigates, armed also with the Aster missile, are equipped with the MFR Herakles radar (Figure 4.5) or Empar already used in Italy. We see that Europe contributes in multiple ways by its technologies to a radar capacity and multi-function and multi frequency firing unit, which includes as well the MFCR radar demonstrator in X band of MEADS, destined for the future German TLVS system (Figure 4.6).

The 'New Start Treaty' opened a new approach

By proposing new discussions on the 'New Start Treaty' agreement, and by opening a dialogue on antimissile defence by clearly separating field of intercontinental defence with medium range defence, derived from Theatre Defence , the Obama administration undertook an approach to dialogue which would set the tone of the 2010 NATO summit in Lisbon, following the NATO-Russia Summit. It is during this summit that NATO decided to seriously explore the possibility of a territorial anti-missile defence and cooperation with Russia, which in itself demonstrates that the proliferation of ballistic missiles is not limited to very short range ballistic missiles (although they are the most common).

The US EPAA

The US EPAA was therefore a novice approach because it changed the priority on the threat, taking into account the MRBMs – Medium Range Ballistic Missiles - (Phases 1 and 2), then the IRBMs – Intermediate Range Ballistic Missiles - (Phase 3), considering ICBMs – Inter Continental Ballistic Missiles - as a secondary threat (Phase 4 finally abandoned) facing Europe and NATO (according to the American BMD review at the start of 2009). It prescribes as well a mobile defense, reconfigurable, like Theatre Missile Defence, mainly naval. The principal decisions of Lisbon were reinforced in Chicago in 2012 with the declaration of the operational character of the NATO interim anti-ballistic capacity 'BMD interim capability', based mainly on the American Aegis systems, partially covering Europe. This declaration was accompanied by the decision to proceed with the BMD expansion of the ALTBMD in order to cover the complete European territory of NATO. This defence was placed under NATO control at its BMDOC – Ballistic Missile Defence Operation Command Centre - in Ramstein, Germany. The final objective was therefore to protect all the territories, populations and troops of member nations against ballistic missiles in the European territory of the Atlantic Alliance , all whilst reaffirming that BMD complements NATO's nuclear deterrence and cannot be substituted. These decisions were also accompanied by conditions on the principles of consultation and of common rules of engagement, on the management of costs, the contribution of the European industry, without forgetting the search for cooperation with Russia, which possesses a deterrence system in the process of modernization and is developing their own high and low altitude IAMD systems such as the S300-PMU2, the S400 and the S500. Russia is designing a defence against spatial, ballistic and air threats including MRBMs/IRBM missiles – such as a capacity which, unlike the American or NATO projects, is destined to prioritize protection against a 'first impact threat' to strategic Russian Command Centres, which could weaken their deterrence. Russia has also its theatre defense and its air defense against cruise missiles and a modern combat aviation. Russia has moreover totally integrated the command of spatial, air and anti-missile defence.

Debates on the threats continue

However, the debates continue on the threat. The crisis in Syria has already demonstrated the reality of a common usage of a conventional and ballistic air threat; in the Syrian territory, more than 500 short range ballistic missiles as well as conventional bombs were fired against soldiers and the population. It was therefore necessary to deploy a system with a 'dual anti-air anti-ballistic' defense capacity near to the borders, on the Turkish side. We must also remember the 9/11 scenario, previously unimaginable. The 'terrorist' air threats are taken into account in Europe also and national exercises have been put into place since 9/11 in a Euro-Atlantic context with NATO participation, participation from European countries, and even that of Russia for certain exercises. A consensus remains to be seen, even at a NATO level, on the hypothesis of an ever present dual threat which targets the territory of the alliance. More recently, the example of Yemen also showed that non-governmental forces can get hold of short range ballistic missiles and put them to use, moving on from the age of the old rockets to that of short range ballistic missiles. But to find an expanded consensus also needs to guarantee the respect of territorial integrity and of the airspace of all countries … even before talking about the coordination of the engagement of high altitude anti-ballistic interceptors.

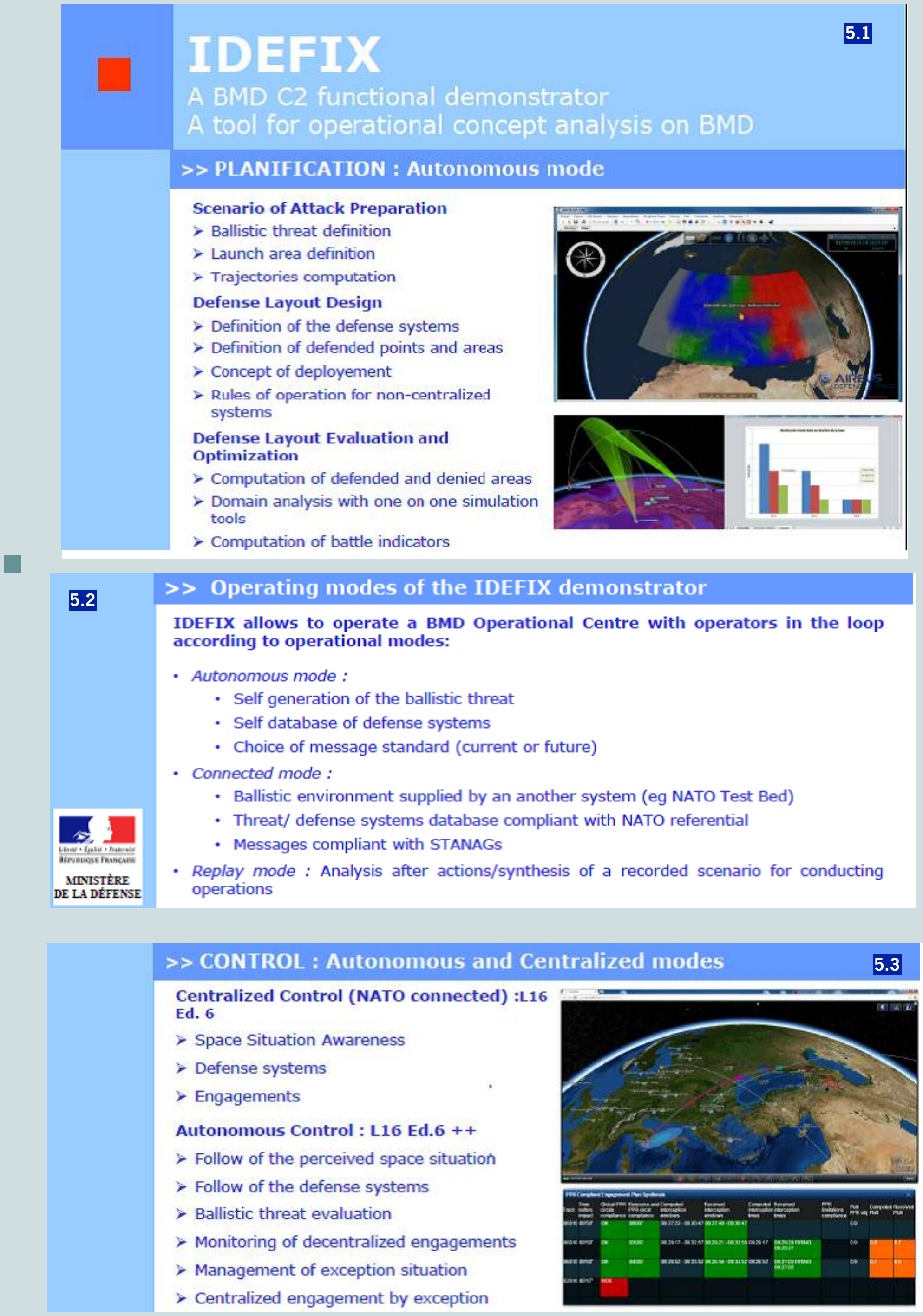
FROM ANTI-MISSILE DEFENCE TO IAMD

If there is not yet a consensus on all threats, there is not yet one on the choice between BMD and IAMD. The 'Theatre Missile Defense' was vital to the origin of IAMD architecture against dual threats. But it remains an architecture destined to the exterior theatre, while the defence of territories has become a dominating aim driving the American EPAA, for the reason of the evolution of the ballistic threat but the conventional as well and the aims of sovereignty in Europe or the influence of regional politics, for the USA, the Russians, not forgetting the Europeans the first concerned. In effect, the command of the long range BMD reveals its large geographical footprint beyond national borders, the questions of sovereignty and the collective decisions which require a consultation process in order to agree to the rules of engagement and their consequences (debris). Likewise, the tensions with Russia on the Ukraine crisis have evidently reinvigorated the need to guarantee the security of national airspaces, and therefore the importance of air defence. Equally, the territorial BMD, conceived as an expansion of the ALTBMD, would have an intrinsic dual capacity notably linked to NATO's command system and the Air Command and Control System (ACCS). The European and American weapon systems deployed in the air, on land or at sea, are moreover already connected with the NATO BMDOC of Ramstein, with the ACCS which is already in the process of evolution (ACCS TMD), in order to expand its missions to anti-ballistic missile defence. The ACCS ensures as well all the NATO air operations in real time, in line with the NATO integrated air defense system (NATINAMDS) and the national Command & Control Systems based on replications of the ACCS system in NATO Control Centres. This system of NATO command and control is interfaced with the 'Ballistic Missile Defense' command centre in the United States, the C2BMC, which covers on its side all the American anti-missile systems of the EPAA – the naval & land Aegis systems and alert radar AN-TPY2 in Turkey. All NATO systems share the running of the ballistic 'Situational Awareness' from Ramstein, but the air capacity of the ACCS allows for NATO defence and air operations. The BMD approach therefore, can evolve into an IAMD architecture which, as with any Theatre Missile Defense or NATO territorial BMD defence, would no longer be focused on one single ballistic threat but would join together NATO air defence and NATINAMDS. For certain nations in Europe, the IAMD is seen as a priority equal to that of 'Theatre Missile Defense', especially since more than a few are directly exposed to conventional air threats. Perhaps we will achieve a consensus sooner or later. The NATINAMDS exists, and the American concept of IAMD exists as well for other systems, notably naval with the US navy's cooperative engagement concept (CEC), or for defence applications in countries outside of Europe.

An Anti-Missile Defence for the European Territory

The decision to create an anti-missile defence architecture for the European territory with an integrated command under NATO's responsibility has been taken by the nations in 2010 (Lisbon Summit), with a collective funding of the command system which must include a process of planning and consultation with common rules of engagement and an evaluation of shared interception consequences. It is a new political goal. Different countries are thus conducting exploratory work to compare their approaches to the planning and decision process, one of which is France who have developed an anti-missile C2 (Command & Control) demonstrator in order to evaluate the planning and execution compatible with the NATO C2 (Figure 5) or other countries with tools for evaluating the consequences of interception. The NATO ACCS, whose functions are extended to the theatre anti-missile capacity (ACCS TMD) has thus been developed in conjunction with the American and European industries via ThalesRaytheonSystems (joint venture between 2 companies Thales and Raytheon) along with other European and American actors. After the summit in Chicago, NATO asked for more cooperation between nations on a 'smart defence.' Concerning missile defence, certain countries would put forward a 'pooling and sharing of American AM3 missiles' whereas others view the naval and notably the alert anti-missile capacity as a subject of cooperation.

Figure 5: IDEFIX



The French Ministry of Defence (DGA, DGRIS, EMA) has developed a functional demonstrator of the C2 BMD named 'IDEFIX' in a fashion of studying the operation concepts of anti-ballistic missile defense of territories and populations, to evaluate the operational planning concepts (Figure 5.1) and of driving operations by integrating political directives to different strategic, operative levels of interoperability in an autonomous mode or coordinated with the C2 BMD of NATO (Figures 5.2 and 5.3).

CAN WE ENVISAGE A BALANCED CONTRIBUTION TO IAMD: WHICH INITIATIVES COMING FROM EUROPE?

In order to arrive at a global consensus on the subject, there needs also to be a more balanced contribution between European countries and the United States, via collective NATO financial contributions. There also needs to be an effort of national defenses to obtain 2% of the national GDP (which is becoming evident in the light of recent terrorist attacks mostly in Europe but also in the USA and even Russia), a demand which was expressed at the NATO Summit in Wales, September 2014. This is not easy at a time when defence budgets are already put under immense pressure, but security and defense are not they an obligation for some European and American nations?

Is this collective obligation – of course more in view of mandatory exterior actions than for contributions to NAT0 budget - compatible with the effort to develop equipment and defence in certain countries? Can they alleviate their budgetary constraints if they are profiting from a contribution to the collective defensive effort? The assessment of priorities and of needs seems quite different in NATO and in the EU.

The United States have already invested around 2 to 3 billion Dollars in the EPAA in Europe, which is remarkable, but some European nations have also invested billions of Euros in air defense systems that are under development, if not operational.

For example the Netherlands are developing a system with advanced alert capacity on the Smart-L EWC naval radar (Figure 6) at first in naval but also on land. France, on the other hand, is developing a ground based long range radar (Figure 7), and has already created an experimental satellite system, Spirale, in order to do tests on spatial anti-missile alerts (Figure 8). France and Italy have also invested billions of Euros in ground-to-air missile system with 100% European technology, based on the Arabel multi-function radar and the Aster 30 missile (Figures 3 and 4). It has been successfully tested against 'Air-Breathing' targets but also against ballistic missiles. Additional improvements are foreseen on the 'Fire-Control' system and the Aster 30 B1 NT, as well as the development of new naval (SF500) and ground (GF-1000) applications (Figure 9). Evidently, the investments also continue in Denmark (Smart-L naval system), in Germany with the TLVS system derived from MEADS (Figure 4.6), in Italy, in Poland, in Turkey, in the United Kingdom and others, which have future plans to modify or develop their antimissile capacities in the air and on the ground.

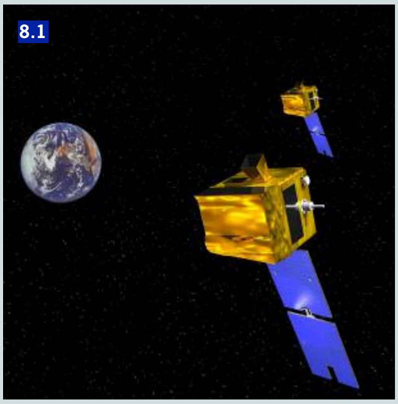
Figure 6: Naval long range alert and poursuit Radar SMART-L EWC.

Naval long range alert and poursuit Radar SMART-L EWC (figure 6a) and in ground version (Figure 6b)

Figure 7: Very long range alert UHF Radar.

This UHF Radar is developed by France with Thales and ONERA which provide a reduced version (1/8 scale) of the complete antenna) (Figure 7a) which is under testing and integration. This modular antenna is based on the active Emission/Reception modules (Figure 7b). The antenna is in a complete version (Figure 7c).

Figure 8 : Spatial demonstrator Spirale



The experimentation Spirale including 2 microsatellites equipped with spectral IR imagers (Made by ThalesAleniaSpace under the responsability of Astrium St under the contract of the French ministry of defence (DGA). The experimentation Spirale has allowed for collecting numerous images in high resolution of the infrared background (figure 8.2) but also to observe IR plumes (missiles and launchers)

Figure 9: Future family of SF/GF AESA Radars in the S band dedicated to the FREMM/FREDA, but also to the future long range MFR alert/pursuit radars GF 1000.

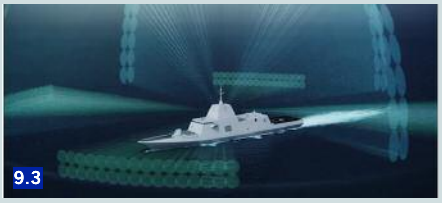


Figure 9.1: radar SF500 4 fixed panels.
Figure 9.2: Long range ground MFR radar GF1000.
Figure 9.3 : Multi- beam management.

Following the GS1000/M3R demonstrator launched in 2004 and onto air defense radars of the GM400 class, they benefit from a new generation AESA technology allowing for the creation of completely digital radar.
On the FREMMs, a new AESA 4 fixed panels SF500 (Figure 9.1) in S band is arriving to replace the multi-function Herakles radar. The ground version of the medium/long range multifunction radars to the AESA GF1000 (Figure 9.2) benefit also from the same antenna technology can be coupled with the SAMP/T B1NT. Thales prepares the marketing of new generation radars with AESA technology, with a chain of reception entirely numeric (FD-AESA), available in naval and ground versions, with fixed or turning panels. These radars are modular and allow for the covering of all ranges and powered uniquely by the dimensioning of the antenna and the adjustment of the number of emission and reception modules which they integrate. The functionalities of the range of radars covers ABT (Air Breathing Target) threats and TBM (Tactical Ballistic Missiles) and manage the effector component by the integration of the radar with a missile link functionality. A high level of performance in standby and in pursuit is attained thanks to the multiple beams simultaneous capacity (>50) and thanks to surveillance motifs and reconfigurable according to missions and targets (See Figure 9.3).

Europe will have to invest more

However, in the economic plan, an investment is essential in Europe as in other places, to accompany developments. Defence officials are therefore being confronted with difficult choices, having strong budgetary constraints, all while maintaining a spending close to 2% of the GDP. For space, they have given priority to investment in military communication and observation satellites, but also in civil satellites and space launchers like Ariane 6. At the same time, they continue with very important investments in the improvement of ‘dual lower layer’ IAMD systems, like for example the ground-to-air missile platforms. They also favour investment in naval antimissile capacities.

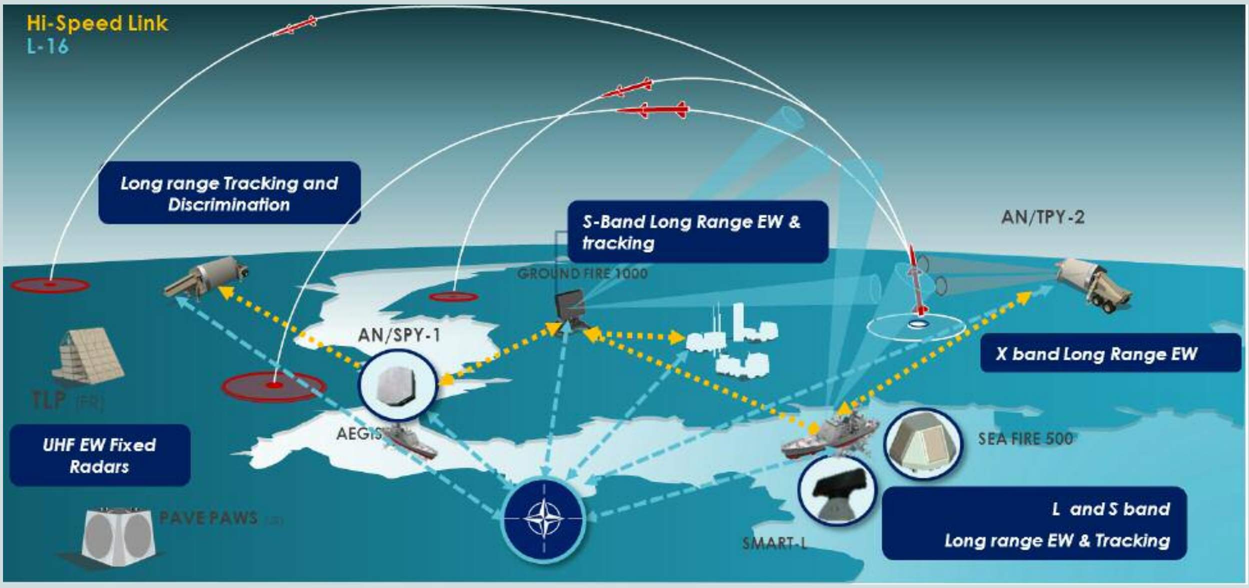
The impression persists, well founded or not, that the United States provides principally American solutions and that access to the market is a real problem for the European industry, to maintain and develop its competencies. But a weak European industry is a risk for all. Without European added value or return on investment, the investment in defense will diminish regularly. This means that, in the long term, there will be need for more investment from the United States in order to maintain security in Europe, with more risks for everybody.

AN EXAMPLE OF A TRANSATLANTIC INITIATIVE FOR MORE COOPERATION

Cooperation between the countries could also be improved by systems using more the NATO chain of command and control, assemblies (clusters) of sensors and IAMD fire-control systems (Figure 10). The target effect would be to obtain interoperability in real time between weapons systems and allowing for more synergy between them, also reinforcing their performance and resilience, all whilst opening lines of cooperation and additional interoperability, liaising with L16 data. An initiative under the theme of ‘multi-sensor cooperation’ has also been taken at the end of 2013 by two transatlantic think tanks (3AF was invited by the US Atlantic Council). It was then pursued by the 3AF with the competition of transatlantic industries (17) who have made a white paper entitled ‘Study of IAMD sensors networking', a subject of study proposed by to the NIAG at the end of 2014, with a particular interest in the study of Multi-Sensor Fire Control Networks.

While the American and European defence industries are sometimes criticized for clashing rather than cooperating, the competition does not prevent the industry from proposing ideas that improve synergy of systems and to reinforce their global effectiveness. Sometimes, the political willingness lacks in order to favour cohesion over competition renowned for guaranteeing the best price, which would be justifiable in abundant budgets, but they are not. The American industry suffers from 'budget sequestration' but has a budget with considerable support from exterior operations, and from FMS contracts, whereas the European Industry, of which the know-how is also undeniable, has been seemingly on a diet for years!

Figure 10: Network concept of MFR sensors and firing units assembled in clusters.



The integration of IAMD or antimissile systems goes through the interoperability of Command and Control (C2) Centres and sensors through link16 type network. In addition, new concepts of networking are proposed to assemble Multifunctions Fire Control sensors into clusters through rapid links.

Towards consensus

A consensus on air and antimissile defense based on a dynamic expansion of the NATO BMD is certain, but only under certain conditions. The dual threat must be a shared priority, and allows for a capitalization of NATO's dual capacities, and of the industries, and notably of theatre defence. The synergy between the industries of the USA and of Europe must be reinforced, creating an added value for the American and European competencies and an equal access to the market, including exports. Finally, the synergy of systems and sensors between them could be improved, which would put together not only the techniques and the industrial know-how for proposing innovative solutions, but also would create the conditions for a political willingness to favour such synergies, which takes time.

GLOSSARY OF ACRONYMS/ABBREVIATIONS

ACCS: Air Command and Control System
ALTBM: Active Layered Ballistic Missile Defence
ARS: ARS is a Control Centre in charge of managing 3 capacities:

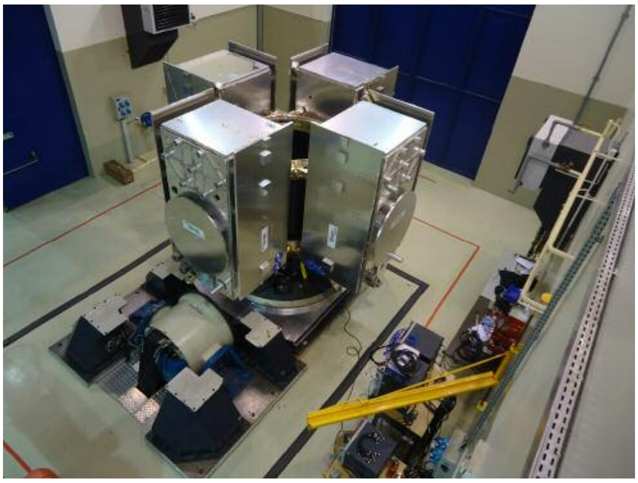
- Air Control Centre
- Recognized Air Picture (RAP) Production Centre
- Sensor Fusion Post

BMD: Ballistic Missile Defence
BMDOC: Ballistic Missile Defence Operation Centre
C2: Command & Control
CEC: Cooperative Engagement Concept
EPAA: European Phased Adaptive Approach
EWC: Early Warning Control
EWD: Early Warning Device
FMS: Foreign Military Sales
FREMM: Frégate MultiMissions
GBI: Ground - Based Interceptor
GDP: Gross Domestic Product
GMD: Ground-based Midcourse Defence
GMDS: Ground anti-Missile Defence System
IAMD: Integrated Anti-Missile Air Defence
IBDM: Interim Ballistic Missile Territory Defence
ICBM: Inter Continental Ballistic Missile
INCA: Initial Capacity
MEADS: Medium Extended Air Defence System
MFR: Principal Anti Air Missile System
MRBM: Medium Range Ballistic Missile
NATO: North Atlantic Treaty Organization
NATINAMDS: NATO Integrated Air Defence System
NIAG: NATO Industry Advisory Group
PAAMS: Principal Anti Air Missile System
SAMP/T: Surface-Air Moyenne Portée/ Terrestre (French-Italian Surface-to-Air Defence Missile System)
TLVS: Taktische Luftverteidigungsystem (German MEADS)
TMD: Theatre Missile Defence

GALILEO'S ARIANE 5 DISPENSER READY AT SPACEPORT GUIANA SPACE CENTRE

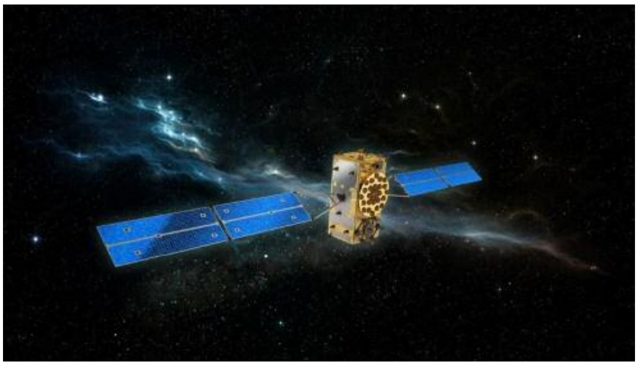
10 June 2016

Following rigorous testing in France and Germany, a new type of dispenser designed to carry four navigation satellites into orbit at once is now in French Guiana, in place for Galileo's first Ariane 5 launch later this year.



Four-satellite dispenser for Galileo's Ariane 5 seen during shaker testing at Airbus Defence and Space near Bordeaux. The dispenser has had four Galileo engineering models attached to it for test purposes.© ESA

The dispenser is an essential element of launch success, with a double role to play. Firstly it must hold the quartet of satellites securely in place during the stresses of liftoff, and then the nearly four-hour long flight to medium-Earth orbit. Then, once the Ariane 5 EPS upper stage reaches its target 23 222 km altitude, the dispenser has to release the four Galileo satellites smoothly using a pyrotechnic release system triggered by separate igniters, each one firing half a second after the other.



Artist's view of a Galileo Full Operational Capability satellite, with platforms manufactured by OHB in Bremen, Germany, and navigation payloads coming from Surrey Satellite Technology Ltd in Guildford, UK. © ESA

The separated satellites are then pushed away from the dispenser in separate directions using a spring-based distancing system.

Galileo satellite

The 447 kg dispenser, designed by Airbus Defence and Space, must support a satellite mass of 738 kg each – nearly three tonnes in all.

Made from a combination of metal and composite materials for maximum stiffness, the dispenser has undergone very comprehensive testing at Airbus Defence and Space near Bordeaux, France, and the IABG testing centre in Ottobrunn, Germany – using both Galileo engineering models and an actual flight satellite, including fit, shock and separation testing.

The test campaign met all objectives, confirming the behaviour performs as predicted, after which the dispenser was shipped to Europe's Spaceport in French Guiana.

Dispenser

Four-satellite dispenser for Ariane 5 Galileo launches with engineering models attached for test purposes. © ESA

Galileo's Ariane 5

In the autumn of this year, four Galileos will be launched together for the very first time, on a specially customised launcher, called the Ariane 5 ES Galileo.

In development since 2012, this new launcher variant has evolved from the Ariane 5 ES (Evolution Storable), used to place ESA's 20 000 kg ATV supply vehicle into low-Earth orbit. This launder has to carry a lower mass payload – four fully fuelled 738 kg Galileo satellites plus their supporting dispenser – but needs to take it up to the much higher altitude of medium-Earth orbit, approximately 23 222 km up.

Galileos in orbit

The target orbit is actually 300 km below the Galileo constellation's final working altitude: this leaves the Ariane's EPS upper stage in a stable 'graveyard orbit', while the quartet of Galileos manoeuvre themselves up to their final set height.

Once the Ariane 5 ES Galileo flight is complete, there should be 18 Galileo satellites in orbit.

J.-P. S. From information provided by ESA

AND YET IT MOVES†: 14 GALILEO SATELLITES NOW IN ORBIT

24 May 2016

Named for the astronomer who pinpointed Earth's true position in the Solar System, the Galileo satellite navigation system that will help Europe find its way in the 21st century now has 14 satellites in orbit after today's double launch. Galileos 13 and 14 lifted off together at 08:48 GMT (10:48 CEST, 05:48 local time) atop a Soyuz rocket from French Guiana.

Europe's 13th and 14th Galileo satellites lifted off at 08:48 GMT (05:48 local time, 10:48 CEST) on Tuesday, 24 May 2016 from Europe's Spaceport in French Guiana atop a Soyuz launcher. © ESA/CNES/ARIANESPACE-Optique Video du CSG, P. Piron

Cutaway view of the Soyuz rocket fairing carrying the Galileo-13 and -14 satellites, seen atop the Fregat upper stage that will fly them most of the way to their intended medium-altitude orbit. © ESA–Pierre Carril, 2016

This seventh Galileo launch went by the book: the first three Soyuz stages placed the satellites safely into low orbit, after which their Fregat upper stage hauled them the rest of the way into their target medium-altitude orbit.

The twin Galileos were deployed into orbit close to 23 522 km altitude, at 3 hours and 48 minutes after liftoff. The coming days will see a careful sequence of orbital fine-tuning to bring them to their final working orbit, followed by a testing phase so that they can join the working constellation later this year.

Galileo satellites 13 and 14 attached to their dispenser ahead of their launch by Soyuz on 24 May 2016.
© ESA/CNES/Arianespace/Optique Video – JM Guillon

Galileo satellites atop Soyuz

The remainder of the Galileo constellation is being progressively deployed in batches, some launched in pairs (using the Soyuz launcher), and some in fours (using Ariane 5). After the launch of four with Ariane 5 in autumn, there will be sufficient satellites in orbit and ground stations in place for the Galileo system to start delivering early navigation services to users worldwide.

The constellation will reach the final 30-satellite Full Operational Capability (FOC) – including spare satellites – which will enable the full range of Galileo services before the end of this decade.

J.-P. S. From information provided by ESA

THIRD SENTINEL SATELLITE LAUNCHED FOR COPERNICUS

16 February 2016

The third ESA-developed satellite carrying four Earth-observing instruments was launched today, ready to provide a 'bigger picture' for Europe's Copernicus environment programme.

The 1150 kg Sentinel-3A satellite was carried into orbit on a Rockot launcher from Plesetsk, Russia, at 17:57 GMT (18:57 CET; 20:57 local time) on 16 February.

After a first burn starting about five minutes after liftoff and a second about 70 min later, Rockot's upper stage delivered Sentinel-3A into its planned orbit, 817.5 km above Earth. The satellite separated 79 min into the flight.

The first signal from Sentinel-3A was received after 92 min by the Kiruna station in Sweden. Telemetry links and attitude control were then established by controllers at ESA's ESOC operations centre in Darmstadt, Germany, allowing them to monitor the health of the satellite.

Sentinel-3 solar array

Replay of the Sentinel-3A liftoff on a Rockot launcher from the Plesetsk Cosmodrome in northern Russia at 17:57 GMT (18:57 CET) on 16 February 2016.
Sentinel-3A is the third satellite to be launched for Europe's Copernicus environment monitoring programme.
Designed as a two-satellite constellation – Sentinel-3A and -3B – the Sentinel-3 mission carries a series of cutting-edge instruments for systematic measurements of Earth's oceans, land, ice and atmosphere. Over oceans, Sentinel-3 measures the temperature, colour and height of the sea surface as well as the thickness of sea ice. These measurements will be used, for example, to monitor changes in sea level, marine pollution and biological productivity. Over land, this innovative mission will monitor wildfires, map the way land is used, provide indices of vegetation state and measure the height of rivers and lakes. © ESA

After the launch and the early orbit phase of three days, controllers will begin checking that all the satellite elements are working and subsequently calibrate the instruments to commission the satellite. The mission is expected to begin operations in five months.

"With the successful launch of Sentinel-3 we are now looking forward to how our teams of experts will steer this mission into its operational life – like they have done the first two satellites of the series," said ESA Director General Jan Woerner.

"This is another demonstration of the broad range of competence we have at ESA from the early design phase until the operational mission in orbit."

The mission is the third of six families of dedicated missions that make up the core of Europe's Copernicus environmental monitoring network. Copernicus relies on the Sentinels and contributing missions to provide data for monitoring the environment and supporting civil security activities. Sentinel-3 carries a series of cutting-edge sensors to do just that.

Over oceans, it measures the temperature, colour and height of the sea surface as well as the thickness of sea ice. These measurements will be used, for example, to monitor changes in Earth's climate and for more hands-on applications such as marine pollution and biological productivity.

Over land, this innovative mission will monitor wildfires, map the way land is used, check vegetation health and measure the height of rivers and lakes.

Sentinel-3

Sentinel-3 is arguably the most comprehensive of all the Sentinel missions for Europe's Copernicus programme. Carrying a suite of state-of-the-art instruments, it provides systematic measurements of Earth's oceans, land, ice and atmosphere to monitor and understand large-scale global dynamics and provide critical information for ocean and weather forecasting. © ESA–Pierre Carril

"This is the third of the Sentinel satellites launched in the less than two years – and it is certainly a special moment. It also marks a new era for the Copernicus Services, with Sentinel-3 providing a whole range of new data with unprecedented coverage of the oceans," said the Director of ESA's Earth Observation Programmes, Volker Liebig.

Sentinel-3B, its twin satellite, is scheduled for launch next year.

Data from all the Sentinels are used worldwide and are free of charge for all users.

J.-P. S. From information provided by ESA

THE NEW ONLINE CAMS CATALOGUE IS NOW AVAILABLE

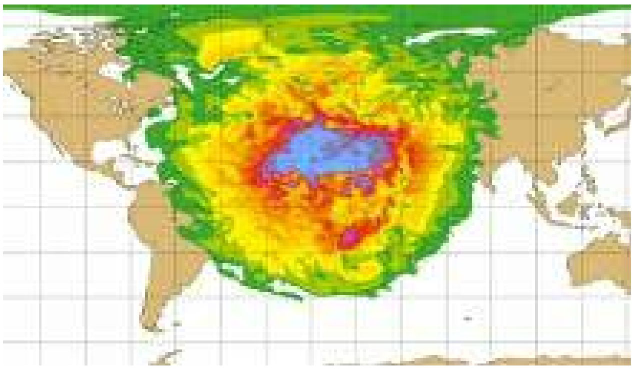
COPERNICUS ATMOSPHERE MONITORING SERVICE

CAMS

ECMWF (European Centre for Medium Range Weather Forecasts) has launched a new interface for its Copernicus Atmosphere Monitoring Service (CAMS) online catalogue, enabling users to find and access data with greater ease.

The new interface provides dynamic visualisations without the need to download data into specialist tools or software and gives global access to maps, charts, numerical data and the information about atmospheric chemistry as generated by Copernicus programme.

The catalogue, originally developed as part of the Copernicus pre-cursor programme MACC, provides map time-series animations showing users the evolution of atmospheric phenomena, an intuitive search system, improved filtering and building of layers, legends and geographical areas as well as other simple 'point-and-click' features. In addition, live maps and charts can be embedded in website content, just like on popular video channels, making them more widely accessible.



(Source CAMS)

The new catalogue marks an important step in broadening access to the wealth of CAMS data as part of Copernicus's mission to equip society to understand and adapt to our changing environment through world-leading science and technology.

J.-P. S. From information provided by ESA

CONSULT THE CPMIS : CEAS CONFERENCE PROGRAMMING MANAGEMENT INFORMATION SYSTEM

The aim of the CPMIS is to facilitate the search of the different aerospace events in the world that are programmed at short and mid-term time horizon, and so allowing to optimise the scheduling of future events by avoiding possible overlapping and redundancies, but on the contrary to encourage co-operations and synergies between the actors concerned.

The address is: http://www.aerospace-events.eu

A search engine selects the events according to specific topics and key words. A graphic display (day, week and months view) eases the access and the view.

- 4 TYPES: Conference, Workshop, Lecture, Air Show
- 6 MAIN CATEGORIES: Aeronautical sciences - Aerospace (for events including all aspects of aviation and space) – Civil Aviation – Air power – Space – Students and Young Professionals.
- 64 SUB – CATEGORIES: aeroacoustics – aeroelasticity – aerodynamics, etc.

AUTOMATIC INSERTION OF NEW EVENTS BY THE ORGANISERS THEMSELVES:

- Go to http://www.aerospace-events.eu
- Click on the "introduction" text
- Redirected on the New Event Form, you have to click on this form and to enter your event related information, validate, click on Save and send.

Point of Contact:

postmaster@aerospace-events.eu is the general address for any question and requests;

– Jean-Pierre Sanfourche, CEAS, responsible for the Events Calendar permanent updating and validation: **sanfourche.jean-pierre@orange.fr**

2016 SECOND HALF

05-08 July • **AIAA** – ICNPAA 2016 Mathematical Problems in Engineering, Aerospace and Sciences – La Rochelle (France) – University La Rochelle – www.icnpaa.com

06-07 July • **RAeS** – The Automated Rotorcraft – London (UK) – RAes/HQ – www.aerosociety.com/events

10-15 July • **IEEE/GRSS** – IGARSS 2016 – International Geoscience and Remote Sensing Symposium – Beijing (China) – China National Conference Centre – www.igarss2016.org/

11-17 July • **Farnborough International Ltd** – Farnborough International Airshow Trade 2016 – Farnborough (UK) – Showcentre – ETPS Rd – www.farnborough.com

19-21 July • **RAeS** – Applied Aerodynamics Conference 2016 – Bristol – Science Centre http://www.aerosociety.com/AA2016

25-27 July • **AIAA/SAE/ASEE** – AIAA Propulsion and Energy 2016 – Salt Lake City, UT – Salt palace Convention Center – http://www.aiaa-propulsionenergy.org

30 July-07 August • **COSPAR** – COSPAR 2016 – Istanbul (Turkey) – Congress Center (Taksim Discrict) – Invited by Scientific and Technological Research Council of Turkey – http://www.cospar-assembly.org

05-08 September • **ERF** – ERF2016 – 42nd European Rotorcraft Forum – Lille (France) – Grand Palais – www.erf2016.com

12-16 September • **EUROMECH** – 11th European Fluid Mechanics Conference (EFMC 11) – Sevilla (Spain) – Universidad – www.efmc.org

13-15 September • **DGLR** – Annual DGLR Conference – Deutsche Luft-und-RaumfahrtKongress (DLRK) – Braunschweig (Germany) – Stadthalle – www.dglr.de – www.dlrk2016.dglr.de

13-16 September • **AIAA/AAS** – AIAA SPACE 2016 – AIAA Space Conference – AIAA/AAS Astrodynamics Specialist Conference – AIAA Complex Aerospace Systems Exchange – Space and Astronautics Forum and Exposition – Long Beach, CA – Long Beach Convention Center – www.aiaa-space.org/

14-15 September • **ESA** – Space for Inspiration – London (UK) – Science Museum www.congrexprojects.com/list-of-events

20-22 September • **ESA** – ISD2016 – Industry Space Days – Noordwijk (NL) – ESA/ESTEC www.congrexprojects.com/list-of-events

25-30 September • **ICAS** – ICAS2016 – Daejon (Republic of Korea) – Convention Center Daejon – 30th Congress of ICAS – http://www.icas2016.com

26-30 September • **IAF** – IAC 2016 – 67th Edition of IAC 2016 – Hosted by Mexican Space Agency (MSA) – Making space accessible and affordable to all countries – Guadalajara (Mexico) www.iafastro.org – www.iac2016.org/

27-28 September • **RAeS** – Annual International Flight Crew Training Conference – London (UK) – RAeS/HQ www.aerosociety.com/events/

27-30 September • **ESA** – ECSSMET2016 – European conference on Spacecraft, Structures, Materials and Environmental Testing – Toulouse (France) – Pierre Baudis Congress Centre www.ecssmet2016.com

27 September-07 October • **ICAO** – 39th ICAO Assembly Session – Montréal (Canada) – ICAO/HQ – www.icao.int/meetings

03-04 October • **RAeS** – UAS in Daily Life – London (UK) – RAeS/HQ – www.aerosociety.com

04-06 October • **RAeS** – 5th Aircraft Structural Design Conference – Lisbon (Portugal) – IST
http://www.aerosociety.com/5ASD

03-07 October • **ESA** – ESCP2016 – European Space Power Conference – Noordwijk (NL) – ESA/ESTEC
www.congrexprojects.com/list-of-events

05-06 October • **EDA** – MAWA Conference 2016 – Military AirWorthiness Authorities Forum – Lisbon (Portugal)
www.eda.europa.eu/info-hub/events

05-07 October • **3AF** – IES2016 – 13th Forum on Economical and Strategic Intelligence – Rouen (France) –
www.ies2016.com

11-12 October • **FTF/INNOVAIR** – Aerospace Technology Congress 2016 – Swedish Aerospace Technology in a Globalized World – Stockholm (Sweden) – Quality Hotel Friends, Solna
www.meetagain.se – www.ft2016.se

11-13 October • **3AF** – GA2016 – 2nd Greener Aviation Conference – Brussels (Belgium) – Square Meeting Center –
www.greener-aviation2016.com

17-18 October • **RAeS** – Delivering Sustainable Growth in Aviation – London (UK) - RAeS/HQ
www.aerosociety.com/events

18-20 October • **Aviation Week** – MRO Europe 2016 – Amsterdam (NL) – RAI Exhibition and Conference Centre –
www.mroeurope.aviationweek.com/

18-20 October • **IATA** – 6th World Passenger Symposium – Dubai (UAE) - JW Marriott Marquis Dubai
www.iata.org/events/

18-21 October • **EASN** – 6th EASN International Conference – Porto (Portugal) – www.esan.net

01-03 November • **NBAA** – NBAA's Business Aviation Convention & Exhibition – Orlando, FL (USA) - Orange County Convention Center – www.nbaa.org/events/bace/2016

01-06 November • **Airshow China** – 11th China International Aviation & Aerospace Exhibition – Zhuhai Guangdong (China) – www.airshow.com.cn/en/

06-11 November • **CANSO** – CANSO Global ATM Safety Conference 2016 – Transforming Global ATM Performance
Budapest (Hungary) – sofitel Budapest Bridge Chain – www.canso.org

08-10 November • **SESARJU** – 6th SESAR Innovation Days – Delft (NL) – TU Delft – www.sesarinnovationdays.eu

08-11 November • **ESA** – 10th Round Table on Micro and Nanotechnologies for Space Applications – Noordwijk (NL)
ESA/ESTEC – www.congrexprojects.com/list-of-events

14-16 November • **FSF** – 69th annual International Air Safety Summit (IASS) – IASS = the largest safety event.
Dubai (UAE) – Congress Centre & Hub – www.flightsafety.org/

15-17 November • **ACI-Europe** – Airport Exchange 2016 – Istanbul (Turkey) – Istanbul Congress Centre
www.aci-europe-events.com

22-23 November • **RAeS** – Simulation Based Training – The Key to Military Operations – London (UK) – RAeS/HQ
www.aerosociety.com/Events

29 Nov. – 1st December • **AEROMART** – AEROMART TOULOUSE 2016 – International Business Convention for the Aerospace Industry – Toulouse (France) – Centre des Congrès Pierre Baudis -
Toulouse.bciaerospace.com

Aerospace Europe 2017 Conference

(6th CEAS Air & Space Conference)

Organized by AAAR - The Aeronautics and Astronautics Association of Romania on behalf of CEAS
PARLIAMENT of ROMANIA, 16th-20th October 2017
with the contribution of ECCOMAS, EUROMECH, EUROTURBO, ERFCOTAC, ACARE, EREA, EDA, EASA, EUROCONTROL, EASN

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