ANASTASIA :

AIRBORNE NEW AND ADVANCED SATELLITE TECHNIQUES AND TECHNOLOGIES IN A SYSTEM INTEGRATED APPROACH

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OVERVIEW

Project Objectives:

The core of ANASTASIA research is to provide on-board Communication, Navigation and Surveillance (CNS) solutions to cope with the foreseen doubling of air traffic by 2020.

ANASTASIA is carrying out research of future technology and system architectures for navigation, resulting in the development of a new generation of airborne GNSS receivers for all phases of flight. Such systems will offer accurate and safe global navigation while reducing avionics cost through the optimisation of the number and complexity of on board equipment.

On the communication side, work is concentrating on the design and implementation of a prototype Satcom system that will meet the evolving European Air Traffic Management (ATM) requirements. Research is also made into higher bandwidth services, systems and airborne equipment to efficiently meet long term future aircraft communication requirements, including both ATM and passenger needs.

The future needs of Surveillance will be consolidated with the requirements and key technology prototypes from Communications and Navigation.

Expected results:

The main goal of ANASTASIA is to pave the way for the introduction of new satellite-based technologies into aircraft operations in both Navigation and Communications.

The main outcome of ANASTASIA will be recommendations for future civil aircraft operation and a set of evaluated technologies and avionics architectures achievable from 2010 that will enable more autonomous, satellite-based aircraft operation.

1. ANASTASIA'S BACKGROUND

1.1. Scope of the project

In the first 20 years of the 21st Century, air traffic is expected to approximately double in volume.

The expected performance of Space Based Technologies such as Satellite Communications (SATCOM) and Satellite navigation (renewed GPS, GALILEO….) beyond 2010 offer the prospect of increasing autonomous aircraft operation to improve the operational capacity and safety of the air transport system as defined by the "Single European Sky" initiative.

Anastasia aims to carry out research, evaluation and cost benefit analyses to define new COM and NAV technologies and avionics architectures suitable for aircraft operation in a future satellite-based European Air Traffic Management environment to deliver the expected future CNS functionality. Outputs will be validated by theoretical analysis, by mock-up evaluations, and by selected flight-testing.(figure 1)

1.2. A 6th framework EC programme

In order to perform these research activities, the ANASTASIA project, [1], [2], consortium consists of 29 partners, from some of the major stakeholders in the European aeronautical domain, including a balanced set of airframers, avionics suppliers, satellite systems suppliers and providers, as well as universities and research centres specialising in aeronautical systems. (figure 2)

ANASTASIA (Airborne New Advanced Satellite techniques & Technologies in A System Integrated Approach) is an IP (Integrated Project), which receives funding from the European Community's 6th framework programme (DG Research). The total cost of the project is around 20M euros, of which about half is funded by the EC, and the other half by the partners themselves.

It started on April 1st 2005 and will last 4 years.

2. ANASTASIA'S OBJECTIVES

2.1. CNS objectives

The overall scientific & technical objective of ANASTASIA is to define navigation and communications avionics based on satellite services that will best meet the needs of civil aviation in the period 2010 to 2020. The project defines an optimised avionics architecture and the resulting recommendations for ground and space infrastructures. It includes the preliminary system development of advanced airborne systems for flight trial evaluation and the dissemination of the results for standardisation activities.

2.2. Communication

The project objective with respect to communications is threefold:

- To establish the requirements for an affordable SATCOM system for ATM, considering also the synergy with passenger use.

- To design, implement and demonstrate a preliminary system development of an affordable aeronautical SATCOM system that will meet evolving European ATM requirements such as using satellites to complement the congested VHF spectrum. The design will be based on the current or planned space segment and will have maximum synergy with existing and planned non-ATM aeronautical SATCOM systems

- To carry out research into higher bandwidth services, systems and airborne equipment to meet future SATCOM requirements for ATM. Due to the very high cost of satellite communication systems, the synergies with revenue-generating passenger use shall also be considered in order to ensure a cost efficient approach.

2.3. Navigation

Objectives in the Satellite Navigation Domain are:

- To consolidate air navigation performance requirements and map them to potential operational benefits from the use of space-based navigation systems in future aircraft and airspace.

- To investigate and evaluate the following techniques and technologies that are the keys to the success of future space-based navigation systems:

  - Multi-constellation, multi-frequency GNSS receivers (GPS/Galileo) for real world-wide autonomous robust navigation

  - Signal processing techniques and antenna design for high robustness to critical Radio Frequency Interference environments

  - High accuracy and integrity techniques for up to Cat III landing and gate-to-gate operations (SMGCS)

  - Low cost inertial sensor technologies (MEMS) and techniques to optimally combine inertial and GNSS sensors for air navigation and landing

  - To define, based on these evaluations, a set of new candidate architectures for navigation taking advantage of the new constellations, as the best trade-off between performance capabilities and cost requirements

  - To contribute to new standards and regulations

2.4. Surveillance

Objectives in the Surveillance Domain are to identify the surveillance needs of the future (2010 to 2020) from which further requirements on the navigation and communication systems will be derived.

3. ANASTASIA: ORGANISATION AND STRUCTURE

3.1. Work breakdown structure

The project is organised in 5 sub-project (figure 3), which are:

- **SP1**, Project management: to manage the consortium and ensure the reporting to the commission and the technical coordination with the partners.

- **SP2**, Needs and future aircraft requirements: to identify the requirements for the new satellite based CN(S) functions for both business jets and air-transport.

- **SP3**, Space based navigation technologies: to investigate the space based systems and to define the different techniques and technologies that must be implemented for an optimal use of new space based technologies in an on-board system.

- **SP4**, Space based communication technologies: to investigate the space based systems and to define the different techniques and technologies that must be implemented for an optimal use of new space based technologies in an on-board system.

- **SP5**, Operational characterisation and evaluation: to investigate specific environmental characteristics and verify in a quasi-realistic environment, behaviour and performance of the key navigation and communication technologies.

- **SP6**, Dissemination: exploit and disseminate results in order to contribute to standards.

3.2. Planning

The general planning of the study reflects the timing in three steps of the research: (figure 4)

First, -SP2- the initial requirements for new satellite based on-board systems are issued. These requirements are based mainly on needs, they do not consider the technological limitations.

Second, -SP3,SP4,SP5- on the basis of these initial requirements, research is performed to check up to which level the satellite based Navigation and Communication technologies can full fill these requirements. This work is done based on simulation, prototyping, mock-up and flight trials when necessary.

Third, the results of this technology assessment are used to issue final requirements, which are feasible and can be presented to appropriate authorities in order to propose updated regulations.

4. ACHIEVEMENTS AND FUTURE WORK

From 1st of April, 2007, the project entered into its third year.

During the first year, the work-plan was focused on the collection of needs and aircraft requirements, and on a state of the art of satellite based technologies in both communication and Navigation Systems.

During the second year, innovative Satellite based architectures for both the Navigation and the Communication on board systems have been studied. Also, part of the work was the specification and the design of the Navigation and Communication mock-ups.

During this third year the work will go on with mainly realisation tasks in order to get the Navigation and Communication mock-ups ready for the final test and evaluation, and feedback towards initial requirements, which will take place during year 4.

The results obtained up to now are reported in more than 20 deliverables, which are available on the ANASTASIA web site, either as full document or executive summary only, according to their confidentiality level.

This work was also the basis for a number of presentations and papers which are also accessible on the Anastasia web site.

5. CONCLUSION

Up to now, the ANASTASIA project is on track and promising results have been obtained in both the navigation and communication domains..

These results have been reported in the project deliverables, into various conferences presentations and publications. They are available on the ANASTASIA website [3].

Throughout the project, close links have been maintained, and will be strengthened in the future, with other European or international initiatives, and in particular with standardisation organisms such as EUROCAE and RTCA, and with the SESAR project [3], which aims at defining the road map for the deployment of the ATM system of the future.

6. ACKNOWLEDGEMENTS

The author would like to emphasize that this paper presents the scope and initial results of the Anastasia project and reflects the collective work of the whole ANASTASIA consortium - he thanks all of the Anastasia partners for their contribution.

He also takes the opportunity to thank the European Community's administrative officers and reviewers for their assistance and support throughout the project.

7. REFERENCES:

[1]: Anastasia EC contract AIP4-CT-2005-516128

[2]: www.anastasia-fp6.org

[3] SESAR : "The Single European Sky for the European Air Transport Community" www.airtraffic-alliance.com

8. FIGURES

FIG 1. ANASTASIA : Poster

FIG 2. ANASTASIA : Consortium

N°	Participant name	Participant Short name	Country
1	Thales Avionics	THAV	F
2	AIRBUS-F	AIRBUS-F	F
3	INMARSAT	INMARSAT	UK
4	Deutsches Zentrum für Luft-und Raumfahrt	DLR	D
5	DASSAULT	DASSAULT	F
6	Airbus Deutschland	AIRBUS-D	D
7	Thales Avionics Ltd	TAUK	UK
8	EADS Astrium France	ASTRIUM	F
9	EADS CRC France	EADS CCR	F
10	EADS Deutschland C R C	EADS CRC	D
11	Selenia Communications S.p.A	SELENIA	I
12	ASCOM	ASCOM	CH
13	NLR	NLR	NL
14	Institut National des Sciences Appliquées	INSA	F
15	ERA Technology	ERA	UK
16	Joanneum research	JOANNEUM	A
17	Imperial college of science technology and medicine	IMPERIAL	UK
18	SIREHNA	SIREHNA	F
19	SKYSOFT	SKYSOFT	P
20	Data Respons	DATAR	N
21	Technische Universität Braunschweig	TUB	D
22	University of Surrey	UniS	UK
23	Uiversity of Vigo	VIGO	E
24	Gatehouse	GH	DK
25	University College of London	U C L	UK
26	Rhea system	RHEA	B
29	TriaGnosis	TGS	D
30	Thales Research and Technology	TRT	UK
31	Wireless Intelligent Systems Ltd	WIS	UK

FIG 3. ANASTASIA : WBS

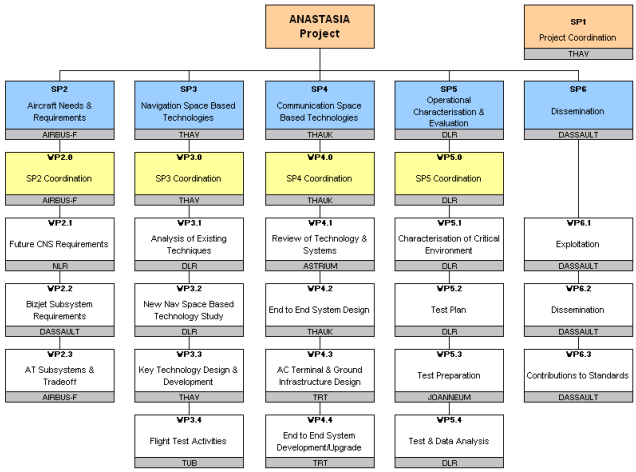

FIG 4. ANASTASIA : Global Planning