

FP7-Space Call 1 Strengthening Space Foundations and Role of ESA

16th May 2007 – Madrid

Overview

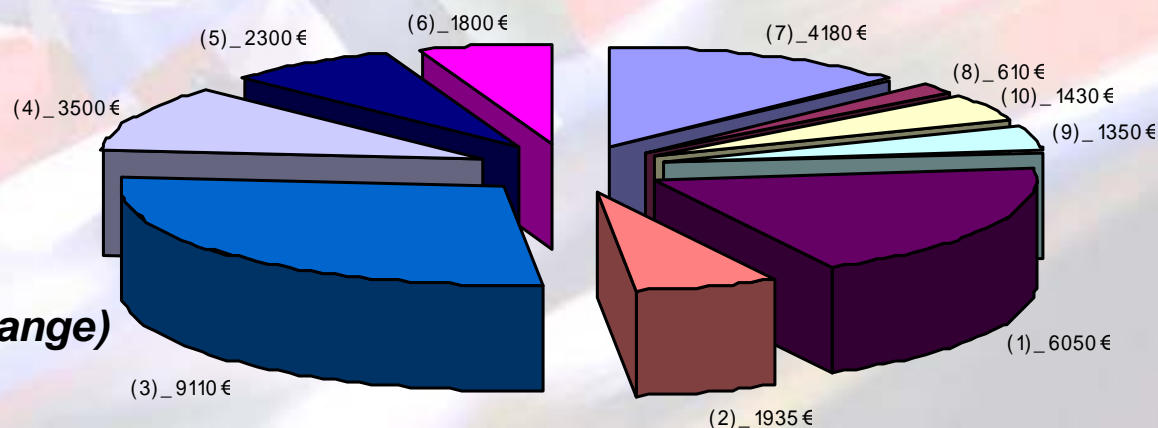
- **The EC 7th Framework Programme**
 - Strengthening Space Foundations
- **Role of ESA in FP7-Space - Strengthening Space Foundations**
- **1st FP7-Space Call on Strengthening Space Foundations**
 - Space Science
 - Space Transportation
 - Space Technology
- **Conclusion**

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FP7 – 2007 - 2013

Ten Themes under the FP7 Cooperation Programme for a total budget of more than 32 B€ over the period 2007-2013

1. **Health**
2. **Food, agriculture and biotechnology**
3. **Information and communication technologies**
4. **Nanosciences, nanotechnologies, materials and new production technologies**
5. **Energy**
6. **Environment (including climate change)**
7. **Transport (including aeronautics)**
8. **Socio-economic sciences and the humanities**
9. **Security**
10. **Space**



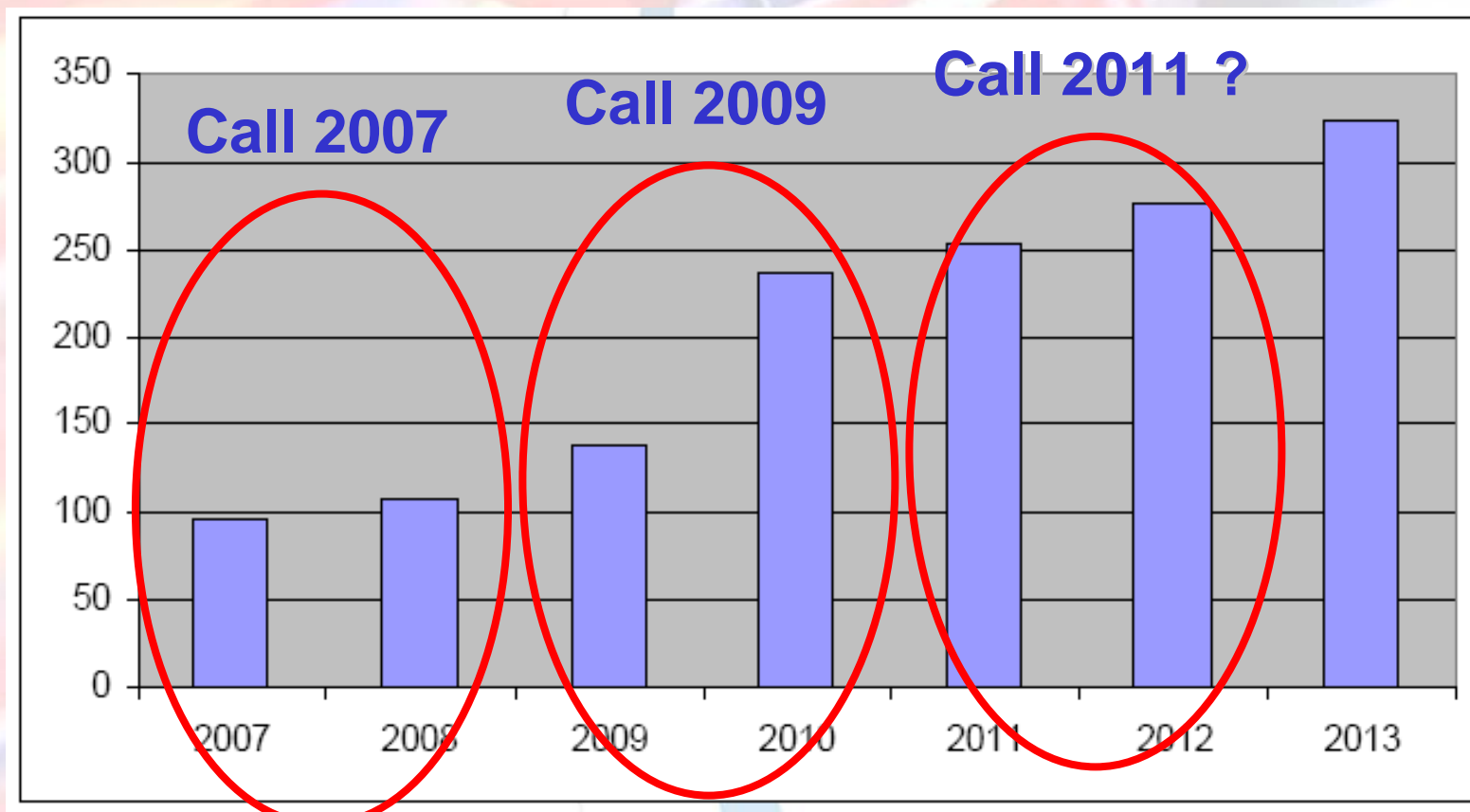
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FP7 Budget for Space

- **Space line in FP7 :**
 - 1,430 M€ for the period 2007-2013
- **approx. 85% of the Space budget will be dedicated to GMES, i.e. approx. 1,215 M€**
- **the remaining approx. 15% will address Space Science, Space Technologies and Space Transportation...**
 - approx. 200 M€ for the period 2007-2013

FP7-Space Draft Budget Annual Commitment

- **Profile 2007-2013 (Mio Euro)**
(subject to annual adoption by budgetary authorities)



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Strengthening Space Foundations

➤ Overview

- Support to research in space science and exploration
- New concepts in space transportation, space technologies and critical components (for Non-Dependence)

➤ Some EC Priorities:

- New FP7 activity in these areas: should ensure **complementarity** with the extensive activities already undertaken by ESA/member states, e.g. ESA road-maps
- Focus on upstream aspects of research (e.g. **innovative** launch/propulsion technologies, optimal preparation of scientific payloads)
- But also downstream aspects (effective **exploitation** of data produced by missions, contribution to the **sustainable** provision of critical components)

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Strengthening Space Foundations Role of ESA

- Framework Agreement between the European Community and the European Space Agency
- ESA will support EC in the evaluation, negotiation and monitoring of FP7 supported actions in the “Strengthening Space Foundations” part, including Space Technology.
- ESA, being on the evaluation side, will not participate to any proposal in answer to FP7 Space call 1, for the “Strengthening Space Foundations”.
- EC has asked ESA to advise Industry, SME’s, Research Institutes and Academia on complementarities of the EC calls for proposals with ESA roadmaps

FP7-Space Call 1 – Space Science (excerpt work programme)

- Focus on up and downstream research and the improvement of the public awareness by:
 - Developing tools to archive, access and process data obtained from different sources,
 - Mobilising the best expertise for the analysis and interpretation of space data, selecting the most innovative and challenging objectives in emerging scientific fields,
 - Promoting the contribution of space assets to the scientific and technological knowledge and foster its transfer to educational bodies.
- Project proposals must targeted specific space science domains in which a strong need for further scientific analysis of data can be demonstrated.
- Proposers should clarify **how advantage is taken of existing infrastructures at European (ESA) or national level**, thereby adding to their value for Europe.

Space Science ESA Activities

- **ESA as Source of Data**
- **Astronomical archives at ESA**
 - XMM-Newton Science Operations Centre
 - Integral ISCO Science Data Archive
 - Planetary Science Archive
 - ESA Virtual Observatory
 - ISO Infrared Space Observatory
- **Freely Available by Internet Access:**
 - <http://xmm.vilspa.esa.es/>
 - <http://integral.esac.esa.int/isda/>
 - <http://www.rssd.esa.int/index.php?project=PSA>
 - <http://esavo.esac.esa.int/>
 - <http://www.iso.vilspa.esa.es/>

Space Science ESA Activities

➤ **ESA Center (ESAC) in Madrid**

- The European Space Astronomy Centre (ESAC) is the ESA centre that specialises in astronomy and space science. It is located in Villafranca del Castillo, Villanueva de la Cañada, close to Madrid, and hosts the science operation centres for all ESA astronomy and planetary missions together with their scientific archives.

➤ **Contact for FP7-Space Strengthening Space Foundation – Space Science in ESAC:** **Christophe Arviset**

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FP7–Space Call 1 Space Transportation (excerpt work programme)

- Innovative Propulsion Concepts, novel techniques or consolidating new technologies
 - **such as heliothermic propulsion, new generation of solid, electric and cryogenic propulsion and associated components technologies.**

Expected impact: To consolidate the long term sustainability and to improve the economical aspects of a domain known to be demanding in terms of reliability by experimenting novel techniques and methodologies.

ESA's Research Activities in the area of Launchers and Complementarities with FP7

Focus on activities performed in the frame of the Future Launchers Preparatory Programme (FLPP)

Infoday on Space Activities (other than GMES) in FP7

Madrid, 16 May 2007

Contents

- ◆ Overview of ESA Launcher Programmes
- ◆ Main objectives of Future Launchers Preparatory Programme (FLPP)
- ◆ Activities performed in the frame of FLPP
- ◆ Indication of potential complementary areas to be funded within the frame of FP7

Providing access to space

Enabling autonomous action in the space sector
Development of space applications sector
Unrestricted access to space for strategic purposes

Developing and safeguarding industrial capabilities

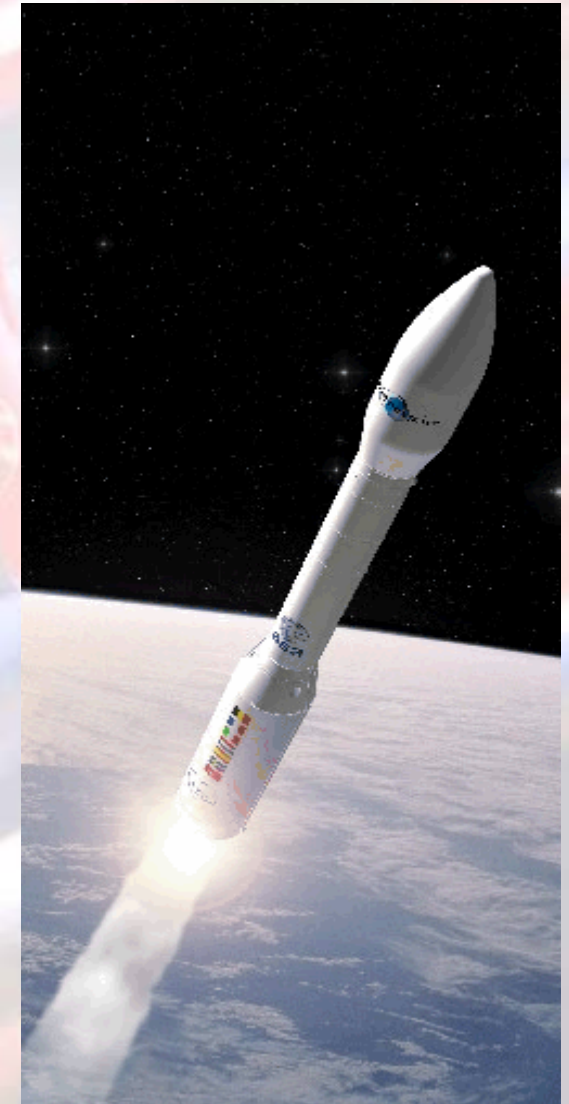
Launcher systems developed and produced by European industry
More than 50 industrialists involved in ESA Member States
Financing more than 3 billion € over 2006-2011 (on-going programmes & CSG)

Promoting research and development

Solid technology base in all critical areas
(system, solid & liquid propulsion and stage & equipment)

European undertaking

12 Main Participating States
European Spaceport located in French Guiana



Launcher Programmes - “the family”

ARIANE

A5 Plus, A5 Evolution, INFRA,
A5 ATV adaptation, A5 slice 10, ARTA,
A5 In-flight demonstration, and ACEP

VEGA

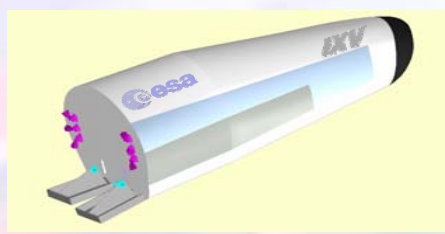
Small Launcher, P80, and VERTA

SOYUZ

Soyuz at the CSG

FUTURE LAUNCHERS

FLPP-1 and FLPP-2 Step-1



The FLPP Programme

The main elements of the European strategy for access to space are the following:

- Responding to European institutional needs
- A guaranteed and affordable access to space through a family of launchers
- The availability of the European spaceport
- The preservation of the European industrial base
- International Cooperation

Within this strategy, the Future Launchers Preparatory Programme (FLPP) is a technology development and demonstration programme aiming at developing European **system and technological capabilities** and enhancing the long-term competitiveness of European launchers within the European industrial organisation;

Main objectives of FLPP

FLPP will allow to develop the technologies required for a future launcher system (Reusable Launch Vehicle and Expendable Launch Vehicle) through:

- ◆ Development of technological and industrial capabilities needed for deciding and developing either:
 - evolutions of existing launchers' (Ariane 5 and Vega)
 - a new launcher for the medium term based on mature technologies
 - the Next Generation Launcher (NGL) in the long term
- ◆ Contribution with technical and programmatic elements to the scenario analysis.
- ◆ Achievement of a significant step forward in maturity increasing and validation of critical technologies dedicated to the long term NGL preparation.

FLPP Programme was then divided into periods, for a step by step approach:

- ◆ Period 1 (2004-2007) (budget 38 M€)
 - Preparation of down-selection of Reusable Launch Vehicle (RLV) system concepts
 - Driving the technology developments
 - Preparation of experimental vehicle concepts
 - Assessment of evolutions to reduce the cost of current Expendable Launch Vehicles (ELV)
- ◆ Period 2 (2006-2009) (budget 313 M€)
 - Provide technical elements for decisions in 2008
 - Preparation of New Generation Launch vehicle concepts (ELV, RLV) down selection
 - Perform associated technology activities focussing on demonstrators (propulsion, cryogenic stage, re-entry, materials and structures...)
- ◆ Period 2 step 2 and Period 3 (2008-2013) : activities to be revised and updated as a function of the selected scenario

Main objectives of FLPP

Overall approach for technologies improvement:

- ◆ **Dedicated system studies of NGL (including both RLV and ELV) concepts**, with a progressive down-selection, allowing comparison of the most promising solutions in each category;
- ◆ **Demonstration of enabling technologies**, through testing of specific demonstrators at component and/or sub-system level (on-ground experiments and in-flight passenger)
- ◆ **In-flight experimentation of integrated key re-entry technologies**, for integrated system demonstration, technologies validation and technologies experimentation.

The following domains are addressed:

- ◆ **System activities**
- ◆ **Technology**
 - **Propulsion:**
 - Liquid Rocket Propulsion : Upper Stage / Main Stage Engine System and Technologies
 - Solid Rocket Propulsion
 - Cryogenic Upper Stage Technologies
 - Materials and Structures
 - Other Technologies
- ◆ **In-Flight Experimentation**

Activities performed in the frame of FLPP

System activities

- ◆ Review of promising RLV concepts and definition of initial design features of following phases (developing and applying a methodology for the concept down-selection)

Technologies / Propulsion

- ◆ Expander cycle engine: demonstration programme to address Cryogenic Re-ignitable Upper Stage need
- ◆ Main stage propulsion
 - propulsion System activities related to tradeoffs, considering combustion cycle and propellant (LOX/HC, LOX/LH2)
 - assessment of LHC specificities for turbopumps including tests (Material compatibility, LCH4 cavitation...)
 - Pathfinder demonstrator for staged combustion (design and tests)
 - Technology for turbopumps (bearing, seals, high pressure turbine...), Nozzle and Equipment (valves reusability, Igniters...)
- ◆ Health Monitoring System and Regulation
- ◆ Solid Propulsion : validation of pressure oscillation models performed and assessment of low cost raw materials screening
- ◆ Other technologies
 - Slush / densified cryogenic propellants
 - Opto-pyrotechnics
 - On-Board Computers technologies

Intermediate eXperimental Vehicle (IXV)

In-flight experimentation of integrated key re-entry technologies, for integrated system demonstration, technologies validation and experimentation.

- ◆ System analysis, including trajectory based on Vega launcher
- ◆ Design and qualification, including Functional Measurements, Vehicle Model Identification Measurements, core and passenger experiments
- ◆ Manufacturing and test of a flight model
- ◆ Flight
- ◆ Post flight analysis

ESA Launcher Programmes and Principles of the Space Transportation topic within FP7

According to the Council of the European Union decision concerning the Specific Programme "Cooperation" (2006/971/EC) and the updated applicable Cooperation Work Programme (FP7-SPACE-2007-1), the Space Transportation topic will focus on:

- Upstream actions
- Providing R&D support to the foundations of space transportation
- Development of new concepts
- Enhancement of scientific added value through synergies with ESA activities

In particular, being an entirely new area of the European Commission Framework Programme, of strong interest to ESA, support to space transportation should be provided through synergies with initiatives of ESA. The Work Programme therefore makes it clear that FP7 projects related to space transportation should be complementary to ESA's activities in the launcher area.

Preliminary indication of technical space transportation areas that would be complementary to those currently funded by ESA

1. Nuclear propulsion, inter alia:

- radioisotope thermoelectric generator technologies;
- power conversion technologies (based on either Stirling or Rankine cycles);
- nuclear-thermal propulsion and nuclear-electric propulsion technologies.

2. Hybrid propulsion, inter alia:

- system and propellant design;
- hybrid fuel regression rate assessment;
- modelling and experimental tools.

3. Use of advanced avionic components, inter alia:

- digital busses and next generation computers
- aluminium wiring.
- smart sensors (autonomous power supply and conditioning, direct cable-less link to launcher emitter),
- new power source technologies,
- use of cots as components whenever possible,
- hybrid navigation systems.

4. Advanced Aerothermodynamics involving computation fluid dynamic tools, ground based facilities and measurement techniques, focusing on the development and validation of standard European aerothermodynamic tools for data basing, design and flight extrapolation studies and on active flow control for drag reduction and heat load mitigation.

5. Ultra-high temperature materials and thermal protection systems for future generations of reusable space transportation systems.

6. Integrated Health Management Systems and technologies

- Sensor miniaturization;
- Advanced sensor technology;
- Algorithms and S/W development;
- Design tools and engineering simulators;
- Real-time simulator with hardware in the loop.

FP7 Space – Call 1 Space Technology (excerpt work programme)

- Critical components for Non-Dependence aspects
- In particular:
 - Focus on Deep Sub-micron Technology (**DSM**), high capacity reprogrammable gate arrays (**FPGA**), high speed digital/analogue and analogue/digital converters (**ADC/DAC**) and high speed serial links (**HSSL**).
 - Focus on Gallium Nitride (**GaN**) technologies, **Schottky** diodes for high-frequency applications, ferrite latched circulators technology
 - Projects are expected to demonstrate their complementarity with existing ESA road maps (see also the Strategic Research Agenda (SRA) of the European Space Technology Platform (ESTP))
- To progress towards the sustainable provision of technologies needed by the European space to become non-dependant

The European Space Technology Platform (ESTP)

- European space technology stakeholders, under ESA initiative and with EC (DG-ENTR) support, launched in September 2004 the **European Space Technology Platform (ESTP)**, as the Technology Platform for Space Technology
- It leverages on the existing **European Space Technology Harmonisation** established in response to 2001 Ministerial Council Resolution:
“Pursue the programmatic coordination and harmonisation of technology programmes in Europe and prepare the European Space Technology Master Plan (ESTMP)”



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ESTP Logic Flow for Call 1



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ESTP Strategic Research Agenda

- **The ESTP SRA 2006 full document plus Executive Summary was issued on 7th July 2006**
 - The Strategic Research Agenda (SRA) of the ESTP conveys the results of the most extensive space technology coordination process in Europe
 - It prepares the ground for a coherent deployment of technologies in the context of a European Space Programme
- **The SRA is available on the ESTP website**
www.estp-space.eu
- **The priorities recommended have been fully reflected in the Work Programme**



EUROPEAN SPACE
TECHNOLOGY PLATFORM
The Technology Platform for Space Technology

Strategic Research Agenda

Version 1.0
22.6.2006
<http://www.estp-space.eu>

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The 3 Pillars of the ESTP SRA

- As it has been the case in the last decades, ESA and National Agencies will continue to play a major role in the deployment of space technologies. A complementary effort is requested from the EU through three strategic Pillars

Pillar 1: Non-Dependence

Strategic space technologies needed for Europe's non-dependence.

Pillar 2: Multiple-use and Spin-in

Synergic actions with the non-space sector in areas of mutual interest (e.g. embedded systems, photovoltaics, fuel cells, nano-technologies, ICT and robotics).

Pillar 3: Enabling technologies

Support the implementation of EU policies by developing needed technology (e.g. in the area of human security).

- Priorities for 2007/2008 have been identified with a special focus on supporting Pillar (1) Non-Dependence, to reduce critical dependence

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ESA Activities : Deep-Submicron Technology

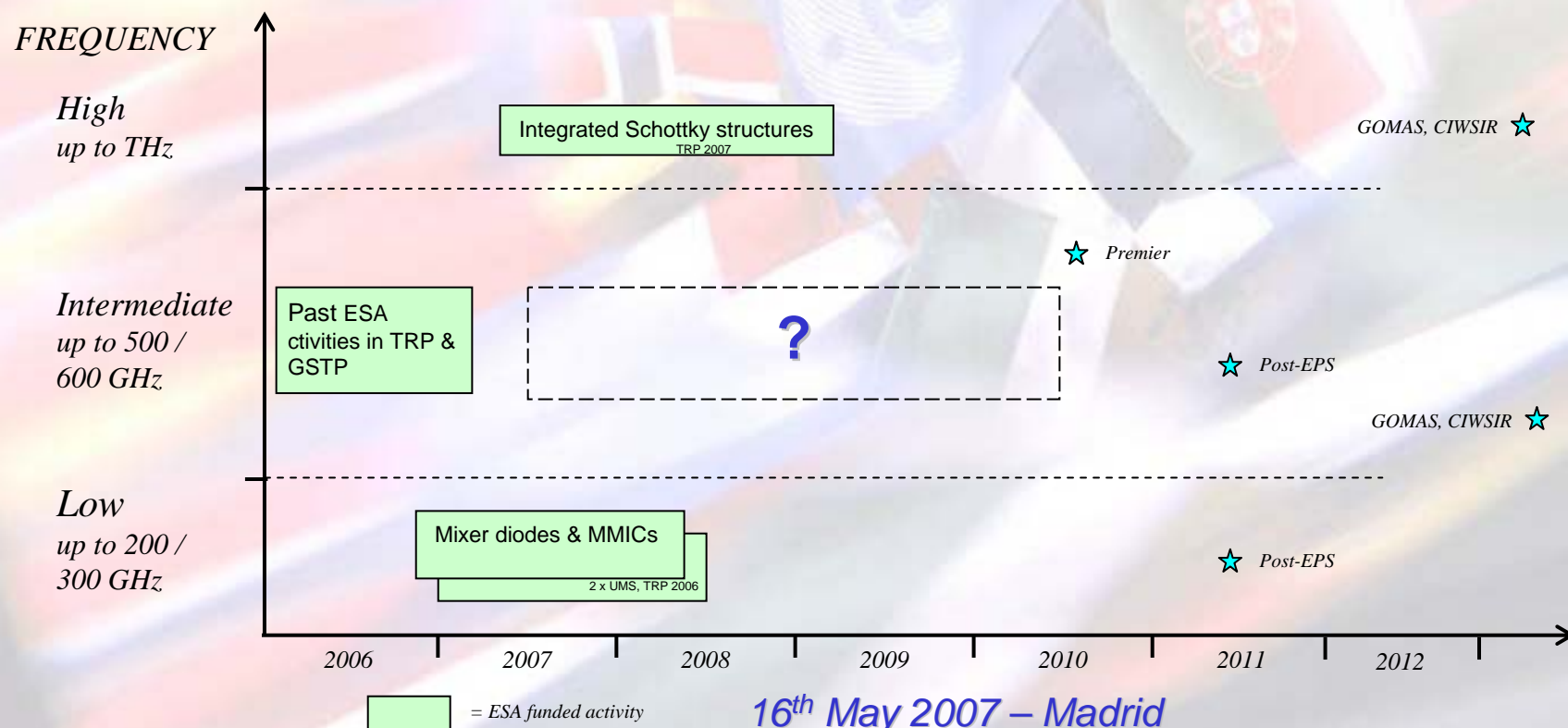
- **ESA opens in next weeks tender in EMITS regard to:**
 - 07.1ET.19 Broadband low-power ADC design & prototyping
 - 07.1ET.20 Broadband low-power DAC design & prototyping
 - 07.2ET.01 Deep-Sub-Micron ASIC technology assessment and high-speed-serial-links design
- **Sustainable provision of critical components**

ESA Activities : Gallium-Nitride (GaN) Technology

- **ESA open tender in regard to:**
 - Reliability production of GaN elements
- **AO 5406 GaN Reliability Enhancement and technology Transfer Initiative (GREAT 2)**
 - focus on: the improvement of GaN device reliability for space application
- **A topic not treated there is e.g. advanced thermal management and packaging solutions for GaN HEMTs and GaN MMICs**

Schottky

- **ESA ongoing activities in the frequency range of up to 200-300 GHz**
- **Complementary actions are needed for critical components > 300 GHz**
 - Planned/proposed EO missions: Post-EPS, Premier, GOMAS, CIWSIR



Conclusion

- **Space has a dedicated line in FP7 and with “Strengthening Space Foundations” addresses Space Science, Space Transportation and Space Technology**
- **ESA together with industry and National Delegations has built in the context of ESTP a Strategic Research Agenda reflected in the EC Workprogramme**
- **ESA advises Industry, SME’s, Research Institutes and Academia on complementarities of the EC calls for proposals with ESA roadmaps**
- **Overall goal is to promote coherent and complementary European space activities**

➤ **Overall Point of Contact for Complementarity in FP7-Space Technology**

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➤ The Netherlands

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Further Points of Contact

➤ Space Science ESAC

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➤ Launchers

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➤ Technology

- Mikko Nikulainen (Mikko.Nikulainen@ esa.int)

Thank you for your attention

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