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# Draft Work Programme Space

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## 2.1.7 Space

Space research is supported in Horizon 2020 under the heading "Industrial Leadership", in line with the main objective and challenge to **foster a cost-effective competitive and innovative space industry (including SMEs) and research community to develop and exploit space infrastructure to meet future Union policy and societal needs**. Building on the successes of FP7, Horizon 2020 will enable the European space research community to develop innovative space technologies and operational concepts "from idea to demonstration in space", and to use space data for scientific, public, or commercial purposes. This will anchor and structure space research and innovation at the European level.

Actions will be carried out in conjunction with research activities of the Member States and ESA, aiming at building up complementarity among different actors.

The Commission proposal for Horizon 2020 sets the following motto for EU Space R&D for 2014 to 2020 'Prepare for the increasing role of space in the future and reap the benefits of space now'.

The work programme has been structured to address these roles by

- Prioritising the three EU Space flagships of **European Global Navigation Satellite System (EGNSS), Earth Observation and Securing Europe's investment in Space against threats**, ensuring their state-of-the-art also in the future;
- Ensuring that industries' leadership in space can still be maintained and enhanced in future global markets, by boosting the **Space industry sector competitiveness, and innovation capacities**;
- Ensuring that Europe's investments made in space infrastructure are exploited to the benefit of citizens, as well as **space science; and**
- Enhancing Europe's standing as attractive partner for **international partnerships in space science and exploration**.

These three four priorities are to be supported prioritising the three EU Space flagships of **European Global Navigation Satellite System (EGNSS), Earth Observation and Securing Europe's investment in Space against threats** with some 60% of the budget.

### 2.1.7.A Calls

#### 2.1.7.A.1 Call "Applications in Satellite Navigation - Galileo" – 2014 & 2015

The European Global Navigation Satellite System (EGNSS), operated under civilian control, encompasses satellite radio-navigation system established under the Galileo programme and European Geostationary Overlay System (EGNOS).

The Galileo programme will provide GNSS services and increase availability and reliability of other GNSS, while ensuring the European non-dependence from other GNSS systems. It will provide a strategic advantage for Europe and maximise the socio-economic benefits for the European citizens.

Horizon 2020 will accompany the infrastructure deployment by 1) fostering the further uptake of EGNSS in applications, 2) preparing the secure utilisation through the development of a PRS receiver and 3) foreseeing the future evolution of the EGNSS infrastructure.

To meet the overall objectives of the Galileo programme and to foster the uptake of EGNOS and Galileo, the development of applications is vital. New satellite navigation applications are being developed every day, covering numerous sectors of the world economy. The expected global market will reach EUR 240 billion by 2020.

These activities will give European industry the right opportunities to acquire the knowledge and expertise required to compete in the international environment. Small and Medium Enterprises are key players for innovation in this sector.

This call should result in the development of applications and implementation of pilot projects with a potential to contribute to the growth and strengthening of the European GNSS market and to have an impact on sectors where the EU's added value and cost effectiveness are the greatest.

The application of space technologies shall also be supported through the respective Societal Challenges, where appropriate.

### ***Topic A – EGNSS applications***

#### Specific challenge:

European society and industry are facing new challenges, requiring more innovation, productivity and competitiveness, whilst using fewer resources and reducing environmental impact. GNSS offers various possibilities for the development of new space enabled applications, which will enhance Europe's capacity to address major societal challenges in focus areas such as health, citizen safety, smart cities, sustainable resources management, regional growth, low-carbon energy infrastructure planning and protection, disaster management and climate action.

Satellite navigation provides continuous, real-time, reliable, accurate and globally available position, velocity and time. The technology fits important societal and market needs. Market uptake of Galileo is to a large extent determined by availability of Galileo-enabled receivers and applications, which are crucial to reap the socio-economic benefits and to ensure that the EU is not dependent on non-European GNSS.

#### Scope:

Proposals should aim at developing new innovative applications, with future commercial impact. Application development should be seen in a broad context - it includes the development, adaptation and/or integration of new software, hardware, services, datasets etc. The use of EGNOS and Galileo Early Services is a key priority for this topic.

Research and innovation activities within this topic should take into consideration possibility of:

1. Exploitation of synergies with other space-based services and systems in order to enable multi-use character of EGNOS and Galileo-enabled applications in all market segments,
2. Validation of early services, ensuring a greater precision and availability of signals,

3. Implementation of pilot projects for further development of EGNSS based applications,
4. Standardisation, certification, legal and societal acceptance, which will foster EGNSS adoption, and
5. Awareness campaigns for the development of EGNSS usage and their promotion worldwide.

Expected Impact:

Activities should promote innovation in order to maximise the potential of the European GNSS and its adoption. They should include synergies with other GNSS, definition and implementation of pilot projects and development of the EGNSS-enabled applications that are close to the market with a high societal benefit and a potential to eventually set common standards in the field of GNSS applications. The project should have a clear intention to commercialise the products and services developed.

Release of practical tools to the GNSS developer community, ideally with free open source license, is of particular interest.

Instrument(s): Collaborative Projects for research and innovation – close to market (70%) The indicative funding earmarked for this topic is 15-20 million Euro.

***Topic B – Small and Medium Enterprise (SME) based EGNSS applications***

Specific challenge:

European society and industry are facing new societal challenges, requiring more innovation, productivity and competitiveness, whilst using fewer resources and reducing environmental impact. GNSS offers various possibilities for the development of new space enabled applications, which will enhance Europe's capacity to address major societal challenges in focus areas such as health, citizen safety, smart cities, sustainable resources management, regional growth, low-carbon energy infrastructure planning and protection, disaster management and climate action.

Satellite navigation provides continuous, real-time, reliable, accurate and globally available position, velocity and time. The technology fits important societal and market needs. Market uptake of Galileo is to a large extent determined by availability of Galileo-enabled receivers and applications, which are crucial to reap the socio-economic benefits and to ensure that the EU is not dependent on other GNSS.

Scope:

This topic will explore new applications in niche market sectors and business models in any application domain. Proposals should aim at developing sophisticated, innovative applications, products, feasibility studies, market tests etc. They should address emerging user needs and taking specifically advantage of the Galileo and EGNOS capabilities. A specific emphasis will be given to support development of technological breakthrough into viable products with real commercial potential, where SMEs, which are considered as the key players for innovation in this domain, play a pivotal role, given their flexibility and adaptability.

Expected Impact:

Activities should aim at developing highly innovative and adaptive applications taking advantage of the Galileo and EGNOS. The project should be led by an SME and have a clear intention to commercialise the products and services developed. Additional partners, within the consortium, should contribute directly to the needs identified by the SME, in the lead, in order to fulfil the above objective of commercialisation.

Release of practical tools to the GNSS developer community, ideally with free open source license, is of particular interest.

Instrument(s): Collaborative Projects for research and innovation – close to market (70%). The Commission considers that projects requesting a contribution from the EU of around € 300.000 would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. The indicative funding earmarked for this topic is EUR 5-10 million.

***Topic C – Releasing the potential of EGNSS applications through international cooperation***

Specific challenge:

Although Galileo is a European programme, it has a strong international dimension. International cooperation in the field of Galileo-enabled applications is therefore an essential element facilitating its breakthrough to new and emerging markets and strengthening Europe's position as a major space player.

Scope:

Activities under this topic will enable the development of innovative applications within international context and related standards with high international impact, ensuring that the EGNSS services are well known and can be used throughout the world. The objective is to support new projects consisting of demonstrators of applications, adaptations of applications to a specific and local context outside of the European Union and the implementation of applications benefiting from multiple constellations, including Galileo. GNSS should be used as the primary positioning technology in the application and positioning should be a key enabler of the application. Non-EU countries will be guided and supported in adapting services and developing applications corresponding to local needs and ensure that no unnecessary restriction to the use of the EGNSS is applied. Focus will be on regions of the world, which represent an attractive market for the European industry.

Expected Impact:

Projects are expected to foster application development through international cooperation and create a broad acceptance of EGNSS in non-European countries. The consortium should aim to transform the research results into innovation in third countries (outside of the EU), through the networking of relevant technology developers with local academia, incubators, SMEs, representatives from civil society as well as local authorities, notably for the provision of public services, best practices and technology through the establishment of self-sustainable partnerships and collaborative initiatives.

Release of practical tools to the GNSS developer community, ideally with free open source license, is of particular interest.



Instrument(s): Collaborative projects for research and innovation – close to market (70% rate), The indicative funding earmarked for this topic EUR 5-8 million.

***Topic D – EGNSS awareness raising, capacity building and/or promotion activities, inside or outside of the European Union***

Specific challenge:

Awareness raising and capacity building in the field of EGNSS are essential elements in facilitating the breakthrough of EGNOS and Galileo inside and outside Europe and in increasing the number of opportunities for future collaboration between European and non-European GNSS entities. Promotion activities should take a more active role in generating new ideas ready to spin-off and/or to go into market introduction, in providing crucial seed financing and in increasing the visibility of the EGNSS.

Scope:

The proposals should aim at capacity building, increasing awareness of EGNSS solutions, providing networking opportunities of centres of excellence and other relevant actors and achieving a critical mass of EGNSS applications success stories, making it an attractive option for private investors in Europe and also globally. Activities under this topic may also contribute to the cooperation schemes, which have been established with partner countries worldwide.

Technology promotion activities can include support to prizes for innovative applications developed by companies and entrepreneurs and based on the EGNSS that will promote the uptake of satellite navigation downstream applications across Europe and beyond. Proposal for support for prizes shall include details about the intended conditions for participation, award criteria and amount of prizes<sup>1</sup>.

Expected Impact:

The main aim of this topic is to support building of industrial relationships by gathering private and public institutions around services offered by EGNSS and related applications. This topic should support the competitiveness of EU industry by identifying strategic partners and by developing market opportunities.

The support for prizes scheme should foster the emergence of new downstream applications based on both Galileo and EGNOS and therefore to support the EU GNSS industry.

Instrument(s): Coordination and Support Action (100% rate), Indicative funding for this topic EUR 5-10 million

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<sup>1</sup> In-line with the requirement of Regulation No 966/2012 of the European Parliament and of the Council of 25 October 2012 and Commission Delegated Regulation No 1268/2012 of 29 October 2012

## **Funding details for Call 2.1.7.A.1**

Publication date: With the launch of Horizon 2020 in 2014

Deadline(s): Two deadlines are foreseen for topics A to D: 24 April 2014 and 28 Nov 2014

Indicative budget: EUR 38 million for 2014 and EUR 38 million for 2015 for the overall call

*[Link to the relevant option on "margin of manoeuvre"]*

Eligibility conditions: The standard eligibility conditions apply. Please read carefully the provisions [Link to the annex on standard eligibility conditions] under Annex X before the preparation of your application.

Evaluation criteria: The standard evaluation criteria apply.

The criterion of impact will be given a higher weighting for proposals for close-to-market actions.

Please read carefully the provisions [Link to the annex on standard evaluation criteria] under Annex X before the preparation of your application.

Overall expected impact: as stated per topic

Evaluation procedure: [Link to the annex on standard evaluation procedure]

- Proposal page limits and layout: The standard guidelines apply. Please read carefully the guidelines [Link to the annex on guidelines] before the preparation of your application.
- Single or two stage procedure: single stage procedure
- Indicative timetable for evaluation and grant agreement: The evaluation is to commence within 2 months of the call deadline, with negotiations of successful proposals commensurate with the 2014 budget/2015 budget expected to commence three months after the call deadline.

Consortia agreements: The conclusion of a Consortium Agreement is required for any action under this call, and applicants are advised to prepare a draft Consortium agreement during the proposal drafting phase.

Implementation:

The Call for proposals 2.1.7.A.1 under this work programme will be implemented by the **EuropeanEuropean GNSS Agency** (GSA) according to the provisions of Commission Decision xxxx [Dir H to complete Decision reference]. The management of all projects to be funded as a result of this call 2.1.7.A.1 will be implemented by GSA.

The **European Space Agency** will not participate in consortia of proposals submitted under this call for proposals.

## **2.1.7.A.2 Call “Earth Observation” – 2014**

### **Objective 1 – Space enabled Applications**

Over the last decade, Europe has established the autonomous capacity for space-borne observations and operational services in the field of environment, civil protection and security. Operational satellites are providing data on a free and open data policy basis as well as commercially, and are complemented by first-of-a-kind research satellites. Scientific exploitation of this existing and emergent European space infrastructure needs to be enhanced, by stimulating the emergence of novel ideas on what can be observed from space, and what information might still be hidden in existing Earth Observation (EO) data of various kinds. Research to promote such new ideas will ensure Europe’s leadership in space-enabled applications in the future, and enable Europe to effectively address its research challenges, as well as the focus areas of the Commission’s strategic programme for Horizon 2020, in innovative ways within the societal challenge pillar.

#### ***Topic A – New ideas for Earth-relevant space applications***

##### Specific challenge:

Space systems produce information which often cannot be acquired in any other way. Specifically, the Copernicus data are expected to provide improved data quality, coverage and revisit times, and increase the value of Earth Observation data for scientific work and future emerging applications. Equally, space data obtained for specific purposes can subsequently reveal novel scientific insights which were not specifically intended or expected at the time of space sensor launch. In order to fuel this scientific cycle of discovery, and further enhance scientific exploitation of collected space data related to Earth (now or in the near future), new upstream data products and analysis methods suitable for subsequent scientific integration into applications (such as for instance conducted in the calls of the Horizon 2020 societal challenges) should be generated. Data could include a wide variety of Earth-relevant space-based data (e.g. remote-sensing data, gravity data, magnetic data, GNSS signals), thereby widening the data scope beyond conventional EO images.

##### Scope:

New and hitherto immature uses of Earth-relevant space-based data should be investigated to enable integration into scientific investigations related to Earth system sciences, or forecasting models at regional or wider geographical extent. It is expected that proposals address also how the insights proposed to be obtained from space based data can be validated, e.g. in combination with ground based observations, with appropriate attention also being given to calibration of space data. Research into specification of the uncertainties associated with the derived results should also be included. To enhance the use of intermediate and final products, due attention is also to be given to standardisation of data, best practices, dissemination mechanisms and reference frames.

Preference shall be given to the usage of data from space-borne European instruments. In case such European data exists, the primary use of non-European data shall be justified by the

bidder. Proposers may thus find it helpful to consult information on availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data, at the Commission's web <http://xxxx>.

Expected impact:

Projects are expected to prepare the ground for further innovative exploitation of European space data in scientific activities and/or future and emerging applications, and are expected to have a significant impact in stimulating wide exploitation of space data.

The excellence and the application potential of these new data products and concepts will have to be demonstrated through selected examples and demonstration cases. The results shall be actively disseminated in the relevant scientific publications, as well as towards potential user communities as appropriate. The research may deliver as well input for drawing up user requirements for enhanced processing tools or future observation instruments.

An important impact is also the applicability of the results for further systematic research usage, either in the context of the societal challenges addressed by Horizon 2020 calls, or research conducted in domains not covered in the scope of other Horizon 2020 funding areas. Results will therefore have to attain the necessary maturity to fulfil this promise.

Instrument(s): Collaborative Projects for research and innovation (100%); The Commission considers that projects requesting a contribution from the EU of 2.5 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 15 million Euro has been set aside for call objective 1.

## **Objective 2 – Tools for access to space data**

Efficient and widespread exploitation of the existing and planned operational European space infrastructure is only possible if further efforts are made for the processing, archiving, standardised access and dissemination of satellite data. Sustainable availability has also to be coupled with generic search, data-mining and visualisation techniques inviting wide data use, also allowing for standardised and automated approaches. Wide use has to be achieved at European and global levels, and coordination with mechanisms promoted in the context of the Global Earth Observation System of Systems (GEOSS) is to be achieved.

For successful exploitation of space borne sensors to take place, it is furthermore necessary to provide access to easy-to-use, calibrated and validated data products, taking into account the latest and emerging remote sensing capabilities. Validation efforts have to provide researchers and users with well-defined uncertainty ranges of space data to make the subsequent usage verifiable and to allow for cross-sensor or cross-satellite use of data.

### ***Topic A – Stimulating science use of Copernicus Sentinel Data***

Specific challenge:

Europe's investment in the Copernicus Sentinel satellites will provide Europe with an unprecedented source of operational satellite data. The first and largest streams of data will become available from Sentinel 1 (SAR data) during 2014, to be followed shortly thereafter

with data from Sentinels 2 and 3 (optical imaging data). Data streams are expected to amount to several terabyte per satellite orbit, thereby delivering unprecedented temporal and spatial resolution and data continuity, calling for new data handling and processing paradigms. While this data is ingested into the operational Copernicus services, wide scientific use is still limited and needs to be stimulated with easy-to-use interfaces for scientific R&D.

Scope:

To utilise the high scientific potential of the Sentinel data, stable and predictable access methods need to be developed, such as

- research into efficient information retrieval from satellite data repositories and dissemination;
- developing software to read and transform data for access by scientific users, including data mining techniques;
- developing data fusion methods (data from several sentinels and /or other contributing satellite missions);
- advanced visualisation techniques (allowing also for sensory exploration of data beyond visual experience).

A particular aspect of interest is also the international use of Sentinel data, as acceptance of Copernicus data in a global context will be a key to success of Europe's contribution of Copernicus to GEOSS.

Proposers are advised to consult further information on availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data, as well as issues recommended to be detailed in the proposals at the Commission's web <http://xxxx>.

Expected impact:

This research topic should attract active participation of researchers in academia, specialising on the use of sentinel data and their integration and/or comparison with other sensor data (from space or in-situ). It should actively involve students performing research with satellite data.

Wider use of data should be achieved, in Europe as well as internationally. Further opportunities for new uptake of satellite data should be created. Possible models for operational supply of data to users, especially for further scientific exploitation should be demonstrated. The work should promote the definition of best practices and their adoption in scientific and commercial user communities, and in a GEOSS context if possible.

Instrument(s): Collaborative projects for research and innovation (100%).The Commission considers that projects requesting a contribution from the EU of 2.5 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 7.5 million Euro has been set aside for this call topic.

## ***Topic B – Land Use/Land Use Change Space-based Data reprocessing and calibration***

### Specific Challenge:

Research areas such as Land use and Land use Change (LULUC) address long time periods, where data acquired in the past are essential. The data from past EO missions, either from European or non-European satellites, must be made accessible in a way to reconstruct seamless time series of similar observations across sensors and technologies over two decades and more. At the same time, parameters derived from space data need to be adapted to be more relevant to current policy issues, such as for example bio-fuel production impacts or shifts to a low carbon economy.

### Scope:

The data contained and maintained in archives of the relevant data holding agencies will require to be reprocessed to ensure consistent time series and data formats, to be updated to latest algorithms, and land use classifications. Manipulation of historical data at the relevant source will be required to enable quick analyses, bulk reprocessing and wide access to different science and application communities. Interoperability of diverse observation collections and sensor-to-sensor inter-calibration will have to be included, as well as establishing of the associated uncertainties and limits. In order to be of value to LULUC research, the results will have to take reference also to existing classification schemes and classes.

Proposers are advised to consult further information on availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data, as well as issues recommended to be detailed in the proposals at the Commission's web <http://xxxx>.

### Expected Impact:

The project is expected to significantly contribute to the availability of validated space-based observational data on Land Use and Land Use Changes as a long time series, providing consistency of land use data records over a time period corresponding to the satellite era.

Activities should thereby lead to a better uncertainty characterisation of available data records, particularly when it comes to change detection, and automated processes to derive these.

The project should also have an impact on promotion of best practices in the derivation of land use information from satellite data, particularly as regards the validation and calibration of satellite data.

Instrument(s): Collaborative Projects for research and innovation (100% rate). The Commission considers that projects requesting a contribution from the EU of 6 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 6 million Euro has been set aside for this call topic.

### ***Topic C – Observation capacity mapping for Climate change monitoring***

#### Specific Challenge:

Climate research is a case that clearly illustrates the full complexity of needs for validation and calibration of space data, and hence of the remote sensing data at source. More atmospheric species need to be monitored, simultaneously and for the same air mass, at local to global level. Space based remote sensing data have to be integrated with measurements taken at different places in the atmosphere, from the middle atmosphere down to ground level, and a comprehensive 3-D coverage has to be developed and implemented together with an appropriate validation strategy. While many validation campaigns are conducted at national and international level, particularly to validate specific sensors and satellites, a European coordinated approach in charting systematically the available and needed instrument suites for systematic climate change monitoring in space and time, and the correspondingly required validation campaigns remains elusive.

#### Scope:

To achieve this, research is needed to assess gaps in remote observation availability and suitable approaches for defining virtual observation constellations. It should include mapping of ground based networks, airborne, balloons and sub-orbital platforms as well as space based sensors. Appropriate validation of data is to be assessed, charting which validation campaigns will be needed to cover the climate change monitoring needs in years to come. A mapping of available/deployed sensor technologies and measurements should be performed as a first step, to identify gaps in available systems to characterise the atmosphere. This information should also lay the basis for drawing up the need for validation campaigns combining instruments and measurements deployed in ground based networks, airborne, balloons, sub-orbital and in-orbit platforms, as relevant for climate change monitoring. Since this activity is highly reliant on consensus of the scientific community involved in climate change and atmospheric measurements/modelling, the project will have to mobilise key players across Europe and globally, and will have to include mechanisms to reach a consensus on the strategies proposed.

#### Expected Impact:

The project is expected to lead to significant advances in greater coherency and cross-calibration/validation of space based measurements, providing a better overview of uncertainty of available data. Based on the work done, best practices regarding validation campaigns should be promoted.

Instrument(s): Collaborative project for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 4 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 4 million Euro has been set aside for this call topic.

## **Funding details for Call 2.1.7.A.2**

Publication date: at launch of Horizon 2020 in 2014

Deadline(s): 24 April 2014

Indicative budget: (from the 2014 budget)

Objective 1 - Topic A: EUR 15 million

Objective 2 - Topics A, B, C: EUR 7.5 million; 6 million; 4 million respectively

[Link to the relevant option on "margin of manoeuvre"]

Maximum EC Contribution:

The maximum EU contribution for a project is specified under each topic

Eligibility conditions: The standard eligibility conditions apply. Please read carefully the provisions [Link to the annex on standard eligibility conditions] under Annex X before the preparation of your application.

Evaluation criteria: The standard evaluation criteria apply. Please read carefully the provisions [Link to the annex on standard evaluation criteria] under Annex X before the preparation of your application.

Overall expected impact: as stated per topic

Evaluation procedure: [Link to the annex on standard evaluation procedure]

- Proposal page limits and layout: The standard guidelines apply. Please read carefully the guidelines [Link to the annex on guidelines] before the preparation of your application.

- Single or two stage procedure: single stage procedure

- Indicative timetable for evaluation and grant agreement: The evaluation is to commence within 2 months of the call deadline, with negotiations of successful proposals commensurate with the 2014 budget expected to commence three months after the call deadline.

Consortia agreements: The conclusion of a Consortium Agreement is required for any action under this call, and applicants are advised to prepare a draft Consortium agreement during the proposal drafting phase.

Implementation:

Calls for proposals 2.1.7.A.2 under this work programme will be implemented by the Research Executive Agency (REA) according to the provisions of Commission Decision xxxxx "delegating powers to the Research Executive Agency with a view to performance of



tasks linked to implementation of specific European Union programmes People, Capacities and Cooperation in the field of research comprising, in particular, implementation appropriations entered in the Community budget". The management of all projects to be funded as a result of this call 2.1.7.A.2 will be implemented by REA.

The European Space Agency will not participate in consortia of proposals submitted under the Horizon 2020 Space Theme to this call for proposals.

### **2.1.7.A.3 Call "Competitiveness of the European Space Sector" - 2014**

Competitiveness of European space industry is strongly dependent on performance in a global market, which has a high variability when compared to the institutional market. The ability to react to contract opportunities world-wide with recurring technologies for satellites is a critical success factor, and depends on ready access for integrators to subsystem and equipment capacities in Europe. To ensure the competitive advantage, subsystems and/or equipment have to be technologically mature (i.e. at adequate TRL<sup>2</sup> level, possibly flight proven) and be accompanied by adequate production rates. This is not necessarily the case for many technologies which are highly specific to high-visibility one-off space missions, and Horizon 2020 is to help Europe's space industrial base to reach a sufficient maturity for those items which offer high potential for use in commercial markets. This provides also complementarity with Member States and ESA activities, as such technology developments are often likely to be outside the scope of ESA's institutional mission needs.

Some such market opportunities, which are open for future global competition, have been identified to be in the growth sectors of protecting space infrastructure from emerging threats of debris and space weather, the ability to interact with or service space systems already in orbit, as well as having an acknowledged lead in space capabilities needed for international space ventures.

#### **Objective 1 - Protection of European Assets in and from Space**

Europe's public and private investments in space needs to be protected against the threats of the space environment, both natural threats posed by the harsh radiation and particle environment and man-made threats posed by the presence of space debris and the risk of collision. In order to contribute to building a European SSA system (Space Situational Awareness), Horizon 2020 will support research in the following four domains:

- Surveillance and accurate tracking of Earth-orbiting objects, both active satellites and space debris, is a pre-requisite for assessing collision risks and planning of collision avoidance manoeuvres. For this reason, Europe has the ambition to build a Space Surveillance and Tracking (SST) system. RTD in this area will be supported through

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<sup>2</sup> Technology Readiness level definition of the European Space Agency "Strategic Readiness Level - The ESA Science Technology Development Route". European Space Agency, Advanced Studies and Technology Preparation Division.

“programme co-funding” of SST (cf. Work Programme section 2.1.7.B.2 - Other actions, Activity 2).

- Monitoring of space weather and understanding of its effects on spacecrafts, humans in space and on specific ground-based infrastructure is of vital importance for the sustainability of space-based services and applications including satellite navigation and communication and Earth observation. In addition, the effect on vital Earth infrastructure such as power grids and telecom networks need to be better understood and mitigated.
- Controlling the alarming growth of the orbital debris population is a priority for all space-faring nations of the world. It is necessary to develop methods to prevent the creation of new debris as well as to remove or mitigate the effects of existing debris in order to sustain space operations in attractive Low Earth Orbit (LEO) , Medium Earth Orbit (MEO) and Geostationary Orbits (GEO).
- Impact of Near-Earth Objects (NEOs) with Earth is a global concern. Research in this area will promote a coordinated international effort to predict and mitigate the threats of NEO. This topic is thus partially addressed under objective 5 “International cooperation in space matters”.

### ***Topic A – Space Weather***

#### Specific Challenge:

Space weather services exist already today in Europe and in several countries outside the EU. New services are also being developed (e.g. in ESA’s SSA programme and in EU FP7 projects). Their goal is to observe and to predict a range of solar events that may impact the near Earth environment including orbiting satellites and ground based systems. Today, the services partly rely on ageing solar observational infrastructure that in the coming years is to be replaced by new space based observatories. The challenge is to harness the expected much richer and larger volumes of data to enable new and more sophisticated modelling of complex physical phenomena and their impact. This will necessitate new approaches to data processing and international cooperation in this domain.

#### Scope:

Exploratory work studying new ideas for data analysis and modeling of space weather with a view to enhancing the performance of space weather prediction.

Research into further improvement of existing models and their validation in the context of international cooperation with leading space weather service providers and/or related to emerging European space weather services.

There is scope for cooperation with international partners with relevant expertise (also non-EU entities with or without EU funding).

#### Expected Impact:

Projects are expected to deliver new insights into the detailed mechanisms and processes that generate space weather. This should contribute significantly to new services able to predict,

with a significantly higher precision than today, space weather events affecting the Earth and the near Earth space environment.

Instrument(s): Collaborative projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 8 million Euro has been set aside for this call topic.

### ***Topic B – Establishing a roadmap for debris removal***

#### Specific Challenge:

Reduce the risk of collision between active satellites and orbital debris. Certain low Earth orbits already have debris populations where cascades of collisions between debris threaten to render attractive orbits unusable. In these cases active removal of existing debris from orbit may become necessary. In order to prepare for this situation, a number of activities including critical demonstration of concepts are currently underway, necessitating a stock taking exercise to assess the potential and frame for a possible Strategic Research Cluster (SRC).

#### Scope:

Studies should be performed which take stock of current relevant activities in the EU and elsewhere, to analyse the long-term evolution of the orbital population under various assumptions together with sensitivity analysis to input data; effect of active debris removal (necessary and if yes, when) and to develop roadmaps for future debris removal technology developments.

#### Expected Impact:

The results of the studies should help defining the priorities for future EU research actions in the area of space debris. The potential for initiating a Strategic Research Cluster (SRC) after 2015 in Horizon 2020 is to be shown.

Instrument(s): Coordination and Support Actions (100%). The Commission considers that projects requesting a contribution from the EU of 500.000 Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 1 million Euro has been set aside for this call topic.

### ***Topic C – Access technologies for Near Earth Objects (NEOs)***

#### Specific Challenge:

In order to conduct missions to NEOs, be it for characterising NEOs in close approach missions, or even to undertake mitigating demonstrations, it will be necessary to have a number of technologies and instruments readily available to conduct missions to asteroids characterised by weak gravitational fields.

Scope:

Research is to be conducted on technologies and instruments relevant to orbiting, hovering, and manoeuvring close to small asteroids with very weak gravity fields. Accurate guidance, navigation and control (GNC) of a high-velocity ( $> 10 \text{ km s}^{-1}$ ) kinetic impactor spacecraft into a small NEO, as well as orbit determination and monitoring (types of observation and precision) before, during, and after a mitigation attempt, require further technology development. The same applies to means for material sampling and collection, in-situ analysis and sample return to Earth, which are of relevance to physical characterisation.

Expected Impact:

The project is expected to contribute to the development of advanced techniques and instruments, which allow approaching and navigating in close vicinity and on the surface of asteroids and comets. The results could provide technological support for deflection as well as for sample return missions.

Instrument(s): Collaborative projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 3 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 6 million Euro has been set aside for this call topic.

## **Objective 2 - European competitiveness of Space Technology**

The ability to access space and to develop, maintain and operate space systems in Earth orbit and beyond, are vital to the future of European society. Europe is playing a leading role in the development of space technologies. European industry has established itself as an exporter of first class satellites and other space related technologies. Nevertheless, this position is challenged by competition from other major space powers. Competitiveness, non-dependence and innovation of the European space sector (including SMEs) must be ensured by fostering the development of space technologies. The overarching objective is to contribute at European level, in conjunction with Member States and ESA, to the safeguarding and further development of a competitive and entrepreneurial space industry and the strengthening of European non-dependence in space systems. This implies enabling advances in space technologies and operational concepts from idea to demonstration in representative terrestrial environments and/or in space. The competitiveness of European space technology will be promoted thanks to the wide interaction of Industry, SMEs, Space Research Organisations, and Academia, among others.

The necessary capabilities require research and innovation investments in a multitude of space technologies (e.g. for launchers, satellites, robotics, instruments and sensors), and in operational concepts. The European focus in future space technologies, beyond the current state of the art, needs to be strengthened along the entire chain: (a) Fundamental technological low technology readiness level (TRL) research, often relying heavily on key enabling technologies, with the potential of generating breakthrough technologies with terrestrial applications; (b) Improvement of the capabilities of existing technologies (e.g. through

miniaturisation, power efficiency, extending ranges of sensitivity or actuation, etc.); (c) In orbit demonstration and validation of the technologies that have already been developed.

Technologies enabling recurrence of use contribute to enhancing industrial competitiveness. Research on modular, reusable elements is therefore encouraged. Standardisation of such modular components and their interfaces across Europe will optimise the investments and will facilitate access to emerging commercial markets.

Boosting innovation between space and non-space sectors is a challenge for those areas where space technologies have parallels to terrestrial technologies. These commonalities offer opportunities for early co-development, in particular by SMEs, of technologies across space and non-space communities including non-space industries, potentially resulting in breakthrough innovations more rapidly than achieved in spin offs at a later stage.

### ***Topic A – Technologies for European non-dependence***

#### Specific challenge:

The space sector is a strategic asset contributing to the independence, security and prosperity of Europe and its role in the world. Europe needs non-dependent access to critical space technologies, which is a *conditio-sine-qua-non* for achieving Europe's strategic objectives. "Non-dependence" refers to the possibility for Europe to have free, unrestricted access to any required space technology. Reaching non-dependence in certain technologies, which are for instance limited in their use through export regulations, can open new markets to our industries and can increase the overall competitiveness of the European Space sector.

#### Scope:

Research in technologies for European non-dependence has been undertaken within the frame of the EC-ESA-EDA joint initiative on Critical Technologies for European non-Dependence, launched in 2008.

To prepare the next steps of this initiative, studies are invited to analyse the results of this initiative and capitalise on the lessons learned, ideally with clear illustrations of the contribution of critical technologies to the competitiveness of the European space sector.

The studies should also examine how best critical technologies for non-dependence can be addressed in the framework of Horizon 2020. It should be kept in mind that development activities up to space qualification should be included to maximise their potential impact. In this context, technological spin-in and/or bilateral collaborations should be enhanced between European non-space and space industries and projects are expected to provide advanced critical technologies that are of common interest to different space application domains (e.g. SatComs, Earth-observation, Science, etc.), or even with applicability to terrestrial domains.

#### Expected impact:

- To propose means to reduce the dependence on critical technologies and capabilities from outside Europe for future space mission projects and programmes, as identified in the EC-ESA-EDA Critical Space Technologies for European Strategic Non-Dependence (see Ref XX).

- A projection about how to improve, from the point of view of the European efforts on Critical Technologies, the overall European space technology landscape and complement the activities of European and national space programmes.

Instrument(s): Coordination and Support Actions (100%). The Commission considers that projects requesting a contribution from the EU of 250.000 Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 1 million Euro has been set aside for this call topic.

### ***Topic B – Access to Space***

#### Specific challenge:

The ability to access space is vital strategic capability for Europe to ensure that it can maintain its leading position alongside other major spacefaring nations, in the face of increasing global competition. A support activity is to be undertaken examining the different options for sub-orbital flights (on-going and future) with European stakeholders, and how best Horizon 2020 can support the research. The potential research efforts should lead to cheaper new vehicle development, ensuring easy, frequent and affordable access to Low Earth Orbit (LEO) and may include technological development, testing and demonstration.

#### Scope:

All possible alternative systems for access to Space will need to be considered for initial studies to determine the necessary research steps for development in Horizon 2020. Examples are air breathing propulsion systems, as well as all feasible possibilities for the mid-term: ground launch assist (hypervelocity accelerators for low-cost delivery of large numbers of small, high-g tolerant payloads to LEO); Air launch / Drop systems; Orbiting space tether assists. This support action should examine the specific position of suborbital flight within the context of access to space, based on concepts which are in a mature state, and is to mobilise actors at European level in a joint action. The different options for suborbital flight (on-going and future) are to be examined with regard to technical and regulatory aspects. (It should be noted that other access to space means will also be assessed within H2020 with studies into breakthrough technologies to provide access to Space, using alternative concepts to conventional rocket-based launch techniques, and this should therefore not be the focus here).

#### Expected impact:

- Assessment of the steps needed for the development of an alternative system for access to Space, including sub-orbital flight.

Instrument(s): One Coordination and Support Action (100%). The Commission considers that a project requesting a contribution from the EU of 500.000 Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 500.000 Euro has been set aside for this call topic.

### ***Topic C – In-Space electrical transportation***

#### Specific challenge:

Advances in-Space propulsion beyond the use of chemical technologies will enable a much more competitive development and exploitation of Space systems. The challenge is to enable major advances in electric propulsion for in-space operations and transportation, and guarantee the leadership of European capabilities in electric propulsion at world level within the 2020-2030 timeframe. The objective is to propose a Programme Support Activity (PSA), for the future implementation of a Strategic Research Cluster (SRC) in Horizon 2020. The overall budget for such an SRC could be in the range of several tens of millions of euros and should achieve a full in-orbit validation of the electric propulsion systems developed at pre-commercial level during the SRC. This validation is to be achieved not later than 2023.

Further information on the concept of a Strategic research cluster in Horizon 2020 is available from <http://xxxx>.

#### Scope:

In-Space transportation begins where the launch vehicle upper stage separates. It comprises the functions of primary propulsion, reaction control, station keeping, precision pointing, and orbital manoeuvring necessary for all satellites.

Some of these technologies are already widely used in commercial communications satellites for orbit positioning and station-keeping. Europe currently faces very strong non-European competition (e.g. all-electric platforms), and European competitiveness is threatened.

Research and development of promising electric propulsion technologies, far beyond the current state of the art, is encouraged. A first objective for the SRC is to foster incremental advances in the development of thrusters by extending their specifications and operative ranges by a factor of at least 3. A second objective is to set up activities for promoting possible disruptive RTD in the field of in-space electrical propulsion.

In order to assess the commercial viability of the technologies developed, the proposal should envisage studying the impact of using electrical thrusters in several types of generic platforms. Examples of these are: kick stages, propulsive modules of interorbital vehicles (as tugs for contribution to in-orbit services), transfer of different payloads towards deep space, GTO transfer for communication satellites, and orbit control. To validate the electrical thrusters to be developed at pre-commercial level during the SRC, a qualification flight will have to be executed not later than 2023. This demonstration will serve as a validation for future mission implementation.

Alternative approaches, not already planned for development by other entities are encouraged.

#### Expected impact:

The initial expected life of the PSA action is 5 years. In this time, the consortium should have delivered:

- Identification and definition of all the activities required to address the challenge of this topic. The contents of the activities must be in agreement with the objectives and boundaries defined in the scope.
- A fully detailed master plan to coordinate all the activities for the whole duration of the SRC.
- A plan for the analysis and evaluation of the results during the execution of the activities within the SRC.
- A plan for the specific exploitation and potential use of the SRC expected outputs.
- A risk assessment and contingency analysis for the SRC.

The execution of the SRC during a first period of 5 years will assure reaching the TRL-6<sup>2</sup> in the future devices that will form the next-generation of European electrical space thrusters. The goal at the end of the SRC will be to guarantee the leadership of European capabilities in electric propulsion at world level within the 2020-2030 timeframe.

Instrument(s): One Coordination and Support Action (100%). The Commission considers that one project requesting a contribution from the EU of 5 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

### ***Topic D – Space Robotics Technologies***

#### Specific challenge:

The challenge is to enable major advances in space robotic technologies for future on-orbit satellite servicing. The objective is to propose a Programme Support Activity (PSA) for the future implementation of a Strategic Research Cluster (SRC) in Horizon 2020. The overall budget for such an SRC could be in the range of several tens of millions of euros and should achieve an in-orbit demonstration at a significant scale of an autonomous system with key elements for the future sector of on-orbit satellite servicing. This demonstration will be achieved not later than 2023. Further information on the concept of a Strategic research cluster is available from <http://xxxx>.

#### Scope:

Driven by the objective of on-orbit satellite servicing, the final target of this topic is to increase the competitiveness of the European Space Industry in sectors demanding robotics solutions. The benefit of investing in space robotics technologies for future on-orbit satellite servicing should also be of benefit in sectors as human-robotic partnership, orbital debris removal, and in-situ planetary exploration.

In addition, synergies with the current industrial robotics shall be fostered.

The SRC led by this PSA is expected to address robotics issues in a wide sense at two levels: (1) design and manufacturing of reliable and high performance robotic building blocks for operation in space environments, and (2) developing advanced robotic concepts and functions.



The robotic building blocks (1) will likely involve: sensors and actuators, materials and structures, manipulators and tools, hardware and control of robotic systems, processing algorithms; sensor fusion and perception; communications and energy systems.

The robotic concepts and functions (2) are expected to involve several of the following areas: mobility, manipulation, and vision; interoperability with other robots; human-machine co-operation; partly and highly autonomous operations (in very remote locations that have high Earth communication latencies).

As most of the space robotics technologies required are mature enough (with the exception of the autonomous operations that require demonstration and/or validation), particular effort must be made to achieve an effective application of technology, i.e. rigorous systems engineering and system performance analysis, rather than an approach based on pure technology development. To validate the performance of integrated servicing systems three different levels of demonstration can be foreseen: Earth analogues; ISS infrastructure and in-orbit demonstration.

In any case, the final stage of the SRC must involve a space demonstration, understood as the spaceflight of a scaled version of a particular technology. However, a validation of the technology at the level of a qualification flight for a future mission is not required.

#### Expected impact:

The initial expected life of the PSA action is 5 years. In this time, the consortium should have delivered:

- Identification and definition of all the activities required by 2023 to address the challenge of this topic. The contents of the activities must be in agreement with the objectives and boundaries defined in the scope.
- A fully detailed master plan to coordinate all the activities for the whole duration of the SRC.
- A plan for the analysis and evaluation of the results during the execution of the activities within the SRC.
- A plan for the specific exploitation and potential use of the SRC expected outputs.
- A risk assessment and contingency analysis for the SRC.
- The execution of the SRC during a first period of 5 years will assure an advance in European robotics technologies for space: consolidation of building blocks, development of advanced concepts and functions. This will be done with the aim of paving the way for the European activity in areas where robotics are key enabling technologies, such as for example on-orbit servicing, orbital debris removal, autonomous operations in planetary surfaces.

The SRC designed and developed by the PSA is expected to deliver its final results at the end of the H2020 cycle (2023-2024). During its lifetime:

- The SRC shall exploit the potential to generate intense public interest by demonstrating an application (such as satellite repair, refuelling or “cleaning space”, etc.), which citizens can easily relate to.
- Some or all the entities involved in the operational projects of the SRC should be in a privileged position to explore the for-profit viability of some or all the solutions and technologies developed within the SRC.

Instrument(s): One Coordination and Support Action. The Commission considers that one project requesting a contribution from the EU of 5 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

### ***Topic E – In-Orbit demonstration/Validation (IOD/IOV)***

#### Specific challenge:

The challenge is to make access to space possible for new technologies and innovations by means of in-orbit demonstrations (IOD) and/or validations (IOV). This maturity level is crucial to enable the competitiveness, non-dependence and innovation of the European space sector. Apart from framing recurrent launching opportunities, platforms may need to be developed (complementary to those already existing in Europe) to affordably harness existing European launching capabilities for placing new space products in orbit.

At this initial stage of Horizon 2020 studies are needed to help define the envelope and the requirements for the implementation of affordable missions of IOD/IOV (in combination with the launching system to be selected) within the Horizon 2020 timing and development contexts.

#### Scope:

Studies should be performed to frame two calls for proposals realising the project scenario for IOD/IOV implementation described below.

The aim is to foster in-orbit demonstrations of a technology, (IOD) and/or validations (IOV) as a final step in the process of supporting space RTD. It is not necessarily required that each type of technology be demonstrated in space: sometimes a qualification test programme on ground is adequate to cover many aspects (e.g. with respect to environmental conditions). Nevertheless, many of the technologies developed for space will need to be demonstrated in orbit in order to be accepted as new space products. In many cases, in order to be considered for future missions, flight heritage is a requirement, in particular when a high risk is associated with the use of totally new technologies and innovations.

IOD refers to the spaceflight of a scaled version of a particular technology or critical technology subsystem, which would still need further steps to be ready for mission adoption. IOV would already serve as a qualification flight for future missions implementation. Such a successful validation flight of a particular technology would not require any additional space testing before it can be adopted for a specific mission.

The studies to be performed should define possible scenarios for two future flight opportunities to be developed as part of this topic. One for Low Earth Orbit (LEO) (to be launched by 2020), and the other for a Geo Transfer Orbit (GTO) mission (to be launched by 2023). The intention is to cater not only for European technology developments from EU R&D programmes, but also for those from projects financed by ESA, National Space Programmes, or European private initiatives.

The studies to be done will cover proposals for the IOD/IOV platforms in connection with affordable launch systems. A description of the missions to be accomplished, with the resources available to host a technological package for demonstration are also required. The

studies will have to consider different approaches for the platform for the IOD/IOV activities, such as: dedicated spacecraft, autonomous multiple payload dispenser systems, segments/rings and upper stages of launchers, among others. Proposed solutions should be suitable to recurrently place new space products into orbit to perform relevant missions, and to demonstrate their viability by proving maturity of technology payloads.

The future technologies that will be hosted in the IOD/IOV missions will have a TRL<sup>2</sup> higher than 6. The industrial applicability of the technologies in the short/medium term is an important requirement. Other prioritization criteria will be based on the balance of packages to ensure the maintenance of a relevant number and variety of technologies in order to optimize the IOD/IOV.

Expected impact:

Identification of a portfolio of solutions to implement IOD/IOV missions for enabling the flight and operation of innovative space technologies developed in Europe. These solutions will be fully parametrised (technical aspects, implementation of the technologies and the mission, cost, commercial viability).

Downselection of those solutions which are suitable for a Horizon 2020 context, and which are RTD based and innovative. These solutions will emphasize the enabling character of techniques and interfaces, favouring the adaptation and integration of the technologies to be proved.

Instrument(s):

Coordination and Support Actions. The Commission considers that projects requesting a contribution from the EU of 500.00 Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 2 million Euro has been set aside for this call topic.

***Topic F –Bottom-up space technologies at low TRL***

Specific challenge:

In the mid- and long-term the competitiveness of the space sector depends on the continuous incorporation of novel, or even disruptive technologies. The European RTD investment in the field of very low-TRL technologies is to be enhanced. A number of challenges in space technologies have parallels to terrestrial challenges, for example in the fields of aeronautics, energy, environment, ICTs, natural resource exploration, sensors, robotics, advanced materials, security, and health.

Scope:

New ideas must be incorporated into the current state of the art. As many of the advances come traditionally from non-space sectors, such sectors must be actively researched for potential ideas. This should mobilize both traditional space actors and non-space actors, to look for space technologies of the future. The aim of this topic is to attract new actors to space activities and demonstrate technologies that are potentially disruptive, and not only incremental. Such highly innovative technologies should lead to radical improvements in

performance, and will enable emerging missions. Drastic improvements in miniaturisation, efficiency and functionality are expected.

Proposals based on low TRL (1-3) ideas and technologies which could have a final application in future space systems are solicited. The target is to demonstrate these up to TRL (4-5). In this first call, proposals on the fundamental areas of knowledge are foreseen, in which for example some of the Key Enabling Technologies (KETs) play a major role. In particular, proposals are sought with relevance for the fields of: " materials and structures"; "in-situ sensors/instruments of physical parameters"; "energy storage"; "energy production"; and "radio frequency communications" in the domain of space.

#### Expected impact:

The spin-in of new enabling technologies to space systems should significantly improve performance in multiple ways. Projects should mobilise SMEs and research groups that are new to the space landscape. The impact would be further enhanced if projects result in opportunities simultaneously affecting several sectors.

#### Instrument(s):

Collaborative projects (100%) of two years. The Commission considers that projects requesting a contribution from the EU of 1 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Only up to two projects will be financed on each of the 5 lines ("engineered materials and structures"; "in-situ sensors/instruments of physical parameters"; "energy storage"; "energy production"; and "radio frequency communications" ) foreseen. A total of 8 million Euro has been set aside for this call topic.

### **Objective 3 - Space Science**

Europe has established a leading position in space science infrastructure, with missions in the ESA's Science Programme, and with access to the International Space Station (ISS).

The objective is to enable the European space science community to make a concerted effort to capitalise on current European space science infrastructure, and to achieve the highest possible science return from future space missions. To this end coordinated activities will be supported which further **Science in the context of space missions**, i.e. preparing for space missions and deploying scientific activities in support of future or operational missions, and enhance **Scientific exploitation of space data** emphasising the use of data from European space missions.

In the next decade, significant steps will be made in the scientific **exploration of Mars** with the ExoMars missions in 2016 and 2018, preparing the ground for Mars Sample Return missions. The 2014 call thus highlights this opportunity.

Proposers should note that helio/plasma physics and Earth observation data are dealt with in call sections on Earth observation and space weather respectively.

### ***Topic A - Science in the context of space missions: sample curation***

#### Specific Challenge:

One of the main mid-term goals of global space exploration activities is to bring back rock samples from the Moon, Mars, or asteroids. The space missions will be developed in the context of ESA programmes or in the international context. However, a European extra-terrestrial sample receiving facility will be required in preparation for such sample return missions. The challenge here is to study and map all the aspects required to develop such a facility at the European level.

#### Scope:

The consortium shall analyse what facilities, analytical methods and instruments, and analogue samples are required in what timeframe in order to adequately serve the extra-terrestrial sample return mission that will take place with European involvement.

#### Expected impact:

The project is expected to result in a roadmap, including analysis of opportunities and risks, for the implementation of a European extra-terrestrial sample curation facility.

Instrument(s): One Collaborative project for research and innovation (100%).The Commission considers that one project requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

### ***Topic B – Scientific exploitation of planetary data: Mars***

#### Specific Challenge:

With the highly successful Mars Express mission, launched in 2003 and still operational, Europe firmly established its role on Mars science and exploration. In the last decade an extensive amount of data has been acquired of the atmosphere, surface and sub-surface of Mars. The challenge is to fully exploit this data for fundamental scientific purposes, and in preparation for the next set of European Mars missions in 2016 (ExoMars orbiter) and 2018 (ExoMars rover).

#### Scope:

The exploitation and development of tools for exploitation of Mars data for scientific research, , and analysis in preparation of the two ExoMars missions. Data available through the ESA Planetary Science Archive or other means (e.g. instrument teams) may be combined with data from NASA missions. This includes data from the atmosphere, surface and sub-surface of Mars, as well as data from the Martian moons Phobos and Deimos.

#### Expected impact:

Projects are expected to result in scientific publications, open access tools for data use, and in high level data products, such as digital maps or atmospheric models, which can be used in the preparation for the operational phases of the ExoMars missions.

Instrument(s): Collaborative projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 8 million Euro has been set aside for this topic.

## **Objective 4 – International Cooperation in Space matters**

Although space information provides great local benefits, space undertakings have a fundamentally global character. This is particularly clear for the cosmic threat to Earth and space systems, for example by Near Earth Objects or by space weather events. Equally global are many space science and exploration projects. The development of cutting edge space technology is increasingly taking place within such international partnerships, making access to such international projects an important success factor for European researchers and industry.

International cooperation projects will in all cases address the following (a) Review the content, structure and organization of ongoing efforts in the fields relevant to international collaboration;

(b) Identify any gaps in the ongoing work where additional coordination is required and/or where other countries or organizations could make contributions;

(c) Propose steps for the improvement of international coordination in collaboration with specialized bodies.

### ***Topic A – Assessing the threat: Near Earth Objects (NEOs) characterisation***

#### Specific Challenge:

The characterisation of internal structure and other physical properties of NEOs is fundamental, not only for the design of most impact mitigation missions, but also for the assessment of the consequences of an impact on Earth. Scientific research is needed to identify suitable objects for possible missions for detailed characterisation of properties or demonstration and testing of deflection techniques.

#### Scope:

In the light of growing information from existing databases and newly available space- and ground-based telescopes, many relevant scientific questions can be addressed, such as the material properties of NEOs, their structural stability, as well as their orbits and the probability of a collision with the Earth.

Further characterisation of the NEO population, in particular the small NEOs (50 – 300 m) is to be undertaken. Typical mitigation-relevant physical properties of NEOs includes sizes, albedos, mineralogy, shapes, densities, structures, porosities, frequency of binaries, frequency of rubble piles, etc.

#### Expected Impact:

The project is expected to lead to a better characterisation of NEO properties, relevant data and their uncertainties. Data is to be made available in an open repository. The identification of suitable targets for and their accessibility for exploratory missions or mitigation demonstration missions is expected. An analysis of subsequent actions in European programmes such as Horizon 2020 and ESA actions is expected.

Instrument(s): One Collaborative project for research and innovation (100%). The Commission considers that one project requesting a contribution from the EU of 3 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 3 million Euro has been set aside for call objective 4.

## **Objective 5 – Outreach and Communication**

### ***Topic A – Global outreach through education***

#### Specific Challenge:

Space exploration bears a significant potential of inspiration and motivation for the younger generations. Positive exposure to and experiences in the space domain can contribute moreover to building long-term partnerships between peoples from different cultural backgrounds and countries. The challenge is to design and run sustainable outreach activities which can act as catalysers, motivating pupils and students at different ages and education levels.

#### Scope:

In addition to communicating the value of space activities for innovation and economic development, the aspect of space exploration as an inherent cultural value, addressing fundamental questions of humankind linked to the origin and existence of life in the universe as well as the limits of human life are to be communicated. Outreach activities are to be funded, which address younger generations specifically at primary school, and/or high school level and inspire them to pursue further scientific training and education.

#### Expected Impact:

Projects will be supported, which develop hands-on as well as virtual and software toolkits for teachers to be used in European but also in developing (in particular African) schools and higher education institutes. Information and training sessions for the teaching personal in different regions should be part of the project.

Instrument(s): One Collaborative Project for research and innovation (100%). The Commission considers that one project requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does

not preclude submission and selection of proposals requesting other amounts. A total of 6 million Euro has been set aside for call objective 5 (Topics A-C).

### ***Topic B – European outreach through education***

#### Specific Challenge:

To develop an initiative to reach out to students (and potentially teachers) between 13 and 17 years old in order to attract their interest for space matters in general and the European Union work on this field in particular. The outreach initiative should cover all Member States and ideally also candidate countries and last for, at least, 4 years.

#### Scope:

One of the main obstacles for the development and sustainability of the European space industrial fabric (and the delivery of cutting-edge scientific achievements) is the lack of scientists, engineers and technicians with specific interest on the area of space research and development.

The main delivery of the action should be an initiative capable of attracting the interest of a significant number of students across Europe on the issue, while creating at the same time a relevant impact outside the targeted population in terms of news coverage, social-media interest, stakeholders' involvement, etc.

The key advancements of the European space initiatives (R&D in FP7-H2020 projects, Copernicus and Galileo) should be given a privileged position in the proposal, but the main objective should remain attracting the interest of students for space science and technology. On the basis of former projects financed by the EU, the focus of this initiative should be in activities outside the normal classroom environment.

One key element of the proposal should be its cross-European character.

#### Expected Impact:

By the end of the action the initiative should have proven its capacity to:

- Reach out to a significant number of students among the target group and stimulate an active response among a significant number of them.
- Establish the foundations of a pan-European connection among some of these students and some type of links among the different partners involved in the outreach.
- Achieve a significant coverage by media and attention by stakeholders.
- Potentially, being able to track and estimate the results of the action, sampling the numbers of students involved and the numbers of students that opt for a technical career related to space when compared to the general population of students in their cohorts.



Instrument(s): One Collaborative Project for research and innovation (100%). The Commission considers that one project requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 6 million Euro has been set aside for call objective 5 (Topics A-C).

### ***Topic C – Transnational and international cooperation among NCPs***

#### Specific Challenge:

Reinforcing the network of national Contact Points (NCP) for Horizon 2020 within the Space domain is to be supported by promoting trans-national and international co-operation. Activities are to build on the achievements obtained already in FP7. Special attention should be given to helping less experienced NCPs rapidly acquire the know-how accumulated already in other countries, and to promote the SMEs participation within the Space Theme of the Seventh Framework Programme.

#### Scope:

The action will focus on identifying and sharing good practices. This may entail various mechanisms such as benchmarking, joint workshops, training, and twinning schemes. Practical initiatives to benefit cross-border audiences should be included, such as the organisation of information days in preparation of calls, and trans-national brokerage events. The specific approach should be adapted to the nature of the theme and to the capacities and priorities of the NCPs concerned.

Proposals are expected to include all European NCPs who have been officially appointed by the relevant national authorities. If certain NCPs wish to abstain from participating, this fact should be explicitly documented in the proposal.

The action may also involve Horizon 2020 contacts from third countries and the international cooperation partner countries. This is of particular importance for countries which have concluded specific S&T cooperation agreements in the Framework Programme context, and where national contact persons may also have been nominated. Where such Horizon 2020 contact points have not yet been active, the establishment of a Horizon 2020 contact could be promoted through the national space agency or space research institutes.

#### Expected Impact:

The proposal is expected to lead to an improved NCP service across Europe, therefore helping to simplify access to Horizon 2020 calls, lowering the entry barriers for newcomers, and raising the average quality of submitted proposals. A more consistent level of NCP support services across Europe and outside should result. More effective participation of SMEs and organisations from third countries is expected, alongside European organisations, in line with the principle of mutual benefit. It is expected that the project should last for at least 3 years.

Instrument(s): One Coordination and Support Action. The Commission considers that one project requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 6 million Euro has been set aside for call objective 5 (Topics A-C).

### **Funding details for Call 2.1.7.A.3**

Publication date: at launch of Horizon 2020 in 2014

Deadline(s): 24 April 2014

Indicative budget: (from the 2014 budget)

Objective 1 - Topic A,B,,C: EUR 8 million, EUR 1 million, EUR 6 million respectively

Objective 2 - Topic A,B,C,D,E,F: EUR 1 million, EUR 0.5 million, EUR 5 million,  
EUR 5 million, EUR 2 million, EUR 8 million respectively

Objective 3 - Topic A,,B: EUR2 million and EUR 8 million respectively

Objective 4 - Topic A: EUR 3 million

Objective 5 - Topic A,B,,C: EUR 6 million

[Link to the relevant option on "margin of manoeuvre"]

Maximum EC Contribution:

The maximum EU contribution for a project is specified under each topic

Eligibility conditions: The standard eligibility conditions apply. Please read carefully the provisions [Link to the annex on standard eligibility conditions] under Annex X before the preparation of your application.

Evaluation criteria: The standard evaluation criteria apply. Please read carefully the provisions [Link to the annex on standard evaluation criteria] under Annex X before the preparation of your application.

Overall expected impact: as stated per topic

Evaluation procedure: [Link to the annex on standard evaluation procedure]

- Proposal page limits and layout: The standard guidelines apply. Please read carefully the guidelines [Link to the annex on guidelines] before the preparation of your application.

- Single or two stage procedure: single stage procedure

- Indicative timetable for evaluation and grant agreement: The evaluation is to commence within 2 months of the call deadline, with negotiations of successful proposals commensurate with the 2014 budget expected to commence three months after the call deadline.

Consortia agreements: The conclusion of a Consortium Agreement is required for any action under this call, and applicants are advised to prepare a draft Consortium agreement during the proposal drafting phase.

Implementation:

Calls for proposals 2.1.7.A.2 under this work programme will be implemented by the Research Executive Agency (REA) according to the provisions of Commission Decision xxxxx “delegating powers to the Research Executive Agency with a view to performance of tasks linked to implementation of specific European Union programmes People, Capacities and Cooperation in the field of research comprising, in particular, implementation appropriations entered in the Community budget”. The management of all projects to be funded as a result of this call 2.1.7.A.2 will be implemented by REA.

The European Space Agency will not participate in consortia of proposals submitted under the Horizon 2020 Space Theme to this call for proposals.

## **2.1.7.A.4 Call 5 – Call “Earth Observation” – 2015**

### **Objective 1 – Space enabled Applications**

New innovative geo-spatial products for commercial exploitation are enabled by space data, and directly enhance the competitiveness of the European value-adding and geo-information service sector. This will also further validate the premise that space systems produce information complementary to in-situ data, which often cannot be acquired in any other way. This is key to return on the major space investments made in Earth Observation space infrastructure, and validating Europe’s investments made, especially in the Union’s Copernicus programme. With the availability of Copernicus data, actions will be funded in 2015 which have high business potential and are developing space enabled EO products and applications close to the market.

### ***Topic A – Bringing EO applications to the market***

Specific challenge:

If space investments made in earth observation are to generate economic return, it is essential that EO products and information generation are taken out of the research environment and products are put into the market. For such applications to succeed, the product needs to be shaped according to users’ demands, to be validated and proven. This needs to be achieved in an environment integrated at the user, in order for users to accept the innovative potential which the product promises. Furthermore, the commercial providers will have to prove that

they can sustain their product operationally based on market revenues. To this end a credible planning for the 3 years after the end of public funding shall be part of the proposal.

Scope:

The outcome of this innovation project [ref to funding art in H2020 RoP] should be a commercial service platform, sustained by a production process capable to deliver to the user a product which is validated and accepted as a marketable product. Transnational collaboration has a key role to play in this context, as it enhances access to markets beyond the national borders, notably by enabling space application providers to absorb market-related tacit knowledge and know-how of their partners. Corresponding validations and customisations are to be undertaken, and the business case for the application is to be demonstrated. Service level models are to be developed, with appropriate quality of service definitions for the application. Application products are expected to adopt open standards for data documentation, data models and services.

The choice of EO application is left to the proposer, but priority will be given to those applications which cannot be addressed in the context of the calls of Horizon 2020 societal challenges. A preference will also be given to SMEs, which are considered to be particularly important players in this European EO applications sector.

Proposers are advised to consult further information on availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data, as well as issues recommended to be detailed in the proposals at the Commission's web <http://xxxx>.

Expected impact:

Projects are expected to establish sustainable supply chains for innovative EO applications with demonstrated commercial value with targeted client communities. Complete integration into the customer's existing business processes and processing chains, as well as the economic viability of the application is to be demonstrated. Projects are expected to enhance the European industry's potential to take advantage of market opportunities and establish leadership in the field, and to boost business activity. It is expected that projects lead to new or improved products, processes or services on the market, which are capable of generating within 3 years after the end of public funding a significant turnover for the participants, and create a significant number of new jobs.

Instrument(s): Collaborative Projects for research and innovation – close to market (70%). The Commission considers that projects requesting a contribution from the EU of 1 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 11 million Euro has been set aside for this call objective 1.

**Objective 2 – Tools for access to space data**

Efficient and widespread exploitation of the existing and planned European space infrastructure is only possible if further effort can be made for the processing, archiving and standardised access to retrieved satellite data. Sustainable availability has also to be coupled with generic search, data-mining and visualisation techniques inviting wide re-use, also

through standardised approaches. Such re-use has to be achieved at European and global level, and coordination with mechanisms promoted in the context of the Global Earth Observation System of Systems (GEOSS) is to be achieved.

For successful exploitation of space borne sensors to take place, it is furthermore necessary to develop easy-to-use, calibrated and validated data products, taking into account the latest and emerging remote sensing capabilities. Validation efforts have to provide researchers and users with uncertainty ranges of space data to make the subsequent usage verifiable.

### ***Topic A – Stimulating science use of Copernicus Sentinel Data***

#### Specific challenge:

Europe's investment in the Copernicus Sentinel satellites will provide Europe with an unprecedented source of operational satellite data. The first and largest streams of data will become available from Sentinel 1 (SAR data) during 2014, to be followed shortly thereafter with data from sentinel 2 and 3 (optical imaging data). Data streams are expected to amount to several terabyte per satellite orbit, thereby delivering unprecedented temporal and spatial resolution and data continuity, calling for new data handling and processing paradigms. While this data is ingested into the operational Copernicus services, wide scientific re-use is limited and still needs to be stimulated with easy-to-use interfaces for scientific R&D.

#### Scope:

To utilise the high scientific potential of the Sentinel data, stable and predictable access methods need to be developed, such as

- research into efficient information retrieval from observations;
- developing software to read and transform data for access by non-specialist, including data mining techniques;
- developing data fusion methods (data from several sentinels and /or other contributing satellite missions);
- advanced visualisation techniques (allowing also for sensory exploration of data beyond visual experience).

A particular aspect of interest is also the international use and re-use of Sentinel data, as acceptance of Copernicus data in a global context will be a key to success of Europe's contribution of GMES to GEOSS.

Proposers are advised to consult further information on availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data, as well as issues recommended to be detailed in the proposals at the Commission's web <http://xxxx>.

#### Expected impact:

This research topic should attract active participation of researchers in academia, specialising on the use of sentinel data and their integration and/or comparison with other sensor data. It should actively involve students performing research with satellite data.

Wider re-use of data should be achieved, in Europe as well as internationally. Further opportunities for new uptake of satellite data should be created. Possible models for operational supply of data to users, especially for further scientific exploitation should be demonstrated. The work should promote the definition of best practices and their adoption in scientific and commercial user communities, and in a GEOSS context if possible.

Instrument(s): Collaborative projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 2.5 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 5 million Euro has been set aside for this call topic.

### ***Topic B – Climate Change relevant space-based Data reprocessing and calibration***

#### Specific Challenge:

Research areas such as Climate Change address long time periods, where past data are essential. The data from past missions available in Europe, either from European or non-European missions, must be made accessible in a way to reconstruct seamless time series of similar observations across sensors and technologies over two decades and more. At the same time, space derived parameters need to adapt and enhance their relevance with respect to needs from current policy issues, such as for example bio-fuel production impacts or shifts to a low carbon economy.

#### Scope:

The data contained and maintained in archives of the relevant data holding agencies will require to be reprocessed to ensure consistent time series of data with the most up to date algorithms. Manipulation of historical data at the relevant source will be required to enable quick analyses, bulk reprocessing and wide access to different science and application communities. Interoperability of diverse observation collections and sensor-to-sensor intercalibration will have to be included, as well as establishing of the associated uncertainties and limits.

Proposers are advised to consult further information on availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data, as well as issues recommended to be detailed in the proposals at the Commission's web <http://xxxx>.

#### Expected Impact:

The project is expected to significantly contribute to the availability of validated space-based observational data on Climate Change as a long time series, providing consistency of data records over a time period corresponding to the satellite era.

Activities should thereby lead to a better uncertainty characterisation of available data records.

The project should also have an impact on promotion of best practices in the derivation of Climate change relevant information from satellite data, particularly as regards the validation and calibration.

Instrument(s): Collaborative Projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 6 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 6 million Euro has been set aside for call topic.

### ***Topic C –Technology developments for commercial imaging***

#### Specific Challenge:

Observation concepts based on fractionated sensors (e.g. telescope arrays) have revolutionised astronomy, and their observation potential from space (swarm missions, satellite constellations...) has yet to be realised. This represents a departure from an approach of many different sensors residing on one satellite, in favour of many smaller single-sensor missions. It remains to be established for which areas of Earth observation (land monitoring, atmospheric measurements etc.) this approach might be particularly effective, be it in performance, risk management and cost effectiveness. Equally, it needs to be understood which technologies would be needed to allow a network/constellation to act as one instrument. Specific requirements for the sensors may also be needed to allow benefit to be taken of such mission concepts.

#### Scope:

Research should be undertaken to review the emerging fractionated observation system concepts. The required technology challenges as regards interfacing, formation flying, communication within the constellation or with ground stations are to be identified. Potential benefits to be obtained (e.g. monitoring performance, risk mitigation, cost effectiveness, responsiveness) are to be examined in light of observation needs in different earth observation domains. Constellations of instruments might be of the same instrument type, or include a variety of different instruments. The results obtained should enable mission designers and implementers to decide what missions should be initiated for which application areas.

#### Expected Impact:

Projects are expected to contribute to increasing the effectiveness of future developments by addressing

- significant advances in performance
- greater coherency between different measurement sources,
- mission planning parameters.

Instrument(s): Collaborative Projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 2.5 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude

submission and selection of proposals requesting other amounts. A total of 5 million Euro has been set aside for call topic.

## **Funding details for Call 2.1.7.A.4**

Publication date: at launch of Horizon 2020 in 2014

Deadline(s): 28 Nov 2014

Indicative budget: (from the 2015 budget)

Objective 1 - Topic A: EUR 11 million

Objective 2 - Topics A-C: EUR 16 million

[Link to the relevant option on "margin of manoeuvre"]

Maximum EC Contribution:

The maximum EU contribution for a project is specified under each topic

Eligibility conditions: The standard eligibility conditions apply. Please read carefully the provisions [[Link to the annex on standard eligibility conditions](#)] under Annex X before the preparation of your application.

Evaluation criteria: The standard evaluation criteria apply. Please read carefully the provisions [[Link to the annex on standard evaluation criteria](#)] under Annex X before the preparation of your application.

Overall expected impact: as stated per topic

Evaluation procedure: [[Link to the annex on standard evaluation procedure](#)]

- Proposal page limits and layout: The standard guidelines apply. Please read carefully the guidelines [[Link to the annex on guidelines](#)] before the preparation of your application.

- Single or two stage procedure: single stage procedure

- Indicative timetable for evaluation and grant agreement: The evaluation is to commence within 2 months of the call deadline, with negotiations of successful proposals commensurate with the 2015 budget expected to commence three months after the call deadline.

Consortia agreements: The conclusion of a Consortium Agreement is required for any action under this call, and applicants are advised to prepare a draft Consortium agreement during the proposal drafting phase.



Implementation:

Calls for proposals 2.1.7.A.2 under this work programme will be implemented by the Research Executive Agency (REA) according to the provisions of Commission Decision xxxxx “delegating powers to the Research Executive Agency with a view to performance of tasks linked to implementation of specific European Union programmes People, Capacities and Cooperation in the field of research comprising, in particular, implementation appropriations entered in the Community budget”. The management of all projects to be funded as a result of this call 2.1.7.A.2 will be implemented by REA.

The European Space Agency will not participate in consortia of proposals submitted under the Horizon 2020 Space Theme to this call for proposals.

### **2.1.7.A.5 Call “Competitiveness of the European Space Sector” – 2015**

Competitiveness of European space industry is strongly dependent on performance in a global market, which has a high variability when compared to institutional market. The ability to react to contract opportunities with recurring satellites is a critical success factor, and depends on ready access for integrators to subsystem and equipment capacities in Europe. To ensure the competitive advantage, subsystems/equipment have to be technologically mature (i.e. at adequate TRL level, possibly flight proven) and be accompanied by adequate production rates. This is not necessarily the case for many technologies which are highly specific to high-visibility one-off space missions, and Horizon 2020 is to help Europe’s space industrial base to reach a sufficient maturity for those items which offer high potential for re-use in commercial markets. This provides also complementarity with Member States and ESA activities, as such technology developments are often likely to be outside the scope of ESA’s institutional mission needs.

Some such market opportunities open for future global competition have been identified to be in the growing need to protect space infrastructure from emerging threats of debris and space weather, the ability to interact with or service space systems already in orbit, as well as having an acknowledged lead in space capabilities needed for international space ventures.

### **Objective 1 - Protection of European Assets in and from Space**

#### ***Topic A – Space Debris***

Specific Challenge:

To reduce the risk of collision between active satellites and orbital debris is a challenge that needs to be addressed at multiple levels.

1. Prevention, avoid adding new debris to the already large debris population.

2. Mitigation, specifically de-orbiting solutions for satellites and launcher upper stages at the end of their operational life.
3. Protection, i.e. shielding satellites from impact of small debris.

Remediation e.g. by acting removal of existing debris from orbit will be addressed in topic D below.

Current standard operational procedures include collision avoidance based on precise surveillance and tracking of orbital objects and calculation of optimal avoidance manoeuvres. This will be included in "Other actions" under section 2.1.7.B Activity 3.

Scope:

To develop and test concepts and technologies needed for safe de-orbiting and disposal of space objects. Planned end-of-life de-orbiting or safe disposal of new satellites and launch vehicle's upper stages as well as non-technical issues including legal issues should be considered.

Expected Impact:

Development of innovative and cost effective solutions for post-mission disposal of satellites and launcher upper stages which are in line with or exceed international and European guidelines and legal requirements.

Instrument(s): Collaborative Projects (100%). The Commission considers that projects requesting a contribution from the EU of 4 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 8 million Euro has been set aside for this call objective 1.

## **Objective 2 - European competitiveness of Space Technology**

### ***Topic A – Technologies for European non-dependence and competitiveness***

Specific challenge:

The space sector is a strategic asset contributing to the independence, security and prosperity of Europe and its role in the world. Europe needs non-dependent access to critical space technologies, which is a *conditio-sine-qua-non* for achieving Europe's strategic objectives. "Non-dependence" refers to the possibility for Europe to have free, unrestricted access to any required space technology. Reaching non-dependence in certain technologies will open new markets to our industries and will increase the overall competitiveness of the European Space sector.

Scope:

Research in technologies for European non-dependence and competitiveness has been undertaken within the frame of the EC-ESA-EDA joint initiative on Critical Technologies for European non-Dependence, launched in 2008.

Activities to be proposed in this call will address technologies identified on the list of Urgent Actions as part of the Joint EC-ESA-EDA task force on Critical Technologies (see Ref XXX), focusing on those areas that have not so far benefitted from prior Framework Programme funding and representing the highest potential for being addressed through the co-funding instruments available in Horizon 2020. These encompass platform, payload and launcher technologies. In this context, technological spin in and/or bilateral collaborations should be enhanced between European non-space and space industries and projects are expected to provide advanced critical technologies that are of common interest to different space application domains (e.g. telecom, Earth-observation, science, etc.), or even with applicability to terrestrial domains.

Expected impact:

- To reduce the dependence on critical technologies and capabilities from outside Europe for future space applications, as identified in the EC-ESA-EDA Critical Space Technologies for European Strategic Non-Dependence (see Ref XX).
- To develop or regain in the mid-term the European capacity to operate independently in space, e.g. by developing in a timely manner reliable and affordable space technologies that in some cases may already exist outside Europe or in European terrestrial applications. Nevertheless, projects should strive to go beyond the present state of the art.
- To enhance the technical capabilities and overall competitiveness of European space industry satellite vendors on the worldwide market. The projects are expected to open new competition opportunities for European manufacturers by reducing the dependency on export restricted technologies that are of strategic importance to future European space efforts. They should enable the European industry to get non-restricted access to high performance technologies that will allow increasing its competitiveness and expertise in the space domain.
- Proposals should include a work package dedicated to the development of a commercial evaluation of the technology, and should address how to access the commercial market with a full range (preload) of recurring products.
- Projects should improve the overall European space technology landscape and complement the activities of European and national space programmes.
- Proposals that include development activities up to space qualification will be favoured in terms of their potential impact.

Instrument(s): Collaborative Projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 2.5 million Euro would allow this specific challenge to be addressed appropriately. A maximum of one project per identified Urgent Action line will be selected for funding. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 15 million Euro has been set aside for this call topic.

## ***Topic B –Bottom-up space technologies at low TRL***

### Specific challenge:

In the mid- and long-term the competitiveness of the space sector depends on the continuous incorporation of brand-new and even disruptive technologies. The European RTD investment in the field of very low-TRL technologies is to be enhanced. A number of challenges in space technologies have parallels to terrestrial challenges, for example in the fields of aeronautics, energy, environment, telecommunications and ICTs, natural resource exploration, sensors, robotics, advanced materials, security, and health.

### Scope:

New ideas must be incorporated into the current state of the art. As many of the advances come traditionally from non-space sectors, an active search must be done in non-Space areas of knowledge. This should mobilize the traditional space actors, and non-space actors, to look for space technologies of the future. The aim of this topic is to attract new actors to space and demonstrate technologies that are potentially disruptive and not only incremental. As “push” technologies, these will promise radical improved performances, and will enable emerging missions. Drastical increments in miniaturisation, power reduction, efficiency and increased functionality are as well expected.

Proposals based on low TRL (1-3) ideas and technologies which could have a final application in future Space systems are solicited. The target is to demonstrate them up to TRL (4-5). In this first call, proposals on the fundamental areas of knowledge are foreseen, in which for example some of the Key Enabling Technologies (KETs) are playing a major role. In particular, proposals are sought with relevance for the fields of: "radiation-hardened instrument components"; "thermal management systems"; "wireless power transmission", in the domain of space.

### Expected impact:

The spin-in of new enabling technologies to space systems should significantly improve performances in multiple ways. Projects should mobilise new incorporation of SMEs and research groups into the Space landscape. The impact would be further enhanced if projects result in opportunities affecting a range of sectors.

### Instrument(s):

Collaborative projects (100%) of two years. The Commission considers that projects requesting a contribution from the EU of 1 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Only up to two projects will be financed on each of the 3 lines "radiation-hardened instrument components"; "thermal management systems"; "wireless power transmission" foreseen. A total of 4 million Euro has been set aside for this call topic.

## **Objective 3 - Space Science**

### ***Topic A – Scientific exploitation of astrophysics data***

#### Specific Challenge:

Europe has an impressive track record in space astrophysics, with missions such as XMM-Newton, and more recently Herschel and Planck. In 2013 GAIA will be launched, which will provide a 3D map of our galaxy to the highest possible precision. Preparations have already started for the international James Webb Space Telescope. The challenge will be to allow the European astrophysics community to make the best possible use of those missions by supporting space astronomy observation proposals, using archived data, and making comparisons (including calibrations) between different missions, instruments, and between space and ground based data.

#### Scope:

Projects shall make use of or prepare for the use of ESA astrophysics missions, possible in combination with ground-based observations, and/or data from non-ESA missions (e.g. NASA, JAXA, or other national missions). Activities shall add scientific value by advanced analysis of the data leading to scientific publications, higher level data products which can be used by other scientists in their studies, possibly in combination with the development of open source tools for processing and visualisation of astrophysics data.

#### Expected impact:

It is expected that projects realise their potential for more scientific publications based on Europe's space data, that higher level data products are being made available through appropriate archives, and tools are developed for the advanced processing of data. Projects are expected to add value to existing activities on European and national levels, and enhance the and broaden research partnerships.

Instrument(s): Collaborative projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 8 million Euro has been set aside for this call objective 3.

### ***Topic B – Scientific exploitation of comet data***

#### Specific Challenge:

Comets are argued to be the most primitive objects in our solar system, recording the processes operating when our solar system was born. Since decades, starting with the ESA Giotto mission to comet Halley (1985), European scientists have been at the forefront of cometary research, from both space and ground observatories. The challenge will be to allow the European astronomy community to make the best possible use of the current European cometary missions such as Rosetta, in combination with information from international (e.g. NASA, JAXA) missions and ground based telescope observations.

Scope:

Projects shall prepare for and make use of ESA cometary missions, possible in combination with ground-based observations, and/or data from non-ESA missions (e.g. NASA, JAXA, or other national missions). Activities shall add scientific value by advanced analysis of the data leading to scientific publications, higher level data products which can be used by other scientists in their studies.

Expected impact:

It is expected that projects realise their potential for more scientific publications based on Europe's space data, that higher level data products are being made available through appropriate archives, and tools are developed for the advanced processing of data. Projects are expected to add value to existing activities on European and national levels, and enhance and broaden research partnerships.

Instrument(s): Collaborative projects for research and innovation (100%); The Commission considers that projects requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 8 million Euro has been set aside for this call objective 3.

## **Objective 4 – International Cooperation in Space matters**

### ***Topic A – Mitigation of threats by Near Earth Objects (NEOs)***

Specific Challenge:

Given the global nature of the threat, a response should have global acceptance. To ensure that the results of scientific and technological investigations into the mitigation are widely accepted by decision makers, it is key that further actions are coordinated amongst international space actors, including United Nations COPUOS, and that results are presented and discussed openly in a global context.

Scope:

The development of an impact mitigation strategy requires expertise in the fields of astronomy, celestial dynamics, materials science, astronautics, propulsion technology, space-mission design, space-sensor systems as well as precise guidance, navigation and control systems. This diverse range of competences is necessarily spread amongst universities, research institutes and space administrations in different countries, and should be harnessed in this proposal. In the interests of establishing a coordinated global approach, research and coordination of actions is carried out with the appropriate international participation (e.g. of Russia, the USA, Japan, China, Ukraine). Networking, expert meetings and workshops resulting in recommendations for further action are part of the effort.

Expected Impact:

Efforts should aim at complementarity with actions currently in progress (e.g. UN Action Team 14 and ESA's SSA and other national programmes). Wide dissemination and discussion of the available methods is to be achieved, providing a means to reach consensus on approaches. Input to existing global impact-hazard response campaign is part of the task.

Instrument(s): One Collaborative Project for research and innovation (100%). The Commission considers that one project requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 5 million Euro has been set aside for this call objective 4 (Topics A to C).

### ***Topic B – EU-Russian roadmap for space R&D cooperation***

#### Specific Challenge:

The exploration of space is a global effort and is based on partnerships and international cooperation. Europe and Russia have a long and extensive history in space cooperation, both at national level as well as at European level. Alignment of specific technical objectives and coordination within selected European and Russian space science and technology programmes could therefore be of mutual benefit, for instance by resulting in savings in budget and time on either side, or by mobilising unique expertise in either research community.

#### Scope:

In 2006 the European Union, ESA and the Russian Federation have established a space dialogue to exchange information and coordinate their actions in developing space based applications, performing experiments at the ISS, prepare missions to explore the solar system or jointly carrying out scientific work. Future activities in human and robotic exploration will require more scientific and technological development as well as financial commitment. Proposers from European actors are required to address issues where mutual benefit can be achieved in a joint effort with Russian counterparts. Some such areas are identified in the latest space dialogue (ref <http://xxx>)

#### Expected impact:

The project should provide the basis for a regular exchange of information on space related research programmes on national and European level, should provide information on opportunities for scientists to participate in EU and Russian research programmes and produce recommendations for joint research activities funded by both parties. Opportunities for reciprocal participation should be identified. Workshops and information events should be part of the activity.

Instrument(s): One Collaborative Project of at least 3 year duration (100%). The Commission considers that projects requesting a contribution from the EU of 2 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 5 million Euro has been set aside for this call objective 4 (Topics A to C).

### ***Topic C – Basis for African Space Technology institute***

#### Specific challenge:

The EU and the African Union Commission have agreed to create a Pan-African University with 5 specialised clusters in the five African regions, one of them, the African Space Science and Technology Institute to be established in the SADC region. This institute will need particular support in establishing competence and a functioning teaching system. Careful choice of specific research and development activities can act both as catalysers for creating local centres of competence and provide opportunities for accompanying courses.

#### Scope:

Overall, about 100 partners from African countries have already participated in proposals submitted for evaluation under FP7, showing the high interest African states have in space related research. This applies in particular to space-based applications at the service of citizens, but also to space science and technology. For example, the installation of the Square Kilometer Array in South Africa has been seen to mobilise wide interest in science in the community, and will further strengthen the development of scientific education in Africa.

This setting up of an African Space Science and Technology Institute will need particular support in establishing competence and a functioning teaching system. Exchange of knowledge and capacities will be part of the activities to be engaged in, as well as the creation of a virtual campus to reach interested students in all interested African nations.

#### Expected impact:

The project should involve several African and European universities or educational administrations to develop solutions for a virtual and on-site campus which allows remote teaching and studying in connection with on-site practicing courses and sessions for African students. Apart from enhancing collaboration within Africa, projects are also expected to positively impact the international collaboration with African actors in the space domain, and should contribute to laying the foundations for new research alliances.

Instrument(s): One Collaborative projects for research and innovation (100%). The Commission considers that projects requesting a contribution from the EU of 1 million Euro would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A total of 5 million Euro has been set aside for this call objective 4 (Topics A to C).

### **Funding details for Call 2.1.7.A.3**

Publication date: at launch of Horizon 2020 in 2014

Deadline(s): 28 Nov 2014



Indicative budget: (from the 2015 budget)

Objective 1 - Topic A: EUR 8 million

Objective 2 - Topics A,B: EUR 15 million and EUR 4 million respectively

Objective 3 - Topics A,,B: EUR8 million

Objective 4 - Topic A-C: EUR 5 million

[Link to the relevant option on "margin of manoeuvre"]

Maximum EC Contribution:

The maximum EU contribution for a project is specified under each topic

Eligibility conditions: The standard eligibility conditions apply. Please read carefully the provisions [Link to the annex on standard eligibility conditions] under Annex X before the preparation of your application.

Evaluation criteria: The standard evaluation criteria apply. Please read carefully the provisions [Link to the annex on standard evaluation criteria] under Annex X before the preparation of your application.

The criterion of impact will be given a higher weighting for proposals for close-to-market actions.

Overall expected impact: as stated per topic

Evaluation procedure: [Link to the annex on standard evaluation procedure]

- Proposal page limits and layout: The standard guidelines apply. Please read carefully the guidelines [Link to the annex on guidelines] before the preparation of your application.

- Single or two stage procedure: single stage procedure

- Indicative timetable for evaluation and grant agreement: The evaluation is to commence within 2 months of the call deadline, with negotiations of successful proposals commensurate with the 2015 budget expected to commence three months after the call deadline.

Consortia agreements: The conclusion of a Consortium Agreement is required for any action under this call, and applicants are advised to prepare a draft Consortium agreement during the proposal drafting phase.

Implementation:

Calls for proposals 2.1.7.A.2 under this work programme will be implemented by the Research Executive Agency (REA) according to the provisions of Commission Decision xxxxx "delegating powers to the Research Executive Agency with a view to performance of tasks linked to implementation of specific European Union programmes People, Capacities

and Cooperation in the field of research comprising, in particular, implementation appropriations entered in the Community budget". The management of all projects to be funded as a result of this call 2.1.7.A.2 will be implemented by REA.

The European Space Agency will not participate in consortia of proposals submitted under the Horizon 2020 Space Theme to this call for proposals.

## **2.1.7.B Other actions (not subject to calls for proposals)**

### **2.1.7.B.1 In 2014**

#### **1 – Developments for a Galileo Public Regulated Service (PRS)**

Financing the development of the security module for the **Galileo Public Regulated Service (PRS) will be addressed**. It should be noted that this development is about cryptology, secured design, etc. and is related to dual-use technology development; hence this corresponds largely to classified development. The proposed activities to be funded from the Horizon 2020 Space theme are only a part of the overall development, and that complementary tasks are expected to be carried out in the Security theme of Horizon 2020, as well as by some Member States.

**Two specific public procurement actions are to be funded** from the Space budget with EUR 10 million each, and these topics are outlined as follows. The procurement will be opened early in 2014, and the contracts are expected to be awarded by mid-2014, and will run for 30 months.

These procurement activities will be implemented and managed by the **EuropeanEuropean GNSS Agency (GSA)** according to the provisions of Commission Decision xxxx [Dir H to complete Decision reference].

#### Procurement topic: Coating-PUF

Physical unclonable functions (PUF) technology is, at present, among the most promising technology to provide secure RED key storage. With Coating-PUF the key is destroyed when a device is tampered with, because tampering alters the device coating that contributes to the device's unique signature. This technique allows a very high level of integration, at near-to-zero cost, and works without the need for a power supply. PUF technology might be also combined with intrusion detection.

The European leader in this field is Intrinsic-ID and it is currently working on demonstrating the applicability of this technology to the PRS domain through an FP7 collaborative project managed by the GSA (PREMISE) for road and ground applications.

However, industrialisation of the coating material and coating process needs to be achieved. This is a gap in the security chain that shall be resolved as a matter of priority through a restricted procedure. Applications are multiple, in particular space for sensitive material.

Expected impact:

Action under this topic shall provide significant improvement in the security performances of the PRS security module and in its different applications, in particular space.

#### Procurement topic: 3D-IC and Scalable SM architecture

European technology is progressively losing grounds in nanotechnology; three-dimensional integrated circuits (3D-IC) may represent an opportunity for another path towards continuing the scaling and optimisation of performance, whilst requiring less investment.

Stacking chips using a 3D-IC processes should allow segregation of layers between different functions and technologies; highly computational layers would be separated by high security layers managing input/output and other security functions. 3D-IC could also enable on-chip antennas to be embedded in silicon ICs. These security layers could be developed within EU secure foundries, using ICs fabricated in EU secure manufacturing facilities. However, access is needed to high performance technologies required to implement the fast processing layers, which at present are produced mainly in Taiwan.

Because there is no standard for 3D-IC fabrication, it is now urgent that an infrastructure is setup to enable broad adoption of 3D-ICs. This will benefit prices, allow more frequent fabrication runs, and boost the availability of engineers. The objective is to build a security module with space capacities with the required skills objective to use it since 2016.

A scalable security module (SM) architecture would enable rapid design turnaround time, without the need to completely redesign the whole SM system. In fact, it should be noted that each time the IC technology process shrinks, design validation becomes exponentially more complex. In this way, it is possible to re-design sub-systems of the PRS (Public Regulated Service) receiver and PRS SM without completely re-designing the whole system; allowing reuse of the effort and time spent developing the original design on technologies that might have become redundant. Initial studies on the feasibility of such an approach for the PRS SM are being undertaken by the GSA. By the end of 2013 an architectural proposal will be delivered, setting the base for the implementation of a first demonstrator for space capacity.

Expected impact:

Action under this topic shall provide significant improvement to the security performance of the PRS security module and in its different applications, in particular space.

## **Activity 2 – Studies & Communication**

During 2014 it is envisaged to support the preparation of communication material, dissemination of material, or conduct public procurement activities to enable communication of Horizon Space activities, and for organisation of events (conferences, workshops or seminars) related to the implementation of the European Space Policy, European R&D research agendas related to Horizon 2020.

Special attention will be given to events which aim to explore and implement specific initiatives in the field of space for innovation, and the question of how space exploration could contribute to innovation as well as events related to space exploration. These events should support the political debate and consensus building in Europe.

Support may be given to the organisation of conferences and information events to strengthen wider participation in the programme (including that of third countries), and to disseminate results of European research in the Space sector.

Furthermore, procurement will be necessary of actions such as studies, preparation of roadmaps to underpin planning or actions to evaluate the outcomes of previous R&D actions such as FP7.

As regards studies, the following are currently foreseen:

- Study of the structural needs of the four distinct space science communities (Earth observation, astrophysics/fundamental physics, planetary sciences, space weather/heliophysics) in order to achieve a marked increase in scientific exploitation of data from European space missions. This should include the analysis of the effects of mission governance structures on the data exploitation chain, the data exploitation funding mechanism (national, ESA and EU), the various (national and ESA) archive set-ups, data dissemination and search mechanisms, data standardization issues, coordination of data processing and analysis, and visualization tools.
- A study is to be performed to establish how best Horizon 2020 can support the research into breakthrough technologies to provide access to Space using alternative concepts to conventional rocket-based launch techniques in parallel to the ongoing work to develop Europe's existing conventional rocket-based launch capabilities.

Activities may include surveys as appropriate implemented through public procurement, and/or appointing (groups of) independent experts. This limited number of contracts may be implemented on the basis of framework contracts, in order to further ensure that the Commission is provided with appropriate and timely analyses, which in turn will facilitate the proper integration of policy studies into the preparation of new policy initiatives.

The overall commitment appropriations for this set of activities (by using framework contracts and/or calls for tender) will be up to EUR 2 million in 2014.

### **Activity 3 – Horizon 2020 project evaluation (EGNSS)**

During 2014 it is envisaged to support the implementation of Horizon 2020 with expert groups advising the Commission and GSA on evaluation of calls for proposals, as well as conducting reviews of activities started with Horizon 2020 funding.

The overall commitment appropriations for this set of activities (by using expert contracts) will be up to EUR 2 million in 2014.

### **Activity 4 – Horizon 2020 project evaluation (REA)**

During 2014 it is envisaged to support the implementation of Horizon 2020 with expert groups advising the Commission and REA on evaluation of calls for proposals, as well as conducting reviews of activities started with Horizon 2020 funding.

The overall commitment appropriations for this set of activities (by using expert contracts) will be up to EUR 2 million in 2014.

## **2.1.7.B.2 In 2015**

### **Activity 1 - GNSS Evolution, Mission and Services related R&D activities**

In the first half of Horizon 2020 the Galileo mission will gradually become operational and will provide, the first European only navigation services to the citizens worldwide on top to the European Geostationary Navigation Overlay Service (EGNOS) which is fully operational

since March 2011. This is the time to make a concerted research and innovation effort in the accompaniment of the gradual deployment of the services, and to consolidate the mission and services to match at best the expectations of the user communities. At the same time Europe should ensure that it maintains the performance of the infrastructure and that the appropriate protection elements are in place to avoid sudden disruption of services.

The main objective is to support the development of enabling technologies for future generations of European GNSS missions, and to support activities that enable the full exploitation of the European GNSS infrastructure in public, scientific and commercial fields.

This should result in a strengthening of the European capacity in this field and in an efficient deployment of services at the benefit of the user communities, supporting at the same time the development in Europe of innovative GNSS-based applications.

*Procurement topic (1): Advanced mission concepts*

To satisfy the EU strategic objective to guarantee uninterrupted GNSS services and to maximise the benefits for European civil society, it is key to anticipate and assess the changes in the global GNSS context and usage, so as to identify the corresponding impacts on the definition of the GNSS services and the related mission objectives. It is therefore instrumental to develop a prospective vision of the GNSS arena at the horizon 2020 and beyond.

Activities should study new and innovative mission concepts for Galileo and EGNOS, with the aim to propose a realistic vision of the use of GNSS and SBAS in the long term future (2020+). Proposed concepts should be seen in a broad context, considering not only the evolution and trends of the sector world-wide but also the evolution of alternative technologies as well as the opportunity to exploit synergies with other space-based missions, in Europe or in cooperation with other space faring nations. The R&D activities should also aim at improving the knowledge on specific parameters (clock drifts, spacecraft position and attitude, difficult environment/multipath, atmospheric delays...), for developing innovative models leading to better performances.

The overall commitment appropriation for this activity area in 2015 is up to EUR 2 million.

**Funding scheme:** public procurement

*Procurement topic (2): Ionosphere prediction service*

Today, GNSS has become an indispensable asset commonly used in the daily life of many EU Citizens through applications such as route guidance. It has become also a critical component for the operations of many national infrastructures, such as air traffic management, power networks, telecommunication and logistics and transport, all key sectors that rely heavily on satellite-based navigation and timing information.

In this situation, a disruption of GNSS signal provision resulting from a technical failure would have a major impact on the European society. One of the main hazards that affect the provision of reliable satellite navigation and timing services is the solar activity, which has proven effects that can cause major failure in the functioning of satellite navigation systems. With the gradual deployment of the Galileo services, it is key to anticipate such effects and advise the user communities of any potential disturbance of service, allowing thus, in case of

critical use of GNSS signals (electrical power grids, telecommunications, transport), the timely shift towards reversionary or back-up systems in case of sudden availability.

It is proposed to continue the research in the field of space weather and ionosphere effects with the aim to define and develop an ionosphere activity prediction tool.

The overall commitment appropriation for this activity area in 2015 is up to EUR 1 million.

**Funding scheme:** public procurement through indirect management with GSA

*Procurement topic (3): Commercial Service*

In 2015, tests involving the Commercial Service and including the real signal in space (SIS) will be executed through the CS Demonstrator, in order to test authentication and real-time data transmission for high accuracy services. In order to complement these activities, GSA will run application demonstrations and co-funded receiver development projects. In addition to the above, H2020 activities shall complement the already foreseen activities for the CS through studying the performance improvement of the CS foreseen services, notably for authentication services, for which a performance and threat framework has not yet been established and fully accepted by the GNSS community. It may also support evolutions of CS service level definitions that will be used as a basis for future contracts with external service providers, and the research and development of new services that can be part of the CS bundle, either by adaptations of the Galileo infrastructure and/or signal definition in future Galileo versions, or by using additional ground-based data services to complement the signal in space. H2020 CS-related activities shall also cover the CS + OS synergies, for example for authentication, by covering the development of technologies and elements related to OS I/NAV evolutions related to OS navigation message authentication (NMA) that will complement the CS spreading code-based authentication.

The overall commitment appropriation for this activity area in 2015 is up to EUR 1 million.

**Funding scheme:** public procurement

*Procurement topic (4): Support to the Galileo Safety of Life Service re-profiling, in particular for Advanced Receiver Autonomous Integrity Monitoring – ARAIM*

The ARAIM concept is the alternative to which more effort is being devoted with the intention to provide a global integrity service based on multiple satellite constellations.

In this respect, cooperation with the United States of America was formally established through the creation of a specific EU-US ARAIM sub-group in Working Group C of the EU-US cooperation agreement. The first Interim Report of the Group was published on February 2013, while the Final Report, with conclusions and recommendations on the Advanced RAIM concept, is targeted by mid-2014.

It is proposed to continue the work on the ARAIM concept based on such conclusions and recommendations produced by the EU-US ARAIM sub-group.

Several actions are foreseen to be then undertaken:

- Technical work will need to be carried out in order to develop, compare, and eventually select the most suitable implementation option of the concept into the actual Galileo System and/or any other additional system concerned.
- Studies will need to be conducted on the optimisation of the user receiver ARAIM algorithms for various types of operations or targeting different user communities. Simulations may be required to assess performance of different solutions and conduct the necessary trade-offs.
- Coordination actions with other GNSS stakeholders to ensure the adoption of a solution which is recognized and shared by all involved parties. First actions in this area should be launched towards the awareness and distribution of such recommendations in the relevant Standardization for a (ICAO, EUROCAE...). As fundamental part of the awareness actions, the use of Galileo in those international fora will be promoted.

The overall commitment appropriation for this activity area in 2015 is up to EUR 1 million.

**Funding scheme:** public procurement

*Procurement topic (5): Signals evolution*

Future improvements of the positioning, navigation and timing services of the European GNSS (EGNSS) programmes Galileo and EGNOS depend to a large extent on potential enhancements of the navigation signals which are transmitted by those systems. The Galileo programme is currently in its in-orbit test and validation phase and the Galileo satellite constellation is gradually being built up. In 2015 several Galileo satellites will broadcast operational signals which will be precisely measured and monitored on-ground in order to validate the signal performance and to identify means for further performance improvements.

In order to analyse and recommend improvements of the EGNSS signal characteristics, the Commission is assisted by the Compatibility, Signal and Interoperability (CSI) Working Group which is reporting to the European GNSS programme Committee.

The activities to be carried out in this procurement topic will aim at supporting and further expanding and evaluating the recommendations stemming from this working group. It will be also necessary to consider feedbacks from receiver manufacturers in order to assess the technical feasibility of new signal structures for the different Galileo services.

The overall commitment appropriation for this activity area in 2015 is up to EUR 1 million.

**Funding scheme:** public procurement

The total indicative budget to be allocated for the subject *Activity 1* tasks under “other actions” for the budget year 2015 **EUR 6 million**.

**Activity 2 - GNSS evolution, infrastructure-related R&D activities**



The Horizon 2020 programme shall cover (under the chapter "*Leadership in enabling and industrial technologies*") the infrastructure-related R&D activities for the EGNSS, which comprise the early phases of Galileo and EGNOS evolution programmes, while their implementation in the EGNSS infrastructures shall be financed out of the EGNSS programmes budget line.

Pursuant to the agreed Galileo and EGNOS governance between ESA, EC and GSA for the period 2014 to 2020<sup>3</sup>, ESA shall be responsible for *research, technology, design, development and procurement of major evolutions and future generations of European GNSS infrastructure*. EC will thus elaborate with the support of ESA shall the detailed GNSS work programmes for technology and infrastructure related R&D which shall be consolidated and eventually endorsed by the Commission through adoption of the work programmes.

Activities are to be conducted pre-dominantly through procurement, with ESA acting on the Commission's behalf as technical programme manager and procurement agent. The mode of implementation as of 2015 is through procurement contracts under an agreement on indirect management with ESA.

The following activities will be supported through funding by the Space theme in 2015:

- 1) EGNOS further evolution Phase B activities
- 2) Galileo 2G phase B (system, satellite, payload and ground)
- 3) GNSS research and technology
- 4) GNSS System Studies and Validation Activities
- 5) EGNSS R&T Technical Management

**Funding scheme:** procurement through indirect management with ESA

The total indicative budget to be allocated for the subject *Activity 1* tasks under “other actions” for the budget year 2015 is **EUR 44 million**.

### **Activity 3 - Programme co-funding of space surveillance and tracking (SST)**

In its proposal (*COM (2013)107 final*) for “**establishing a space surveillance and tracking support programme (SST)**”, it is foreseen that the financing of R&D elements in the SST support programme will be partly supported by Horizon 2020, since R&D activities for better space surveillance are part of the Horizon 2020 Specific programme. This contribution to the SST programme will be realised through “Programme co-fund actions under Horizon 2020” (RfP Art 22.5-b), which is designed to supplement programmes funded by entities, other than Union bodies, managing research and innovation programmes.

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<sup>3</sup> Galileo and EGNOS Governance 2014-2020 (text is subject to approval of the GNSS Regulation by the Co-Legislator)

This action specifically aims (1) at better attracting and pooling national resources on the SST objectives outlined in COM (2013) 107 and coinciding with objectives and challenges of H2020 related to protecting Europe's investment made in space infrastructure, and (2) at achieving significant economies of scales by adding related H2020 resources to this joint effort, instead for the Commission to implement its own specific activities.

A grant agreement is to be concluded in 2014 in the context of the SST support programme, in which the eligible participants in "European joint-programme" are legal entities owning or managing public research (and innovation) programmes:

- a. All research funders or research organisations that receive top-up funding to implement the joint-programme activities are partners in the Grant Agreement.
- b. In addition, other research funders or research organisations may become partners in the grant agreement if they participate in non-EU funded activities of the consortium

The main activity of the action is the implementation of the joint programme of SST activities to attain objectives common to H2020, ranging from research to coordination and networking activities, including training activities, research services for SMEs, demonstration and dissemination activities, sub-granting etc.

The European Joint Programme would implement the action on the following basis:

- Adoption of an annual work programme aligning member's activities on objectives common to H2020.
- Transparent process to define new activities or existing ones, whether direct or indirect, to be funded with the EU contribution (international peer review in line with H2020 standards in the case of calls for proposals).
- Annual review of activities implemented and results achieved through peer review.

The financial contribution of EU shall be determined (1) as a ratio of national budget pooled (2) by the reimbursement of eligible costs of EU funded activities and (3) subject to the total expenditures of the coordinated programmes. **Rules for participation of Horizon 2020 will apply by default.**

The maximum reimbursement rate may reach a **maximum of 50%** of the total expenditure of the SST support programme (sum of national and EU contributions), but not exceeding 10 million Euro from the H2020 Space budget line. For 2015, as sum of EUR 2 million contribution is earmarked to start activities.

#### **Activity 4 – Studies & Communication**

During 2014 it is envisaged to support the preparation of communication material, dissemination of material, or conduct public procurement activities to enable communication of Horizon Space activities, and for organisation of events (conferences, workshops or seminars) related to the implementation of the European Space Policy, European R&D research agendas related to Horizon 2020.

Special attention will be given to events which aim to explore and implement specific initiatives in the field of space for innovation, and the question of how space exploration could contribute to innovation as well as events related to space exploration. These events should support the political debate and consensus building in Europe.

Support may be given to the organisation of conferences and information events to strengthen wider participation in the programme (including that of third countries), and to disseminate results of European research in the Space sector.

Furthermore, procurement will be necessary of actions such as studies, preparation of roadmaps to underpin planning or actions to evaluate the outcomes of previous R&D actions such as FP7.

Activities may include surveys as appropriate implemented through public procurement, and/or appointing (groups of) independent experts. This limited number of contracts may be implemented on the basis of framework contracts, in order to further ensure that the Commission is provided with appropriate and timely analyses, which in turn will facilitate the proper integration of policy studies into the preparation of new policy initiatives.

The overall commitment appropriations for this set of activities (by using framework contracts and/or calls for tender) will be up to EUR 1 million in 2014.

### **Activity 5 – Horizon 2020 project evaluation (EGNSS)**

During 2015 it is envisaged to support the implementation of Horizon 2020 with expert groups advising the Commission and GSA on evaluation of calls for proposals, as well as conducting reviews of activities started with Horizon 2020 funding.

The overall commitment appropriations for this set of activities (by using expert contracts) will be up to EUR 2 million in 2014.

### **Activity 6 – Horizon 2020 project evaluation (REA)**

During 2015 it is envisaged to support the implementation of Horizon 2020 with expert groups advising the Commission and REA on evaluation of calls for proposals, as well as conducting reviews of activities started with Horizon 2020 funding.

The overall commitment appropriations for this set of activities (by using expert contracts) will be up to EUR 1 million in 2014.

## ***2.1.7.C Perspectives for 2016***

The **EGNSS** will continue to be supported for the duration of the Horizon 2020 programme, addressing the evolution of the EGNSS infrastructure by funding the EGEP programme through ESA, and continuing application and service development.

In the domain of **Earth Observation**, an initial support for application development and service innovation close to the market will continue to be funded for the next work programme period until 2018. The subject of tools and technologies to obtain earth monitoring data and access these efficiently will continue for the remainder of Horizon 2020.

The support given to **Space Surveillance Tracking (SST)** in 2015 is expected to continue as a European Programme co-funding to the SST Programme for the remainder of Horizon 2020.

The protection of the EU Infrastructures from space threats will continue along the lines started in 2014 and 2015.

The initiation of the Support Actions in the domain of Orbital Debris Mitigation will enable the start-up of dedicated targeted calls for research proposals as of 2016 onwards, allowing for large demonstrations at the end of Horizon 2020. The potential for PSA will be examined.

**Space weather research** will continue with new opportunities for proposals in 2016.

Technology development including low-TRL is expected to be supported by financing projects in several lines.

Dedicated calls for **critical technology for non-dependence** similar to 2015 may be addressed in 2017 and 2019 dependent on the study findings from 2014.

A topic devoted to bottom-up **technologies at low TRL** will continue 2016, and later.

The orbital access may start with activities to demonstrate alternative systems to reach outer space, dependent on the scenario elaborated in the studies from 2014.

The initiation of the Programmatic Support Actions (PSA) in the domains of Space Robotics and In-space Transportation will enable the start-up of dedicated targeted calls for research proposals as of 2016 onwards, allowing for large demonstrations at the end of Horizon 2020.

Space science support in the context of space missions will be continued yearly, to be enhanced by space exploration activities in conjunction with ISS capabilities available.

International cooperation will be open yearly from 2016 onwards, as an instrument to foster the Space Cooperation beyond European frontiers.

Space outreach activities will have a continuous support along H2020, as a way to the raise the European awareness about Space and the EU Space Policy initiatives.