



**EN**

**Horizon 2020**

**Work Programme 2016 - 2017**

*5 iii. Leadership in Enabling and Industrial Technologies - Space*

**Important notice on the second Horizon 2020 Work Programme**

**This Work Programme covers 2016 and 2017. The parts of the Work Programme that relate to 2017 (topics, dates, budget) have, with this revised version, been updated. The changes relating to this revised part are explained on the Participant Portal.**

*(European Commission Decision C(2016)4614 of 25 July 2016)*

## **Table of contents**

<b>Introduction .....</b>	<b>5</b>
<b>Call - Earth Observation .....</b>	<b>7</b>
EO-1-2016: Downstream applications .....	8
EO-2-2016: Downstream services for public authorities .....	10
EO-3-2016: Evolution of Copernicus services.....	11
<b>Conditions for the Call - Earth Observation .....</b>	<b>14</b>
<b>Call - Competitiveness of European Space Sector: Technology and Science .....</b>	<b>16</b>
COMPET-1-2016: Technologies for European non-dependence and competitiveness.....	18
COMPET-2-2016: Maturing satellite communication technologies.....	20
COMPET-3-2016-a: SRC - In-Space electrical propulsion and station keeping - Incremental Technologies .....	22
COMPET-3-2016-b: SRC - In-Space electrical propulsion and station keeping - Disruptive Technologies .....	23
COMPET-4-2016: SRC - Space Robotics Technologies.....	25
COMPET-5-2016: Scientific Instrumentation .....	28
<b>Conditions for the Call - Competitiveness of European Space Sector: Technology and Science .....</b>	<b>29</b>
<b>Call - Applications in Satellite Navigation – Galileo – 2017.....</b>	<b>31</b>
GALILEO-1-2017: EGNSS Transport applications .....	32
GALILEO-2-2017: EGNSS mass market applications.....	34
GALILEO-3-2017: EGNSS professional applications .....	37
GALILEO-4-2017: EGNSS awareness raising and capacity building .....	38
<b>Conditions for the Call - Applications in Satellite Navigation – Galileo – 2017.....</b>	<b>40</b>
<b>Call - Earth Observation .....</b>	<b>42</b>
EO-1-2017: Downstream applications .....	43
EO-2-2017: EO Big Data Shift .....	45
EO-3-2017: Preparation for a European capacity to monitor CO2 anthropogenic emissions .....	48

**Conditions for the Call - Earth Observation ..... 53**

**Call - Competitiveness of the European Space Sector: Technology and Science ..... 55**

COMPET-1-2017: Technologies for European non-dependence and competitiveness..... 56  
COMPET-2-2017: Competitiveness in Earth observation mission technologies ..... 58  
COMPET-3-2017: High speed data chain ..... 60  
COMPET-4-2017: Scientific data exploitation ..... 62  
COMPET-5-2017: Space Weather ..... 63  
COMPET-6-2017: Space portal ..... 64  
COMPET-7-2017: Technology transfer and business generators..... 65

**Conditions for the Call - Competitiveness of the European Space Sector: Technology and Science..... 67**

**SME instrument ..... 69**

**Fast track to innovation - Pilot..... 70**

**Other actions..... 71**

1. Galileo Evolution, Mission and Service related R&D activities..... 71  
2. EGNOS, Mission and Service related R&D activities ..... 71  
3. Horizon 2020: preparation, evaluation and project monitoring ..... 72  
4. GNSS evolution, infrastructure-related R&D activities..... 72  
5. Framework Partnership Agreement on Space Surveillance and Tracking (SST) ..... 73  
6. Space surveillance and tracking (SST)..... 74  
7. Improving the Performances of the SST at European Level..... 75  
8. Engineering support by ESA..... 76  
9. Studies & Communication ..... 77  
10. Horizon 2020 project monitoring ..... 78  
11. Horizon prize for low cost access to space..... 78  
12. Galileo Evolution, Mission and Services related R&D activities ..... 79  
13. EGNOS, Mission and Service related R&D activities ..... 80  
14. Horizon 2020 project monitoring and audits (EGNSS) ..... 80  
15. GNSS evolution, infrastructure-related R&D activities..... 81  
16. Space surveillance and tracking (SST)..... 81  
17. Improving the Performances of the SST at European Level..... 83  
18. Engineering support by ESA..... 84  
19. Studies & Communication ..... 84  
20. Horizon 2020 project monitoring ..... 85

**Budget..... 86**

## **Introduction**

Space research is supported in Horizon 2020 under the priority "Industrial Leadership", in line with the main objective and challenge to ensure that space will remain accessible to Europe and safe to operate in the long run. This is a long-term challenge that requires a long-term approach that must encompass several areas such as security of supply of critical space technologies, including components, at cost effective and affordable conditions, industry capability and technology readiness as well as space situational awareness to cope with threats such as space orbital debris (including space surveillance and tracking). An important challenge and an opportunity for Europe is to reap the benefits of European investments in the space sector, primarily by carrying out research and innovation actions for preparing applications and downstream services exploiting the opportunities of data and signals available through the Galileo and Copernicus systems. Whenever "*users*" are mentioned in this work programme part, inclusive actions should be considered, when appropriate, to cater for users of all ages and genders.

Needs expressed by main European space stakeholders, including industry and SMEs, have been reflected in this work programme. An increasing industrial participation is expected across the work programme with industry lead encouraged in particular for technology topics under the COMPET calls. The Horizon 2020 Space Work Programme 2014-2015 already covered the major strands of activities required to address these challenges. These major strands are foreseen to remain for the full 2014-2020 period. Thus, there is an element of continuity in the Horizon 2020 Space Work Programme 2016-2017.

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 challenges by:

- Prioritising the existing two EU Space flagships of European Global Navigation Satellite System (EGNSS) and Earth Observation reaping the benefits they can generate in the coming years and ensuring their state-of-the-art also in the future;
- Ensuring support for the third programmatic priority of the EU space policy: the protection of space infrastructure and in particular the setting up of a Space Surveillance and Tracking system (SST) at European level;
- Ensuring support to EU industry to meet the objectives defined in the Commission communication on Space Industrial Policy, notably to maintain and enhance industry's competitiveness and its value-chain in the global market;

- Ensuring that Europe's investments made in space infrastructure are exploited to the benefit of citizens; as well as supporting European space science; and
- Enhancing Europe's standing as attractive partner for international partnerships in space science and exploration.

The following applies for all calls with opening dates falling between 14/10/2015 and 25/07/2016 inclusive:

A novelty in Horizon 2020 is the Open Research Data Pilot which aims to improve and maximise access to and re-use of research data generated by projects. While certain Work Programme parts and areas have been explicitly identified as participating in the Pilot on Open Research Data, individual actions funded under the other Horizon 2020 parts and areas can choose to participate in the Pilot on a voluntary basis. The use of a Data Management Plan is required for projects participating in the Open Research Data Pilot.

Further guidance on the Pilot on Open Research Data<sup>1</sup> and Data Management<sup>2</sup> is available on the Participant Portal.

The following applies for all calls with an opening date on or after 26/07/2016:

Grant beneficiaries under this work programme part will engage in research data sharing by default, as stipulated under Article 29.3 of the Horizon 2020 Model Grant Agreement (including the creation of a Data Management Plan). Participants may however opt out of these arrangements, both before and after the signature of the grant agreement. More information can be found under General Annex L of the work programme.

Where appropriate, beneficiaries are invited to follow the GEOSS Data Sharing Principles and to register in GEOSS the geospatial data, metadata and information generated as foreground of the project. Further contact and information on GEOSS can be found from [www.earthobservations.org](http://www.earthobservations.org).

Initial efforts in stimulating space-based applications in the areas of Earth observation and satellite navigation are being made through the Leadership in Enabling and Industrial Technologies-Space part of Horizon 2020. However, the uptake of space data for the development of innovative applications addressing specific challenges is expected to primarily take place through the Horizon 2020 Societal Challenges to ensure full integration and direct uptake by the users.

---

<sup>1</sup> [http://ec.europa.eu/research/participants/data/ref/h2020/grants\\_manual/hi/oa\\_pilot/h2020-hi-oa-pilot-guide\\_en.pdf](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf).

<sup>2</sup> [http://ec.europa.eu/research/participants/data/ref/h2020/grants\\_manual/hi/oa\\_pilot/h2020-hi-oa-data-mgt\\_en.pdf](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf).

## **Call - Earth Observation**

***H2020-EO-2016***

Horizon 2020 Earth observation (EO) activities are considered an essential element to accompany the investments made by the Union in Copernicus, the Union Earth observation and monitoring programme. Through Copernicus and Earth Observation activities in the Horizon 2020 the European Union also contributes to advancing the Global Earth Observation Systems of Systems (GEOSS).

In particular, activities under the societal challenge for climate action, environment, resource efficiency and raw materials focus on GEOSS, notably the development of comprehensive and sustained global environmental observation and information systems that stimulate the smart use of strategic resources, support the development of evidence-based policies, foster new environmental and climate services, and develop new opportunities in global markets. Activities under the Leadership in Industrial Technologies part focus on the evolution of Copernicus and the exploitation of existing European space infrastructure by promoting the development of innovative products and services based on remote sensing, geo-positioning or other types of satellite enabled data as well as geo-information generated already by services such as Copernicus services.

Moreover, taking into account the wider relevance of EO to all parts of Horizon 2020, proposals addressing application and uptake of EO for the development of innovative applications addressing specific challenges can also be submitted to the Horizon 2020 Societal Challenges where related references are included. To that end, applicants to those parts of Horizon 2020 can also access Copernicus data and information (licensing conditions may apply)<sup>3</sup>.

To facilitate access to opportunities for applicants, the following list includes dedicated Earth observation activities in calls in other work programme parts, in addition to those in this call:

- Blue Growth – demonstrating an ocean of opportunities (H2020-BG-2016-2017):
  - BG-9-2016: An integrated Arctic observing system
  - BG-12-2016: Towards an integrated Mediterranean Sea Observing System
- Sustainable Food Security – resilient agri-food chains (H2020-SFS-2016-2017):
  - SFS-43-2017: Earth Observation services for the monitoring of agricultural production in Africa

---

<sup>3</sup> Access to Copernicus Sentinel data and service information is provided to users on a free, full and open basis. For other satellites data, the DataWareHouse document 2.0 is available at <http://www.copernicus.eu/main/library/technical-documents/> and licensing details can be consulted at [http://gmesdata.esa.int/web/gsc/dap\\_document](http://gmesdata.esa.int/web/gsc/dap_document) as well as [http://gmesdata.esa.int/web/gsc/terms\\_and\\_conditions](http://gmesdata.esa.int/web/gsc/terms_and_conditions).

- Climate Action, Environment, Resource Efficiency and Raw Materials - Earth Observation (H2020-SC5-2016-2017):
  - SC5-18-2017 - Novel in-situ observation systems
  - SC5-19-2017 - Coordination of citizens' observatories initiatives
  - SC5-20-2016 - European data hub of the GEOSS information system
- Earth Observation (H2020-EO-2016 and H2020-EO-2017)
  - EO-1-2016 and EO-1-2017: Downstream applications
  - EO-2-2016: Downstream applications for public sector users
  - EO-3-2016: Evolution of Copernicus services
  - EO-2-2017: EO Big Data Shift
  - EO-3-2017: Preparation for a European capacity to monitor CO<sub>2</sub> anthropogenic emissions
- Competitiveness of the European Space Sector: Technology and Science (H2020-COMPET-2017)
  - COMPET-2-2017: Competitiveness in Earth observation mission technologies
- SME Instrument (H2020-SMEInst-2016-2017), although not dedicated uniquely to Earth Observation, is particularly well suited for SMEs addressing space based applications
  - SMEInst-04-2016-2017: Engaging SMEs in space research and development
  - SMEInst-12-2016-2017: Boosting the potential of small businesses in the areas and priorities of Societal Challenge 5

Proposals are invited against the following topic(s):

**EO-1-2016: Downstream applications**

Specific Challenge: Copernicus, the Union's Earth observation and monitoring programme entered into force in 2014 and produces a wealth of data and information regarding the Earth sub-systems (land, atmosphere, oceans) and cross-cutting processes (climate change, emergency and security). Copernicus data and information are mainly made available on a free open and full basis. This is expected to unleash unique market opportunities. It is important to foster market development exploiting the added value of integration of EO observation technologies (both satellite, airborne and ground based) with positioning ones and ICT (enhancing new frontiers opened by web) across different market segments through the development of applications, and encourage their insertion into the market.



For such applications and developments to succeed in the market, the product needs to be shaped according to users' needs and their value to users must be openly demonstrated to the wider user community. This needs to be achieved in an environment integrated at the level of the user, in order for users to accept the innovative potential which the product promises. This will require also specific attention to be given to the various processes in place in the users' workflows which incorporate the EO information. Furthermore, the transition of R&D product prototypes to viable commercial product lines after the end of the EU funded phase remains a challenge to be addressed early on during product development.

Scope: Proposals may address a wide variety of applications stemming from the use of Earth observation and its smart integration with other related technologies. Copernicus should be considered as part of the solution which may include other space or non-space inputs. This is likely to lead to greater value, opportunities and especially market uptake. To this aim, a business model, which includes the phase of the project following the end of the public funding, should be part of the proposal.

The outcome of this innovation project 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 including data processing, visualisation and cataloguing.

The choice of EO application is left to the proposer.

Applicants 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 website<sup>4</sup>.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

---

<sup>4</sup> <http://www.copernicus.eu/main/data-access>

- Establish sustainable supply chains for innovative EO value added products and services with demonstrated commercial value with targeted client communities. Complete integration, based on international standards, into the customer's existing business processes and processing chains, as well as the economic viability of the application is to be demonstrated;
- Enhance the European industry's potential to take advantage of market opportunities and establish leadership in the field, and to boost business activity;
- 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 new jobs.

Type of Action: Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

### **EO-2-2016: Downstream services for public authorities**

Specific Challenge: Copernicus, the Union's Earth observation and monitoring programme entered into force in 2014 and produces a wealth of data and information regarding the Earth sub-systems (land, atmosphere, oceans) and cross-cutting processes (climate change, emergency and security). Such information can be very helpful for reporting obligations of Member States and can enable informed decision-making. At the same time such information needs either adaptation to local conditions and contexts, or adaptation to the specific needs of public authorities as part of workflow and procedures. The challenge is to deepen user integration and thus foster exploitation of Copernicus information to match the needs of public authorities at national, regional or local levels.

New and innovative solutions are needed to address the existing and emerging societal challenges faced among others by the public sector. Some of these societal challenges require public sector transformations for which no commercial stable solutions exist, and that require a more forward looking public procurement strategy either through incremental or radical innovation.

Scope: The objective is to launch demand-driven innovation actions by public authorities aiming at customising Copernicus information as part of the solution (i.e. possibly alongside other space or non-space data sources) for their needs. Transnational collaboration has a key role to play in this context, as it can facilitate knowledge transfer and optimisation of resources for public authorities. It also fosters service providers who can benefit from an strengthened digital single market. Application products are expected to adopt open standards for data documentation, data models and services.

The choice of Copernicus service and associated downstream EO-based services left to the proposer.

Applicants 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 website<sup>5</sup>.

It should also be noted that coupling with ESIF<sup>6</sup> actions could facilitate this process and can ensure continuity.

Expected Impact:

- The establishment of buyer groups for Earth observation services;
- Copernicus-enabled national, regional or local applications in support of public authorities;
- Fostering the emergence of similar EO-based actions in smart specialisation strategies;
- Establish sustainable supply chains for delivery of downstream EO-based services to public authorities.

Type of Action: Pre-Commercial Procurement

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

**EO-3-2016: Evolution of Copernicus services**

Specific Challenge: Copernicus operational services are not static, but need to evolve with recognised and emerging user requirements and state of the art methodologies. While immediate service maintenance and enhancement in response to the Copernicus work programme is part of operational tasks, long-term evolutions will need input from R&D outside the programme. A process has been put in place in the Copernicus services by the Entrusted Entities to review service evolution and any emerging adaptation needs as to their urgency, closeness to the operational delivery process, and availability of capacities. R&D activities which are suitable for Horizon 2020 are identified to this end by the Commission and/or the Entrusted Entities for each service. An information document is published together with this work programme<sup>7</sup>. The challenge is to have the results of R&D available in a sufficiently timely manner to support an informed discussion, if and under which conditions an evolution of the operational service portfolio of the Copernicus service is appropriate. The schedule of the activities should thus consider the overall planning of the Copernicus programme and its specific services concerned.

Scope: The research and innovation action should aim at demonstrating the technical operational feasibility of a specific service evolution proposal. The proposers are expected to

---

<sup>5</sup> <http://www.copernicus.eu/main/data-access>

<sup>6</sup> European Structural and Investment Fund.

<sup>7</sup> <http://ec.europa.eu/growth/sectors/space/research/horizon-2020>

demonstrate at the proposal stage an active link with the Copernicus service by suitable means. The output of these research and innovation project should aim at providing a proof-of-concept or a prototype for a proposed evolution of the Copernicus services, respecting the border between Copernicus services and downstream services. This proof-of-concept or prototype should allow to demonstrate the appropriateness to implement the proposed evolution later on at European level, i.e. potentially with operational Copernicus funding. To allow a discussion of such potential operational funding, the activity should as well result into one or more possible scenarios how this evolution could potentially be integrated into the existing service architecture and if it could be built on the existing observation data or if new observation requirements would be needed.

Proposers are advised to consult information on the Copernicus programme in general at <http://copernicus.eu>, the evolution topics identified there, as well as the availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data at the Commission's website<sup>8</sup>.

The proposal should indicate:

- To what extent the proposed evolution could be a candidate for the operational Copernicus service in terms of cost-benefits, calendar and operational feasibility;
- The conditions for making available, for use and exploitation, the results (including IPR) to the entities implementing the EU Copernicus programme, including its contractors and service providers;

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Enhance the European industry's potential to take advantage of emerging market opportunities and capacity to establish leadership in the field;
- Boost competitiveness of the industrial actors in EU and national procurements;
- Establish a proof-of-concept or a prototype, which can act as reference for the independent assessment of Copernicus service evolution, in light of product extensions and service improvements.

Type of Action: Research and Innovation action

---

<sup>8</sup> <http://www.copernicus.eu/main/data-access>

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

## Conditions for the Call - Earth Observation

Opening date(s), deadline(s), indicative budget(s):<sup>9</sup>

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2016	
Opening: 10 Nov 2015		
EO-1-2016 (IA)	9.85	03 Mar 2016
EO-2-2016 (PCP)	4.18	
EO-3-2016 (RIA)	9.00	
Overall indicative budget	23.03	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Exceptional funding rates:

EO-2-2016	The funding rate for Pre-Commercial Procurement (PCP) actions is limited to 90% of the total eligible costs (PCP is procurement of R&D services) to leverage co-financing from the procurers.
-----------	---

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme.. The following exceptions apply:

EO-1-2016, EO-2-2016, EO-3-2016	Considering the nature and objectives of the actions, and in view of favouring wider competition and participation, the European Space Agency will not participate in consortia of proposals
---------------------------------	--

<sup>9</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The budget amounts for the 2017 budget are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget 2017 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

	submitted under this call for proposals
--	---

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

## **Call - Competitiveness of European Space Sector: Technology and Science**

***H2020-COMPET-2016***

### ***Competitiveness of European space technology***

Competitiveness, non-dependence and innovation of the European space sector 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 (including SMEs) 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.

Attention will be given to some clear trends in space technology development; on the one hand miniaturization on system and subsystem level, as well as in the development of instrumentation. On the other hand the development to generic technologies coming available for a number of different science and application areas. This leads to obvious synergies that should be promoted.

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 technology readiness level (TRL<sup>10</sup>), possibly flight proven) and be accompanied by adequate production rates. European focus in future space technologies, beyond the current state of the art, needs to be strengthened along the entire TRL scale: from low TRL key technologies to in-orbit demonstration and validation. Concrete support for IOD/IOV opportunities is planned for subsequent work programmes (2018-2020), considering previous results and evolving European priorities.

Technologies for satellite communication will be supported in particular in topics COMPET-2-2016 "Maturing satellite communication technologies" and in COMPET-3-2017 "High data rate chain". In addition, the topics COMPET-1-2016/2017 "Technologies for European non-dependence and competitiveness" and COMPET-3-2016 "In-space electrical propulsion and station keeping" address important objectives for the satellite communication industry.

Technologies for Earth observation will supported in particular in topics COMPET-2-2017 "Competitiveness in Earth observation mission technologies" and COMPET-3-2017 "High

---

<sup>10</sup> Technology Readiness Levels are defined in part G of the General Annexes. In the specific area of space, further details can be found in the European Space Agency website "The ESA Science Technology Development Route": <http://sci.esa.int/sre-ft/50124-technology-readiness-level/05>.



speed data chain". In addition, the topics COMPET-1-2016/2017 "Technologies for European non-dependence and competitiveness" also contribute to enabling technologies for Earth observation.

Technologies for satellite navigation are addressed in the Galileo part of the work programme.

Technologies enabling recurrence of use contribute to enhancing industrial competitiveness. Research on modular, reusable elements is therefore encouraged. Standardisation of such modular components by existing initiatives such as the European Space Components Coordination (ESCC) and the European Cooperation for Space Standardisation (ECSS), and their interfaces across Europe can optimise the investments and when applied appropriately facilitate access to emerging commercial markets. Synergies with ongoing work with ESA and Member States in the area of technology standardisation will be sought.

### ***Strategic research clusters***

In the frame of Horizon 2020 work programme 2014, two strategic research clusters (SRC) were initiated in the fields of *In-Space electrical propulsion and station keeping* and *Space Robotics Technologies* – with two coordination and support actions<sup>11</sup> awarded having as main objective to oversee and prepare European roadmaps for each SRC.

Subsequently, this work programme dedicates two SRC topics which are in line with the information contained in the aforementioned roadmaps. Additional topics are planned to follow in the years 2018-2020.

Regarding the cluster "Space Robotics Technologies" applicants may also wish to refer to the ICT part of the work programme on *Robotics and Autonomous systems*<sup>12</sup> where generic robotic technologies are addressed.

Within each SRC the beneficiaries of each awarded grant will collaborate for the purposes of the cluster with the beneficiaries of the other awarded grants.

Applicants to both SRC topics are advised to consult the corresponding guidelines<sup>13</sup>.

### ***Space exploration and science***

Europe has, over the years, established a leading position in space exploration and space sciences. The proposed approach is to enable European communities to make a concerted effort to capitalise on current European space sciences, as well as space and planetary exploration infrastructures, and to achieve the highest possible science return from operational and future space missions. Activities which further science in the context of space missions, i.e. supporting scientific instrumentation in support of future or operational missions, will be supported.

---

<sup>11</sup> EPIC for In-Space electrical propulsion and station keeping and PERASPERA for Space Robotics Technologies

<sup>12</sup> Topics from ICT-05-01 to ICT-05-07.

<sup>13</sup> <http://ec.europa.eu/growth/sectors/space/research/horizon-2020>

Proposals are invited against the following topic(s):

**COMPET-1-2016: 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. Whenever possible multiple (>1) sources for the critical technologies shall be promoted across Europe. 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 Joint EC-ESA-EDA Task Force on Critical Technologies for European non-Dependence, launched in 2008. The Joint Task Force recently updated the list of actions for 2015-2017<sup>14</sup>.

Activities shall address technologies identified on the list of Actions for 2015/2017 focusing on those areas that have not so far benefitted from prior Framework Programme funding and representing the highest potential for being implemented through the types of action available in Horizon 2020.

Accordingly, the following priority technologies have been identified:

- U14 - Active discrete power components.
- U18 - Enhanced performance and space qualified detectors.
- U19 - High speed DAC-ADC based on European technology.
- U20 - Very high performance microprocessors.
- U22 - ASICs: Deep Sub-Micron (DSM).
- N27 - RF components.

Technological spin in and/or bilateral collaborations should be enhanced between European non-space and space industries and proposals 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.

Proposals should strive to go beyond the present state-of-the-art or, preferably, the expected state of the art at the time of completion if alternative technologies are being developed

---

<sup>14</sup> Excerpt from "Critical Space Technologies for European Strategic Non-Dependence – Actions for 2015/2017" (<http://ec.europa.eu/growth/sectors/space/research/horizon-2020>)

outside Europe. High level specifications and key requirements can be found in the list of actions for 2015-2017.

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.

A maximum of one proposal per identified priority technology line will be selected for funding.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 5 million would allow this specific topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

Expected Impact:

- Reduce the dependence on critical technologies and capabilities from outside Europe for future space applications, as identified in the list of Actions for 2015/2017 as part of the Joint EC-ESA-EDA task force on Critical Technologies;
- 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;
- Enhance the technical capabilities and overall competitiveness of European space industry satellite vendors on the worldwide market;
- 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;
- 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;
- Improve the overall European space technology landscape and complement the activities of European and national space programmes;
- Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry, including SMEs, and stronger take-up of research results;

- Fostering links between academia and industry, accelerating and broadening technology transfer.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

### **COMPET-2-2016: Maturing satellite communication technologies**

Specific Challenge: Today, it is a critical challenge for Europe to establish a level playing field with its global competitors and support activities to bridge the digital gap across European regions and deliver broadband and telecommunications services to under-served areas and populations.

In the mid to long-term, the competitiveness of the space sector and its ability to serve EU policies, notably the Digital Single Market, depends on the continuous integration of pertinent technologies and the availability of demonstrated/validated systems and sub-systems. While European companies have managed to capture a significant share of the global commercial telecommunications satellite market, technological advances must consolidate competitive positions. An objective of the sector is to move towards the Terabit satellite systems (space and ground segment). Other approaches target constellations in lower Earth orbit.

Scope: The aim of this topic is to demonstrate, in a relevant environment, technologies, systems and sub-systems for satellite communications. The proposed work should address and demonstrate significant improvements in miniaturisation, power reduction, efficiency, performance, flexibility, resilience, versatility, security and/or increased functionality and should demonstrate complementarity to activities already funded by Member States and the European Space Agency (e.g. the ARTES programme).

Proposals that demonstrate technologies targeting TRL 6 are welcome.

In this context, proposals are sought with relevance for space in the following fields:

- Advanced communication technologies for feeder or service links, preparing satellite networking in the Terabit-throughput including optical communication and RF communication at high frequencies (Q/V/W). Optical communication technologies will indicatively include laser communication terminals for ground and satellite segment. This could include transmitter and receiver technologies, hybrid RF-photonics technologies, pointing and tracking approaches, ground station design, site diversity technique to adapt to weather conditions, turbulence mitigation techniques (like Adaptive Optics, Predistortion and Transmitter Diversity), gateway management and interface with ground networks.
- Photonics technology (for high capacity reconfigurable payloads).

- Active antennas building blocks at different frequencies up to Ka/Ku bands and higher, GaN SSPA - Solid State Power Amplifier.
- Flexible repeater (equipment enabling flexible frequency plans, flexible channelization, evolution to new RF bands such as Q- and V-band, etc.).
- Reconfigurable coverages, flexible interbeam connectivity, antijamming and interference mitigation techniques, on-board spectrum monitoring, interference management and support for full duplex relaying.
- New generation of waveforms and related protocols, as well as photonic building blocks and technologies, devoted to seamless integration of SatCom Systems with terrestrial networks (including hybrid terrestrial-satellite network architectures) with specific focus on mobile machine to machine (m2m) applications, high-security communication services, future internet architectures, SDN and Cloud Computing paradigms, and security needs.
- End to end system enablers in telecommunications: technical enablers to increase the security, efficiency and performance of satellite-based communications solutions for weather conditions adaptation and optimisation of EO data distribution.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 4 million would allow this specific topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

Expected Impact:

- Increase the maturity level of key satellite communication technologies with clear and measurable progress over the state of the art in terms of step changes in technical capabilities, as evidenced by improvements in performance.
- Contributing by 2020 to a more competitive positioning of satellite communication manufacturers in the marketplace, in terms of their penetration in new or emerging markets.
- Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry, including SMEs, and stronger take-up of research results.
- Fostering links between academia and industry, accelerating and broadening technology transfer.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

**COMPET-3-2016-a: SRC - In-Space electrical propulsion and station keeping - Incremental Technologies**

Specific Challenge: The challenge of this strategic research cluster (SRC) is to enable major advances in Electric Propulsion (EP) for in-space operations and transportation, in order to contribute to guarantee the leadership through competitiveness and non-dependence<sup>15</sup> of European capabilities in electric propulsion at world level within the 2020-2030 timeframe, always in coherence with the existing and planned developments at national, commercial and ESA level.

Furthermore, electric propulsion will have implications on several aspects of space systems, such as the need to increase on-board power supply capabilities, which may be addressed in future calls of this SRC.

Scope: Incremental technologies are those considered mature enough at the moment to allow for incremental steps to enable capabilities such as dual mode, higher/lower power, Electric Orbit Raising (EOR), required by a number of applications such as telecommunications, LEO / MEO missions, space science and exploration, space transportation which the current systems (some of them qualified and some with flight heritage) are not able to provide.

Proposals shall, therefore, enable incremental advances in the already known technologies for Electric Propulsion systems based on:

1. Hall Effect Thrusters (HET)
2. Gridded Ion Engines (GIE)
3. High Efficiency Multistage Plasma Thrusters (HEMPT)

A detailed description of the above lines is included in the corresponding guidelines<sup>16</sup>.

Proposals on incremental technologies should demonstrate the readiness and interest to carry the developments further on through future calls of this SRC, by including a long-term plan and specifications for the developments to reach the higher TRLs in 2023-2024 and a business plan on how to access the selected market with a full range of competitive products. These plans and specifications should be analysed in depth through a dedicated work package as an integral part of the proposal.

Proposals should seek to cover developments suited for more than one application domain, in order to widen the achievable capabilities.

---

<sup>15</sup> See definition of "non-dependence" in the Joint EC-ESA-EDA Task Force list of actions for 2015-2017 (<http://ec.europa.eu/growth/sectors/space/research/horizon-2020>).

<sup>16</sup> <http://ec.europa.eu/growth/sectors/space/research/horizon-2020>

A maximum of one proposal per aforementioned technology (1, 2, 3) will be selected, with the target of supporting all three technologies.

The Commission considers that proposals for the incremental technologies requesting a contribution from the EU of between EUR 7.5 and 11 million (line 1 / HET), EUR 5.5 and 7.5 million (line 2 / GIE), EUR 4.5 and 5.5 million (line 3 / HEMPT).

Grants awarded under this sub-topic will be complementary to each other and complementary to grants awarded under sub-topic COMPET-3-2016-b ("complementary grants"). In order to ensure a smooth and successful implementation of this Strategic Research Cluster (SRC), the beneficiaries of complementary grants ("complementary beneficiaries") shall conclude a written "collaboration agreement". The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will apply.

Expected Impact:

- To develop, in the mid-term, the European capacity to compete in the worldwide arena of electric propulsion satellites.
- To substantially increase medium and long term competitiveness of existing EP system technologies with a technology/application-driven approach.
- To pursue developments which shall be mainly market-oriented, beneficial at system level and with a strategic view to long term needs.
- To enable medium and longer term applications: Telecom, Space Transportation, LEO, MEO, Exploration and Science.
- To anticipate ambitious long-term market evolution and strategic opportunities, so that the developed systems create new markets and shape existing ones.

Type of Action: Innovation action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

**COMPET-3-2016-b: SRC - In-Space electrical propulsion and station keeping - Disruptive Technologies**

Specific Challenge: The challenge of this strategic research cluster (SRC) is to enable major advances in Electric Propulsion (EP) for in-space operations and transportation, in order to contribute to guarantee the leadership through competitiveness and non-dependence<sup>17</sup> of European capabilities in electric propulsion at world level within the 2020-2030 timeframe,

---

<sup>17</sup> See definition of "non-dependence" in the Joint EC-ESA-EDA Task Force list of actions for 2015-2017 (<http://ec.europa.eu/growth/sectors/space/research/horizon-2020>).

always in coherence with the existing and planned developments at national, commercial and ESA level.

Furthermore, electric propulsion will have implications on several aspects of space systems, such as the need to increase on-board power supply capabilities, which may be addressed in future calls of this SRC.

Scope: A ‘disruptive space technology’ is an emerging technology that disrupts the status quo of the space sector by replacing the dominant technology and provides a radical improvement in performance that is perceived as valuable by a customer or part of the market, or it opens up new opportunities not possible with the incumbent technology. If a disruptive technology can be identified early enough, accelerating the development of that technology would help sustain advances in performance. Emerging technologies that are potentially ‘disruptive’ often underperform compared to the dominant technology in early development phases – the underlying physics may not be fully understood for example and more R&D is required to properly ascertain performance attributes.

This topic focuses on promoting promising and potentially disruptive concepts in the field of Electric Propulsion, in order to allow the increase of the currently low or very low TRL of breakthrough concepts which in the long term could change the EP landscape.

Proposals are expected in the areas of disruptive technologies for Electric Propulsion and for EP thrusters, that are currently at low TRL ( $\leq 4$ ) and not part of the incremental lines mentioned above. Indicatively, these disruptive technologies are based on Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance plasma thrusters (ECR), Magneto Plasma Dynamic thrusters (MPD), pulsed plasma thrusters (PPT), micro-propulsion electric thrusters. This list is non-exhaustive and any other innovative electric thruster concepts and relevant technologies for disruptive electric propulsion systems not mentioned here can be addressed (e.g. direct drive, radical new PPU architectures, dedicated spacecraft power system architectures and/or materials).

Proposals for disruptive technologies shall not address incremental thruster technologies (e.g. micro-GIE, etc.).

A detailed description of the above lines is included in the corresponding guidelines<sup>18</sup>.

Proposals should also include a validation plan, including one or more validation methods to apply through the course of the project, which would allow to verify how the development targets are being met and how the landscape disruption shall take place in the future. These plans should be analysed in depth through a dedicated work package within the project.

A maximum of one proposal addressing transversal relevant technologies for disruptive Electric propulsion systems (not thrusters), and a maximum of 4 proposals addressing the remaining ones devoted to specific disruptive EP thrusters will be selected.

---

<sup>18</sup> <http://ec.europa.eu/growth/sectors/space/research/horizon-2020>



The Commission considers that proposals for the disruptive technologies requesting a contribution from the EU of between EUR 1 and 1.5 million, would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Grants awarded under this topic will be complementary to each other and complementary to grants awarded under sub-topic COMPET-3-2016-a ("complementary grants"). In order to ensure a smooth and successful implementation of this Strategic Research Cluster (SRC), the beneficiaries of complementary grants ("complementary beneficiaries") shall conclude a written "collaboration agreement". The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will apply.

Expected Impact:

- To anticipate, in the long-term, the necessary evolutions in order to maintain the European capacity to compete in the worldwide arena of electric propulsion satellites, by providing Europe with competitive and innovative EP products in the long-term.
- To promote and accelerate the development of potentially breakthrough EP or EP-related concepts in order to be able to provoke a disruption in the propulsion landscape in the long-term
- To identify, target and enable the types of future markets and/or applications which are not yet addressed by the current well-established products or their expected improved versions.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

**COMPET-4-2016: SRC - Space Robotics Technologies**

Specific Challenge: The overall challenge of this strategic research cluster (SRC) is to enable major advances in space robotic technologies for future on-orbit satellite servicing (robotics and rendezvous), and the exploration of the surfaces of the other bodies in our solar system.

This specific challenge consists of designing, manufacturing and testing of reliable and high performance common robotic building blocks for operation in space environments (orbital and/or planetary), which will be useful for the SRC (demonstrations of on-orbit satellite servicing and planetary surface exploration). It can also be useful for (i) the wider European space robotics goals; and (ii) potential spin-off and spill-over effects to other areas of robotic activity on Earth (such as automotive or underwater but not limited to those).

Through the mastering of common building blocks, which allow inexpensive re-use across multiple applications, European actors will have a competitive advantage and industrial partnering will be facilitated. For the common building blocks to be successful, particular

effort must be made in systems engineering, system performance analysis, reliability, availability, maintainability and safety improvement, rather than an approach based on pure technology development.

Scope: Proposals shall address one of the following six specific robotic building blocks:

**a) Space Robot Control Operating System:** an open source space robot control operating system (RCOS) that can provide adequate features and performance with space-grade Reliability, Availability, Maintainability and Safety (RAMS) properties. RCOS control any robot/spacecraft systems whether for orbital or planetary applications, for all phases and modes of the mission.

**b) Autonomy framework Time/Space/Resources planning and scheduling:** a software framework for the development of highly autonomous space robotics missions. In these a robot system, given a high level goal, will (re)plan, schedule and oversee the execution of elementary actions to attain the goal, considering Time/Space/Resources constraints, interleaving planning with execution and providing formal verification capabilities of the functional layer.. The activities will comprise planning/scheduling capabilities to decompose high level commands into sub-tasks; resource management to fulfil in a dynamic way the high level mission/goals; Fault management with reconfiguration capability; Interaction management with other robotic systems to allow cooperation and tasks sharing, guidance, navigation and control to attain execution.

**c) Common data fusion framework:** a software framework implementing data fusion techniques for various sensors such as LIDAR, Imagers, radar, sonar, IMUs, and sun sensors capable of localising robots in natural and man-made environments, geometrical/topological reconstruction of environment, map making. Robots need to perceive their environment and to understand where they are with respect to their operational goals. No single sensor can convey reliably localisation and mapping information in all conditions of space.

**d) Inspection Sensor Suite:** a suite of perception sensors that allow localisation and map making for robotic inspection of orbital assets (under space representative conditions and taking into account in-orbit inspection scenario requirements) and for planetary surface exploration. The activities comprise the identification of suitable sensors which may include imaging sensors for inspection operations, stereo imaging sensors, holographic sensors, zoom cameras for inspection and proximity operations, infrared sensors, imaging radar and LIDAR as well as illumination integrated solution considering data processing, realisation of common interfaces for data provision, mechanical and electrical integration.

**e) Modular interfaces for Robotic handling of Payloads:** a set of interfaces (mechanical, data, electrical, thermal) that allow coupling of payload to robot manipulators and payload to other payload (or to a platform) enabling manipulation of payload by robots in orbital and planetary environment assembly of structures out of elemental blocks, spacecraft deployment aid.

**f) Validation Platforms and Field Tests:** test vehicles (platforms or facilities) and validation environment for common testing of building blocks reference implementations. Relying upon existing assets, this would include the provision of test means (e.g. rovers, robots, dynamic robotics, RVD facilities), the support for integration in these of common building blocks, instrumentation and the execution of tests in realistic or analogue environments.

A detailed description of the above building blocks is included in the corresponding guidelines<sup>19</sup>.

Each common building block shall be validated in a test scenario by means of a reference implementation (the specific prototype).

A minimum of one proposal per building block (a)-(f) will be selected for funding.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 3.5 million for specific building blocks (a)-(e) and in the range of EUR 1 million for the specific building block (f) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Grants awarded under this topic will be complementary to each other ("complementary grants"). In order to ensure a smooth and successful implementation of this Strategic Research Cluster (SRC), the beneficiaries of complementary grants ("complementary beneficiaries") shall conclude a written "collaboration agreement". The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will apply.

Expected Impact: For each specific building block, the expected impacts are:

- a) Technologies compliant with very high standards of RAMS which can be usable in future space robotics missions;
- b) Technologies useful for space robots (especially the planetary ones) requiring autonomy to cope with the potential inability to communicate to the Earth and in terrestrial applications needing autonomy for environmental monitoring and security purposes;
- c) Navigation/localisation and map making applications for robots whether in space or on planetary surfaces while coping with the performance and reliability issues of sensors;
- d) Availability of a standard reliable sensor suite which will be an enabler for space robotics missions in general;
- e) Experimentation on deployment of very large structures (e.g. antenna reflectors and active telescope mirrors);
- f) Validation of common building block in the most relevant environment with minimal duplication of means and activities.

---

<sup>19</sup> <http://ec.europa.eu/growth/sectors/space/research/horizon-2020>

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

### **COMPET-5-2016: Scientific Instrumentation**

Specific Challenge: Support the development of scientific instrumentation for science and exploration missions (including planetary exploration missions) enabling increased cooperation between scientists, engineering teams, industry and SMEs across Europe.

Scope: Scientific instrumentation is understood in this context as mission payloads that perform scientific tasks. Proposals may cover different stages of development of scientific instrumentation from concepts, to breadboarding and prototype demonstration. Proposals are particularly welcome that develop novel and advanced technologies, such as new sensors and other sub-systems that may be used in scientific instrumentation. Projects supported through this call should address planned and future European scientific and exploration missions, as well as collaboration in the context of third country missions as a European contribution to global efforts.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1.5 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The integration of scientific teams with engineering and industrial teams will stimulate new and improved instrumentation designs and lead to potential opportunities for spin-in/spin-out effects between space and non-space technology fields. This research topic should attract also active participation of researchers in academia and SMEs.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

## Conditions for the Call - Competitiveness of European Space Sector: Technology and Science

Opening date(s), deadline(s), indicative budget(s):<sup>20</sup>

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2016	
Opening: 10 Nov 2015		
COMPET-1-2016 (RIA)	14.85	03 Mar 2016
COMPET-2-2016 (RIA)	7.00	
COMPET-3-2016-a (IA)	18.00	
COMPET-3-2016-b (RIA)	5.00	
COMPET-4-2016 (RIA)	18.00	
COMPET-5-2016 (RIA)	3.00	
Overall indicative budget	65.85	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme.. The following exceptions apply:

COMPET-3-2016-a, COMPET-3-2016-b	No beneficiaries of grant agreement EPIC (640199) except DLR research institutes, Eurospace and SME4Space VZW will participate in consortia of proposals submitted under this call for
-------------------------------------	--

<sup>20</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The budget amounts for the 2017 budget are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget 2017 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

*HORIZON 2020 - Work Programme 2016 - 2017  
Leadership in Enabling and Industrial Technologies - Space*

	proposals.
COMPET-4-2016	No beneficiaries of grant agreement PERASPERA (640026) except DLR (research institutes) will participate in consortia of proposals submitted under this call for proposals.
COMPET-1-2016, COMPET-2-2016, COMPET-3-2016-a, COMPET-3-2016-b, COMPET-4-2016, COMPET-5-2016	Considering the nature and objectives of the actions, and in view of favouring wider competition and participation, the European Space Agency will not participate in consortia of proposals submitted under this call for proposals

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

## **Call - Applications in Satellite Navigation – Galileo – 2017**

### ***H2020-GALILEO-GSA-2017***

The European Global Navigation Satellite System (EGNSS) encompasses the satellite navigation system established under the Galileo programme and the European Geostationary Overlay System (EGNOS). The Galileo system will provide position, navigation and timing services and increase availability and reliability of other GNSS, while ensuring the European non-dependence from other GNSS. The EGNOS system improves the accuracy and provides information on the reliability of the GPS system, and in the future also of the Galileo system.

Satellite navigation technology is an increasingly common component of innovative applications in different market segment. Over the years satellite navigation has become more affordable and more reliable. GNSS is used all around the globe, with 2.8 billion GNSS devices in use in 2013. By 2019, this is forecasted to increase to over 7 billion – on average one device per person. This large base of satellite navigation powered devices opens a huge opportunity for innovation in terms of applications in transport, consumer and professional markets. In addition, the new generation of GNSS, such as Galileo, brings new specific features and increased performance that can trigger innovation and enable more accurate and robust applications.

Development of downstream applications is key to maximise adoption of Galileo and EGNOS and also to stimulate the EU GNSS downstream industry competitiveness, while capturing public benefits. Small and Medium Enterprises (SMEs) are key players for innovation in the sector of GNSS applications for their capacity of innovating quickly, adapting to this fast growing and changing domain. While EGNOS is already fully operational, Galileo is still in deployment phase and will gradually start to deliver services from 2016 onwards up to a full capability in 2020. The use of the available Galileo initial services and test beds<sup>21</sup> in the course of the proposed projects is encouraged if and when necessary and beneficial for the project.

GNSS technology is advancing fast. Current trends that will influence innovation in the field of GNSS applications should be taken into account by applicants. These trends concern for example the appearance of a multi-constellation environment, leading to new multi-frequency devices that are becoming accessible also for mass market applications, as well as the increased combination of GNSS with other sensors and positioning techniques (e.g. Bluetooth beacons, localisation through Wi-Fi base stations, etc.). GNSS receivers itself are undergoing miniaturisation and are more and more "always connected".

To facilitate access to opportunities for applicants the following list includes dedicated 'Applications in Satellite Navigation – Galileo' activities in related calls and topics from the societal challenge Smart, Green and Integrated Transport, in addition to those in this call:

---

<sup>21</sup> List of Galileo test infrastructure is available: [http://gnss-test-portal.eu/tools/list\\_all\\_in\\_category/3](http://gnss-test-portal.eu/tools/list_all_in_category/3)

- Societal Challenge Smart Green and Integrated Transport:
  - o Automated Road Transport:
    - ART-02-2016: Automation pilots for passenger vehicles
  - o Mobility for Growth:
    - MG-5.2-2017: Innovative ICT solutions for future logistics operations
- SME Instrument (H2020-SMEInst-2016-2017), although not dedicated uniquely to Satellite Navigation, is particularly well suited for SMEs addressing space based applications:
  - o SMEInst-04-2016-2017: Engaging SMEs in space research and development
- Applications in Satellite Navigation (H2020-GALILEO-GSA-2017)
  - o Galileo 1 – 2017 – EGNSS Transport Applications;
  - o Galileo 2 – 2017 – EGNSS Mass Market Applications;
  - o Galileo 3 – 2017 – EGNSS Professional Applications;
  - o Galileo 4 – 2017 – EGNSS Awareness raising and capacity buildings

In accordance with the Commission decision C(2014)4995 this call will be implemented by the European GNSS Agency in indirect management.

Proposals are invited against the following topic(s):

**GALILEO-1-2017: EGNSS Transport applications**

Specific Challenge: Transport is fundamental to our economy and society. An efficient and sustainable mobility is vital for the internal market and for the quality of life of the citizens. Transport enables economic growth and job creation. Satellite navigation application technology is an increasingly common component of modern transport systems. It contributes to a competitive, safe and resource efficient transport system and enables new challenging solutions in terms of positioning and navigation performances in aviation, road, maritime and rail, as well as in multi-modal applications. The use of EGNSS is also a key factor in many EU transport related policies, such as Intelligent Transport System, emergency call (eCall), enhanced digital tachograph, European Single Sky, European contribution to the Worldwide Maritime Radionavigation System.

The specific challenge of this topic is to develop innovative EGNSS based applications in aviation, road, maritime and rail that will make EGNOS and Galileo more available to transport users and enable new end-to-end solutions that require accurate and resilient positioning and navigation.



Scope: Proposals should aim at developing new innovative applications, with commercial impact and a clear market uptake perspective. Innovation activities within this topic should build on:

- Exploitation of the distinguishing features of EGNOS and Galileo signals and operational advantages in downstream applications;
- Implementation of EGNSS based pilot projects and end-to-end solutions, ready for use by the private or public sector;
- Standards, certification, legal and societal acceptance, which will foster EGNSS adoption; and
- Exploitation of synergies with other positioning and navigation systems and techniques, with focus in valorising EGNOS and Galileo in the frame of multi-constellation and multi-frequency environment.

EGNSS should be part and parcel of the envisaged solution(s). However, where a combination of EGNSS with other technologies is required to make the application(s) work, this is not excluded from the scope. Proposals may be submitted in any of the following four transport domains:

**Aviation:** The development of EGNSS solutions for navigation, surveillance and communication in all phases of flight (aircraft and rotorcraft) should be addressed, including the possibility to determine the location of aircraft in distress. In particular, GNSS based PBN (Performance Based Operations), advanced operations for approach and landing benefitting from robust vertical guidance and LPV-200/CAT1 services<sup>22</sup>. Furthermore, surveillance applications, such as ADS-B (Automatic Dependent Surveillance Broadcast) and use of reliable PVT for signal integrity, precise positioning and orientation of remotely piloted aerial systems (RPAS) might be addressed. Synergy and complementarity with the Sesar Joint Undertaking and other initiatives shall be clearly identified. Proposals should in particular build on multi-constellation/multi-frequency, current and future EGNOS integrity features and service levels, as well as integration of multi-constellation enabling capabilities.

**Road:** Development of EGNSS solutions in emerging innovative domains, such as autonomous vehicles, that are safety critical and require a specific accurate and resilient positioning, timing and navigation should be addressed. Development of EGNSS solutions in policy driven applications, such as new generation of eCall, enhanced digital tachograph, dangerous goods transport, etc. might also be addressed. Proposals should in particular build on Galileo specific signal features and differentiators and new services such as authentication and high precision, as well as current and future EGNOS integrity features.

**Maritime:** Development of EGNSS based solutions in the different maritime and inland waterways (including the Arctic), such as vessels navigation, traffic management and

---

<sup>22</sup> The recent EASA Notice of Proposed Amendment 2015-01 should be taken into account.

surveillance, search and rescue, port operations, custom fraud control, fisheries monitoring should be addressed. Proposals should in particular build on the use of current and future EGNOS dedicated services for maritime, and the Search and Rescue service of Galileo, other Galileo differentiating features and services, such as authentication, and high precision.

**Rail:** Development of EGNSS based solutions in train signalling and control, contributing to the evolution and cost competitiveness of the European Rail Traffic Management System, and in non-safety-critical applications, such as passenger information system, asset management, etc. should be addressed. Synergy and complementarity with the Shift 2 Rail Joint Undertaking and other initiatives shall be clearly identified. Proposals should in particular build on the current and future EGNOS integrity services and multi-constellation, multi-frequency, and specific signal features of Galileo that improves position performances in the challenging railway environment (e.g. urban parts).

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

Proposals addressing PRS (Public Regulated Service) related applications are not in the scope of this action.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Activities should promote innovation in order to maximise the potential of the EGNSS and its adoption in transport. They should build on specific features and differentiators of Galileo and EGNOS, demonstrating the advantage of their use in transport. The applications shall contribute to the modern, efficient and user-friendly transport system. The activities should be complemented with a systems' approach, taking care of infrastructure and regulatory requirements, coordination of multiple actors and pilot projects to encourage market take-up.

The proposals shall have a clear intention and rationale to commercialise the products and services developed, including a business plan.

Type of Action: Innovation action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

### **GALILEO-2-2017: EGNSS mass market applications**

Specific Challenge: The past 10 years have seen a wider and wider uptake of GNSS based user technology, initially with the Personal Navigation Devices in our cars and then with smartphones in our pockets. Nowadays this also includes tablets, laptops, cameras, fitness gears and wearable devices, etc. In addition, recent trends are showing that not only “every

person” but in the future also “everything” will be connected and equipped with a GNSS device (e.g. connected vehicles and internet of things). This is opening a new generation of Location Based Services (LBS). The development of this new generation of LBS is driven by different needs, depending on the application: mobility, productivity, safety, etc. To satisfy these needs, the key requirements for GNSS are Time-To-First-Fix (TTFF), accuracy and availability. Galileo satellites will further improve signal availability, thus enhancing continuity of service for LBS in urban or challenging environments. By contributing to multi-constellation solutions, Galileo can satisfy the need for higher accuracy and fast TTFF of demanding applications.

The specific challenge of this topic is to exploit the availability of GNSS enabled mass market devices, developing innovative EGNSS applications that will:

- Foster the adoption of EGNOS and Galileo in mass markets and ensure that the benefits will be captured by the users.
- Create applications that will make best use of EGNSS innovative features such as better multipath resistance, authentication etc.
- Contribute to the competitiveness of the European GNSS industry in the area of mobile applications, with special focus on the innovative role of SMEs.
- Maximise public benefits by supporting the development of applications that will address major societal challenges in focus areas such as health, citizen safety, mobility, smart cities, sustainable resources monitoring and management, regional growth, low-carbon energy infrastructure planning and protection, climate action.

Scope: Proposals should aim at developing new innovative applications, with commercial impact and a clear market uptake perspective. Below are some areas which are identified as especially promising for further EGNSS applications development:

**Mobility as a service and Smart Cities:** Development of EGNSS solutions for cross-modal mobility and new emerging “mobility as a service” approach should be addressed, in which the user does not buy a vehicle or a public transport ticket, but a service to comply with her/his mobility needs. This area may include innovative telematics applications in which the positioning, timing and navigation are used both to deliver the mobility service and to calculate a fair price based on the actual use of it. Development of EGNSS solutions for other areas of future Smart Cities are also included in the scope.

**Internet of things:** Development of EGNSS solutions for “internet of things” should be addressed, exploiting the interconnectivity of uniquely identifiable devices and the availability of their location. Proposals should duly reflect the fact that the internet of things is not only improving productivity and efficiency of organisations (with applications in almost every sector of the economy, from automotive to consumer electronics, healthcare or manufacturing and logistics), but that the internet of things technology is also changing our daily lives.

**Commercial and social LBS:** Proposals should address one of the two following application areas. 1) Applications for commercial LBS, such as: secure financial transactions; mobile workforce management, tracking solutions; augmented reality; social networking and sport. 2) Applications for social LBS, such as: safety and emergency (E112), e-health (health services more and more connected), and solutions supporting visual and mobility of impaired people.

For all the mass market areas, the development and innovation should build on:

- Galileo features that improve performances in urban environment ;
- Multi-constellation, fusion with other positioning techniques, including sensor fusion and innovative network fusion techniques;
- Authentication services that will be provided by Galileo; and
- Techniques to optimise power consumption.

Attention should be paid to socio-economic considerations such as consumer needs, consumer behaviour (including early adopters), lifestyles, as well due consideration should be given to applicable legal frameworks and ethical issues such as privacy and data protection.

EGNSS should be part and parcel of the envisaged solution(s). However, where a combination of EGNSS with other technologies is required to make the application(s) work, this is not excluded from the scope.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

Proposals addressing PRS (Public Regulated Service) related applications are not in the scope of this action.

The Commission considers that one proposal requesting a contribution from the EU of between EUR 1 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Activities should aim at developing highly innovative and adaptive applications taking advantage of the Galileo and EGNOS added value. The proposal shall have a clear intention to commercialise the products and services developed, including a business plan. The consumer chipset and devices manufacturers (e.g. for smartphones and tablets) are mainly produced in non-European countries and the expected impact of this topic is to foster the competitiveness of European GNSS application providers that build innovation on these chipsets and devices, contributing to increase the overall EU competitiveness in the mass market. In addition, considering that the EU has a good market share of machine to machine chipset and module providers, the expected impact is also to foster applications building on this capacity.

Type of Action: Innovation action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

### **GALILEO-3-2017: EGNSS professional applications**

Specific Challenge: Professional applications are covering different market segments. Precision agriculture, mapping and surveying have been the pioneers in the use of GNSS since the early years. The challenge is to make these applications more affordable, easy to use and integrated with other solutions and technologies, including for example earth observation, e.g. Copernicus services, in order to enable new targeted innovative solutions. EGNSS is offering additional accuracy and features, such as multiple frequencies and the high precision service in the frame of the future commercial service, contributing to enabling these innovative solutions, including in challenging environments. Power networks, telecommunication networks and financial transactions<sup>23</sup> are today synchronised, many of them using GNSS. These networks are becoming more and more distributed (e.g. distributed power generation of renewable energies), interconnected and more demanding in terms of synchronisation performances (e.g. in 4G-LTE and future internet), or requiring authenticated solutions as for the financial transaction time stamping. The specific challenge is in this case to build on the enhanced capabilities offered by Galileo that will provide high accurate timing information and authentication services, to develop a new generation of high performing, reliable and EU independent timing and synchronisation applications that can cope with these emerging and demanding needs.

Scope: Proposals should aim at developing new innovative applications, building also on the combination of EGNSS with earth observation and Copernicus services, with commercial impact or with satellite communication. Proposals should have a clear market uptake perspective. Below are some areas which are identified as especially promising for further EGNSS application development:

**Agriculture:** Automated machine guidance, precision farming and machine control and field boundary measurements are possible areas to be addressed.

**Surveying and Mapping:** Land survey, marine survey, cadastral and geodesy, and construction are possible areas to be addressed.

**Timing and Synchronisation:** Telecommunications, power generation and finance are possible areas to be addressed.

**Other professional applications:** clearly demonstrating amongst others the contribution of EGNSS differentiators, the potential of integration with earth observation data, and the future commercial potential are also invited.

---

<sup>23</sup> Cf. also Article 50 of Directive 2014/65/EU on Markets in Financial Instruments.

For all the professional areas, the development and innovation should build on:

- Multiple-frequencies E1, E5 and E6;
- Galileo specific signal modulation, e.g. AltBOC;
- High precision and authentication services that will be provided by Galileo, i.e. in the frame of the commercial service;
- Fusion with other data, such as from earth observation satellites or other in-situ sensors.

EGNSS should be part and parcel of the envisaged solution(s). However, where a combination of EGNSS with other technologies is required to make the application(s) work, this is not excluded from the scope.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

The proposal shall have a clear intention to commercialise the products and services developed, including a business plan.

Proposals addressing PRS (Public Regulated Service) related applications are not in the scope of this action.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Activities should aim at developing highly innovative applications taking advantage of Galileo and EGNOS aiming at decreasing the barriers to access such professional applications, in term of price of the solution and easiness to use, increasing the number of users and explore new innovative use of GNSS. Specifically for agriculture the expected impact is also to improve the productivity and decrease the environmental impact. For timing and synchronisation applications, the expected impact is to contribute to cope with emerging network synchronisation needs in terms of accuracy and robustness, while contributing to improve EU dependency from other GNSS.

Type of Action: Innovation action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

#### **GALILEO-4-2017: EGNSS awareness raising and capacity building**

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 incentive schemes in the form of financial support to third parties 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.

Proposals addressing PRS (Public Regulated Service) related applications are not in the scope of this action.

The Commission considers that proposals requesting a contribution from the EU of between EUR 0.5 and 1 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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 to incentive schemes should foster the emergence of new downstream applications based on either Galileo and/or EGNOS and therefore to support the EU GNSS industry.

Type of Action: Coordination and support action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

**Conditions for the Call - Applications in Satellite Navigation – Galileo – 2017**

Opening date(s), deadline(s), indicative budget(s):<sup>24</sup>

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2017	
Opening: 08 Nov 2016		
GALILEO-1-2017 (IA)	14.50	01 Mar 2017
GALILEO-2-2017 (IA)	9.00	
GALILEO-3-2017 (IA)	8.00	
GALILEO-4-2017 (CSA)	1.50	
Overall indicative budget	33.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme.. The following exceptions apply:

GALILEO-1-2017, GALILEO-2-2017, GALILEO-3-2017, GALILEO-4-2017	Considering the nature and objectives of the actions, and in view of favouring wider competition and participation, the European Space Agency will not participate in consortia of proposals submitted under this call for proposals
---	--

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

<sup>24</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.  
All deadlines are at 17.00.00 Brussels local time.  
The Director-General responsible may delay the deadline(s) by up to two months.  
The budget amounts for the 2017 budget are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget 2017 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.



Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

## **Call - Earth Observation**

***H2020-EO-2017***

Horizon 2020 Earth observation (EO) activities are considered an essential element to accompany the investments made by the Union in Copernicus, the Union Earth observation and monitoring programme. Through Copernicus and Earth Observation activities in the Horizon 2020 the European Union also contributes to advancing the Global Earth Observation Systems of Systems (GEOSS).

In particular, activities under the societal challenge for climate action, environment, resource efficiency and raw materials focus on GEOSS, notably the development of comprehensive and sustained global environmental observation and information systems that stimulate the smart use of strategic resources, support the development of evidence-based policies, foster new environmental and climate services, and develop new opportunities in global markets. Activities under the Leadership in Industrial Technologies part focus on the evolution of Copernicus and the exploitation of existing European space infrastructure by promoting the development of innovative products and services based on remote sensing, geo-positioning or other types of satellite enabled data as well as geo-information generated already by services such as Copernicus services.

Moreover, taking into account the wider relevance of EO to all parts of Horizon 2020, proposals addressing application and uptake of EO for the development of innovative applications addressing specific challenges can also be submitted to the Horizon 2020 Societal Challenges where related references are included. To that end, applicants to those parts of Horizon 2020 can also access Copernicus data and information (licensing conditions may apply)<sup>25</sup>.

Earth observation underpins the mitigation of Europe's climate change challenges by facilitating sustainable services enabled by Copernicus.

To facilitate access to opportunities for applicants, the following list includes dedicated Earth observation activities in calls in other work programme parts, in addition to those in this call:

- Blue Growth – demonstrating an ocean of opportunities (H2020-BG-2016-2017):
  - BG-9-2016: An integrated Arctic observing system
  - BG-12-2016: Towards an integrated Mediterranean Sea Observing System
- Sustainable Food Security – resilient agri-food chains (H2020-SFS-2016-2017):

---

<sup>25</sup> Access to Copernicus Sentinel data and service information is provided to users on a free, full and open basis. For other satellites data, the DataWareHouse document 2.0 is available at <http://www.copernicus.eu/main/library/technical-documents/> and licensing details can be consulted at [http://gmesdata.esa.int/web/gsc/dap\\_document](http://gmesdata.esa.int/web/gsc/dap_document) as well as [http://gmesdata.esa.int/web/gsc/terms\\_and\\_conditions](http://gmesdata.esa.int/web/gsc/terms_and_conditions).

- SFS-43-2017: Earth Observation services for the monitoring of agricultural production in Africa
- Climate Action, Environment, Resource Efficiency and Raw Materials - Earth Observation (H2020-SC5-2016-2017):
  - SC5-18-2017 - Novel in-situ observation systems
  - SC5-19-2017 - Coordination of citizens' observatories initiatives
  - SC5-20-2016 - European data hub of the GEOSS information system
- Earth Observation (H2020-EO-2016 and H2020-EO-2017)
  - EO-1-2016 and EO-1-2017: Downstream applications
  - EO-2-2016: Downstream applications for public sector users
  - EO-3-2016: Evolution of Copernicus services
  - EO-2-2017: EO Big Data Shift
  - EO-3-2017: Preparation for a European capacity to monitor CO<sub>2</sub> anthropogenic emissions
- Competitiveness of the European Space Sector: Technology and Science (H2020-COMPET-2017)
  - COMPET-2-2017: Competitiveness in Earth observation mission technologies
- SME Instrument (H2020-SMEInst-2016-2017), although not dedicated uniquely to Earth Observation, is particularly well suited for SMEs addressing space based applications
  - SMEInst-04-2016-2017: Engaging SMEs in space research and development
  - SMEInst-12-2016-2017: Boosting the potential of small businesses in the areas and priorities of Societal Challenge 5

Proposals are invited against the following topic(s):

**EO-1-2017: Downstream applications**

Specific Challenge: Copernicus, the Union's Earth observation and monitoring programme entered into force in 2014 and produces a wealth of data and information regarding the Earth sub-systems (land, atmosphere, oceans) and cross-cutting processes (climate change, emergency and security). Copernicus data and information are mainly made available on a free open and full basis. This is expected to unleash unique market opportunities. It is important to foster market development exploiting the added value of integration of EO observation technologies (both satellite, airborne and ground based) with positioning ones and

ICT (enhancing new frontiers opened by web) across different market segments through the development of applications, and encourage their insertion into the market.

For such applications and developments to succeed in the market, the product needs to be shaped according to users' needs and their value to users must be openly demonstrated to the wider user community. This needs to be achieved in an environment integrated at the level of the user, in order for users to accept the innovative potential which the product promises. This will require also specific attention to be given to the various processes in place in the users' workflows which incorporate the EO information. Furthermore, the transition of R&D product prototypes to viable commercial product lines after the end of the EU funded phase remains a challenge to be addressed early on during product development.

Scope: Proposals may address a wide variety of applications stemming from the use of Earth observation and its smart integration with other related technologies. Copernicus should be considered as part of the solution which may include other space or non-space inputs. This is likely to lead to greater value, opportunities and especially market uptake. To this aim, a business model and a value chain market analysis, which includes the phase of the project following the end of the public funding, should be part of the proposal.

The outcome of this innovation project 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 including data processing, visualisation and cataloguing.

The choice of EO application is left to the proposer.

Proposers are advised to consult information on the Copernicus programme in general at <http://copernicus.eu>, and 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 website<sup>26</sup>.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

To reinforce continuity of skills, proposers could consider associating post-graduate researchers.

---

<sup>26</sup> <http://www.copernicus.eu/main/data-access>

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Establish sustainable supply chains for innovative EO value added products and services with demonstrated commercial value with targeted client communities. Complete integration, based on international standards, into the customer's existing business processes and processing chains, as well as the economic viability of the application is to be demonstrated;
- Enhance the European industry's potential to take advantage of market opportunities and establish leadership in the field, and to boost business activity;
- Lead to new or improved products, processes or services on the market, by industry including SMEs, which are capable of generating, after the end of public funding, turnover and thus create new jobs.

Type of Action: Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

**EO-2-2017: EO Big Data Shift**

Specific Challenge: Effective access to Copernicus dedicated mission data and Copernicus service information by public and private users is a sine qua non condition for the achievement of Copernicus' objectives.

In this context, Copernicus faces important challenges. First, the multiplicity of Copernicus partners involved in Copernicus dissemination activities requires both flexible and effective coordination. At the moment Copernicus dissemination infrastructure is built around different dissemination platforms operated by ESA, EUMETSAT, and service operators. In addition some Member States provide access to Sentinel data in the context of the collaborative ground segment. Second, the sheer volume of data and information to be disseminated and used puts Copernicus at the forefront of the big data challenges. This new paradigm requires a change of approach to data curation and dissemination, in the form of a technological leap to both ingest processing and make available the increased volume of Copernicus data and information considering both temporal and spatial resolutions. The Big Data paradigm offers new perspectives for data intensive activities where Europe could still close its technological gap with the US with huge industrial implications.

The free, full and open data policy will support the development of a strong Earth observation downstream service industry if an effective and scalable access system is implemented to

meet the Big Data exploitation challenges and to address the full data cycle needs (e.g. standardised data query, retrieval, data exchange methods, processing and data fusion involving diverse datasets). Therefore, Europe needs to foster Copernicus access and dissemination services spurred by a vibrant European downstream sector taking advantage of the timely availability of the Copernicus data and information to provide innovative Earth observation information products on a worldwide basis, based on European Internet platforms using advanced big data technologies and serving a worldwide market.

The future Copernicus data access architecture is expected to follow the following broad approach:

- A back office service essentially ensuring access to Copernicus data and information and offering storage and processing capacities.
- Different front office services managed by intermediate users (public or private) would serve the need of other intermediate users or end-users via appropriate tool (e.g. search, visualisation, data analytics, knowledge extraction, animation of user communities, etc.
- Intermediate layers allowing the exploitation of the back office resources for the benefit of the various front offices as well as providing the necessary modules to foster EO data analytics and the chaining of value adding activities between different front offices.

This multi-layered approach would allow the mutualisation and efficient use of storage and processing capacities (generic or EO-specific) while providing flexibility to Copernicus services, Member States, intermediate commercial users to engage with and serve their constituency with localised/specialised higher value services.

Scope: Activities are expected to address the adaptation of big data technologies to Copernicus user scenarios and should concentrate on the intermediate layers describe above. They shall enable Copernicus services, public and intermediate commercial users to engage with and serve their constituency with localised/specialised higher value services.

Activities should include the development of tools allowing for the chaining of different value adding activities increasing incrementally the information and knowledge content of EO and non EO data and possibly triggering new commercial initiatives. The aim would be to allow many users either public or private to provide advanced services to intermediate or end users without having to build up storage and processing capacities for Copernicus data and information but benefiting from the storage and processing services provided by ICT companies.

Big Data, activities shall bridge the gap between Earth observation and information technology sectors taking into account the user needs for EO Big Data and aiming at developing innovative solutions taking into account the needs of 1) non-expert users like policy makers involved in societal challenges, 2) experts involved, and 3) small and medium innovative enterprises. Activities shall be complementary to activities enabled by the ICT and

research infrastructures work programmes which address generic challenges in the area of data mining, open linked data, web ontology, digital earth<sup>27</sup>.

Activities should address any relevant aspect of the data lifecycle which can solve EO big data challenges, in particular data management activities (e.g. collection, processing including online processing, quality control, documentation, dissemination, cataloguing, preservation, usage tracking, integration) and usage activities (e.g. discovery, analysis (including visual), product generation, user feedback, tagging, knowledge extraction, decision making). Activities are also expected to extensively use flexible coverage and open processing standards.

Activities shall rely on open source software/tools/modules/plugin-ins and shall include small-scale demonstrations.

Proposers are advised to consult information on the Copernicus programme in general and linked actions within Copernicus including the Integrated Ground Segment at the Commission's website<sup>28</sup>. An information document is published together with this work programme<sup>29</sup>.

Proposers are invited 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 website<sup>30</sup>.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

#### Expected Impact:

- Enable value adding services on generic data and information storage and processing facilities which can allow public and commercial users effective production environment to interact with and serve their user base without deploying their own storage and processing facilities.
- Make access to the Copernicus data and information easy and user friendly through scalable dissemination and exploitation software based on international standards.
- Foster the establishment of interoperable access facilities to all EU Member States.

---

<sup>27</sup> For example e-infrastructure for Research: Network (GÉANT), processing (PRACE), data network, Federation of research infrastructure with single sign on (eduGAIN).

<sup>28</sup> <http://copernicus.eu>

<sup>29</sup> <http://ec.europa.eu/growth/sectors/space/research/horizon-2020>

<sup>30</sup> <http://www.copernicus.eu/main/data-access>

- Link with other big data initiatives.
- Provide user community tools including best-practices.
- Ensure resilience of the overall dissemination and exploitation system.
- Optimise the use of Copernicus data by non-traditional user communities to meet societal challenges.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

**EO-3-2017: Preparation for a European capacity to monitor CO<sub>2</sub> anthropogenic emissions**

Specific Challenge: A recent expert report has assessed the need and opportunity for an independent European capacity for CO<sub>2</sub> anthropogenic emissions, which includes space-borne observation. It recommends stepwise approach to implement a requirement-driven integration of remote-sensing, in situ and modelling capabilities for an operational end-to-end system. While the report recognises the importance of other observing other GHGs contributing to global warming it focuses on closing specifically the gap of monitoring anthropogenic CO<sub>2</sub> emissions linked to the COP21 context. Also, as the use of satellite observations has been rather successful for CH<sub>4</sub> flux inversions in the past, the potential to monitor other GHGs in particular methane and carbon monoxide are to be investigated only as secondary mission objectives in this coordination and support action (CSA). It is noteworthy that designing a space-borne observation instrument for CO<sub>2</sub> anthropogenic emissions will largely benefit from lessons learnt in the context of the European Space Agency's Earth Explorer programme 8 with the Carbonsat exploratory mission.

The development, the implementation and eventually the operation of such a European capacity will need the involvement of various players, such as space agencies, operators of in-situ measurement stations and of numerical weather prediction, leading experts for modelling and data assimilation. In particular, it has to build on past activities of the European Space Agency (ESA) and will be coordinated with the ESA's on-going and future programmes. Initiating the establishment of this community while delivering first concrete elements is at the heart of this action to cluster all relevant existing competences within Europe on the CO<sub>2</sub> emissions topic and thus reach the critical mass required for addressing such a challenging endeavour.

Following the Copernicus Space Component Evolution Plan, the Commission has set up a CO<sub>2</sub> monitoring task force with two work packages addressing separate but interconnected tasks. The first work package (Task A co-convened by ESA and the Commission) is dealing with the Space Component (specifically: a CO<sub>2</sub> pre-operational mission), the second work package task (Task B convened by the Commission) is addressing the end-to-end operational



emission monitoring system, including in addition inverse modelling, in-situ observation networks, and emission inventories. These activities will be conducted in full collaboration with ESA, EUMETSAT and ECMWF. As regards the interaction with the Task Force, the CSA is expected to act as an accompanying scientific and technical support to the CO<sub>2</sub> monitoring task force, which in turn will provide the necessary programmatic guidance.

Scope: To advance in a coordinated preparation of a mature European capacity there is need to bring together the key European stakeholders and competent entities which are engaged in activities that can answer the questions outlined below, have the ability to network with suitable research actors to fill the knowledge gaps, and have the required expertise to assess the needs for an end-to-end operational system, with due attention to potential international cooperation opportunities for tackling this global challenge.

Activities will encompass the coordination of ongoing efforts, include mutual identification of research and infrastructural gaps, and facilitate a cooperation of further research and development to be undertaken to reach sufficiently mature capacities for an operational integration as a subsequent step.

The following four areas need to be coordinated to prepare a suitable and operational European approach. To be adequate, the responses to these series of questions addressing engineering oriented issues should capitalize and benefit from basic research projects as available in the H2020 framework and ESA preparatory studies:

#### 1. Reconciling top down and bottom up estimates

The combined use of both satellite and in-situ observations with advanced data assimilation techniques should offer the possibility to monitor the emissions of anthropogenic CO<sub>2</sub> and at the same time to better quantify the biogenic fluxes. However, satellite or surface measurements and different assimilation systems may currently deliver different estimates of sources and sinks of CO<sub>2</sub>. There is thus a strong need to improve both the processing of satellite observations as well as the structure of the data assimilation systems (e.g., components, modelling framework), in particular when systems are conceived for implementation in an operational context like Copernicus. Empirical bias correction schemes have been designed for satellite observations to reconcile satellite versus in-situ flux estimates, but the origin of the inconsistencies is still debated: possible weaknesses of the chemistry transport models that link the two types of measurements, possible systematic errors of the retrieval algorithms or the high impact of biased prior information from external sources on the estimated fluxes are three causes that have been mentioned, among others. There is a need to reduce or even remove the empiricism from the processing chains for these measurements in order to increase their effective impact for carbon studies. Additionally, especially for flux estimates at national and sub-national scales, the transport model component of both the transport inversion schemes and the carbon cycle/Fossil Fuel data assimilation systems (CCDAS/FFDAS alike) needs to be improved, and more observational constraints need to be integrated in an objective way to separate fossil from biogenic fluxes and reduce uncertainty in the derived flux estimates.

Studies are to be undertaken, and ongoing efforts by participants are to be directed at reducing or even avoiding the need for satellite bias-correction schemes by proposing new methods (e.g., CCDAS as a physically-based filtering tool), new numerical experiments, and/or inter-comparison exercises, that allow identifying the origin of the above-mentioned biases, regardless their origin (measurements, physical equations, inputs to the physical equations, etc.). Proposals should also address current weaknesses of data assimilation systems with for instance the use of better transport model, improved model data fusion techniques or advanced surface flux descriptions.

## 2. Library of simulations for emissions and atmospheric transport

The development of an operational capacity for monitoring fossil CO<sub>2</sub> emissions needs to be based on a series of simulations of these emissions and atmospheric transport at the relevant spatial and temporal resolutions. The simulations should build upon actual inventory emissions derived from a catalogue of emission objects and uncertainties. These simulations should feature patterns representative of regions such as Europe benefiting from good bottom up data infrastructure reporting accurate inventories of emissions as well as other regions reporting less accurate but important contributions to the global CO<sub>2</sub> emissions. These simulations should be as realistic as possible that is, accounting for the natural CO<sub>2</sub> sinks and source fluxes, including cloud cover, atmospheric aerosol load and type and any other atmospheric contributions that could hinder the retrieval of atmospheric CO<sub>2</sub> content from space-borne sensors operating in the NIR and SWIR spectral domains.

Studies are to be undertaken, and ongoing efforts by participants are to be directed at providing series of simulation scenarios that could serve to adequately dimension a space mission, in particular as regards the spatial and temporal sampling that would be required to assess the fossil fuel emissions with a limited enough uncertainty to make it useful for policy makers.

## 3. Uncertainty trade-off for fossil fuel emissions

The adequate dimensioning of the ensemble of space-borne and in-situ observations to monitor fossil fuel CO<sub>2</sub> emission must be driven by requirements from policymakers in charge of assessing the impacts of international agreements that foresee the reduction of CO<sub>2</sub> emissions in the atmosphere. The monitoring of anthropogenic emissions from space-borne sensors involves inverse transport modelling methods together with source and sink process models that have intrinsic limits regarding the accuracies that can be reached. It is essential to assess these current limits, so that the likely emission uncertainties associated with ensemble CO<sub>2</sub> observations can be estimated reliably for a variety of spatial and temporal resolutions. The potential synergies between actual CO<sub>2</sub> emissions estimates based on physical measurements and those derived from inventories and statistics should be addressed as well in view of reducing the overall budget of emission uncertainties.

Studies are to be undertaken, and ongoing efforts by participants are to be directed evaluating the current state of affairs and the possible improvements that should issue from an enhanced space-borne and in-situ observation scenarios. These studies should

- be based on a few modelling scenarios capturing typical situations of CO<sub>2</sub> emissions and atmospheric transport and accounting for biogenic sources and sinks;
- consider different scenarios regarding the density, reliability and quality of the information available in-situ;
- establish metrics and methods to assess CO<sub>2</sub> emission uncertainties at the appropriate scales and time-space resolutions;
- outline a set of concrete protocols for undertaking future closure experiments between top down and bottom up emission datasets at a variety of scales.

#### 4. Attributing CO<sub>2</sub> emissions from in-situ measurements

Physically-based estimates of fossil fuel CO<sub>2</sub> emissions using jointly transport and process models together with space-borne observations require dedicated in-situ observation networks to attribute the emissions to anthropogenic activities in contrast to natural sources. Several techniques are available to achieve this task including measurements of atmospheric CO and radiocarbon concentration measurements. The latter are critically dependent on in-situ sampling and, consequently, sampling protocols have to be established according to the spatial and temporal variability of the main emission sources and the required space-time resolution of the estimates. Sampling scenarios need to be elaborated which could optimally contribute to achieving the task.

Studies are to be undertaken, and ongoing efforts by participants are to evaluate the optimisation of in-situ network of radiocarbon measurements in the space-time dimension so that concurrent CO<sub>2</sub> observations from space-borne instruments can be fully exploited to derive accurate estimates of fossil fuel emissions. To this end, a family of typical emission scenarios representing local and regional scales processes have to be considered. These scenarios should feature a range of realistic cases and conditions that could be taken as representative of a larger ensemble of occurrences. The optimization of the sampling procedures should be based on generic techniques enabling to trace the sources and evolutions of the uncertainties in the assessment of the contributing fossil fuel emissions.

The Commission considers that a proposal requesting a contribution from the EU of EUR 3.5 million with a duration of two to three years would allow this specific challenge with its several components to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting other amounts. It is intended to fund a single project coordinating the different activities listed above.

**Expected Impact:** The proposal is expected to lay the mature foundation for an independent space-borne observation capacity for CO<sub>2</sub> in the context of Europe's Climate Change

challenges. Coordination and networking efforts are expected to lay the foundation for the operational integration of all relevant European capacities as a subsequent step.

More specifically, the results are to:

- Make a significant contribution to addressing the unresolved issue of ground-based versus space derived estimates of CO<sub>2</sub> fluxes.
- Generate a large database of CO<sub>2</sub> sources, sinks and atmospheric transport processes to help dimensioning the various elements to develop an operational EU anthropogenic CO<sub>2</sub> emission monitoring capacity.
- Establish a set of requirements regarding the accuracy as well as spatial and temporal resolutions for anthropogenic CO<sub>2</sub> emissions estimates, such that the policymakers can be provided with reliable CO<sub>2</sub> emission trends to evaluate the impact of (I)NDCs.
- Shape the appropriate dimension and distribution of a surface network to separate biogenic from anthropogenic CO<sub>2</sub> emissions.

Type of Action: Coordination and support action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

## Conditions for the Call - Earth Observation

Opening date(s), deadline(s), indicative budget(s):<sup>31</sup>

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2017	
Opening: 08 Nov 2016		
EO-1-2017 (IA)	12.00	01 Mar 2017
EO-2-2017 (RIA)	6.50	
EO-3-2017 (CSA)	3.50	
Overall indicative budget	22.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme.. The following exceptions apply:

EO-1-2017, EO-2-2017, EO-3-2017	Considering the nature and objectives of the actions, and in view of favouring wider competition and participation, the European Space Agency will not participate in consortia of proposals submitted under this call for proposals
---------------------------------	--

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

<sup>31</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The budget amounts for the 2017 budget are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget 2017 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

## **Call - Competitiveness of the European Space Sector: Technology and Science**

***H2020-COMPET-2017***

### ***Competitiveness of European Space Technology***

Competitiveness, non-dependence and innovation of the European space sector 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 (including SMEs) 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.

Attention will be given to some clear trends in space technology development; on the one hand miniaturization on system and subsystem level, as well as in the development of instrumentation. On the other hand the development to generic technologies coming available for a number of different science and application areas. This leads to obvious synergies that should be promoted.

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 technology readiness level (TRL<sup>32</sup>), possibly flight proven) and be accompanied by adequate production rates. European focus in future space technologies, beyond the current state of the art, needs to be strengthened along the entire TRL scale: from low TRL key technologies to in-orbit demonstration and validation. Concrete support for IOD/IOV opportunities is planned for subsequent work programmes (2018-2020), considering previous results and evolving European priorities.

Technologies for satellite communication will be supported in particular in topics COMPET-2-2016 "Maturing satellite communication technologies" and in COMPET-3-2017 "High data rate chain". In addition, the topics COMPET-1-2016/2017 "Technologies for European non-dependence and competitiveness" and COMPET-3-2016 "In-space electrical propulsion and station keeping" address important objectives for the satellite communication industry.

---

<sup>32</sup> Technology Readiness Levels are defined in part G of the General Annexes. In the specific area of space, TRL are defined under the standard ISO 16290. Further details on the TRL scale can be consulted in the European Space Agency website "The ESA Science Technology Development Route": <http://sci.esa.int/sre-ft/50124-technology-readiness-level/05>.

Earth observation underpins the mitigation of Europe's climate change challenges by facilitating sustainable services enabled by Copernicus. Technologies for Earth observation will be supported in particular in topics COMPET-2-2017 "Competitiveness in Earth observation mission technologies" and COMPET-3-2017 "High data rate chain". In addition, the topics COMPET-1-2016/2017 "Technologies for European non-dependence and competitiveness" also contribute to enabling technologies for Earth observation.

Technologies for satellite navigation are addressed in the Galileo part of the work programme.

Technologies enabling recurrence of use contribute to enhancing industrial competitiveness. Research on building blocks, components and items with potential for use in a variety of programmes and applications is therefore encouraged. Standardisation of such items by existing initiatives such as the European Space Components Coordination (ESCC) and the European Cooperation for Space Standardisation (ECSS), and their interfaces across Europe can optimise the investments and when applied appropriately facilitate access to emerging commercial markets. Synergies with ongoing work with ESA and Member States in the area of technology standardisation will be sought.

### *Space exploration and science*

In 2017 support for space sciences and space exploration will address the exploitation of space science data on astrophysics (including exoplanets), heliophysics and the Solar System exploration, including the Moon. Other scientific domains will be addressed in following years.

This call will also address space weather.

Proposals are invited against the following topic(s):

### **COMPET-1-2017: 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 condition-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. Whenever possible multiple (>1) sources for the critical technologies shall be promoted across Europe. 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 Joint EC-ESA-EDA Task Force on Critical Technologies



for European non-Dependence, launched in 2008. The Joint Task Force recently updated the list of actions for 2015-2017<sup>33</sup>.

Activities shall address technologies identified on the list of Actions for 2015/2017 focusing on those areas that have not so far benefitted from prior Framework Programme funding and representing the highest potential for being implemented through the types of action available in Horizon 2020.

Accordingly, the following priority technologies have been identified:

- U09 – Cost effective multi - junction solar cells for space applications.
- U16 – Space qualified GaN components and demonstrators.
- U17 – High density (up to 1000 pins and beyond) assemblies on PCB and PCBs.
- U21 – Very high speed serial interfaces.
- U23 – Development of large deployable structures for antennas.
- U26 – Space qualified carbon fibre and pre-impregnated material sources for launchers and satellite subsystems.

Technological spin in and/or bilateral collaborations should be enhanced between European non-space and space industries and proposals 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.

Proposals should strive to go beyond the present state-of-the-art or, preferably, the expected state of the art at the time of completion if alternative technologies are being developed outside Europe. High level specifications and key requirements can be found in the list of actions for 2015-2017.

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.

A maximum of one proposal per identified priority technology line will be selected for funding.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 5 million would allow this specific topic to be addressed appropriately.

---

<sup>33</sup> Excerpt from "Critical Space Technologies for European Strategic Non-Dependence – Actions for 2015/2017" (<http://ec.europa.eu/growth/sectors/space/research/horizon-2020>)

Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Reduce the dependence on critical technologies and capabilities from outside Europe for future space applications, as identified in the list of Actions for 2015/2017 as part of the Joint EC-ESA-EDA task force on Critical Technologies;
- 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;
- Enhance the technical capabilities and overall competitiveness of European space industry satellite vendors on the worldwide market;
- 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;
- 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;
- Improve the overall European space technology landscape and complement the activities of European and national space programmes;
- Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry, including SMEs, and stronger take-up of research results;
- Fostering links between academia and industry, accelerating and broadening technology transfer.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

**COMPET-2-2017: Competitiveness in Earth observation mission technologies**

Specific Challenge: European industrial competitiveness in Earth observation depends on the availability of demonstrated/validated systems and sub-systems for operational and advanced missions in the commercial and institutional domain, but also on the readiness in the emerging market for innovative missions relying on small and very small systems (constellation, formation flying and fractionated instruments).

The specific challenge, for the mid-term is to bring the Technology Readiness Levels (TRL) forward for a number of Earth observation technologies and to ensure the readiness of European solutions to propose and support new mission concepts taking advantage of nano-, micro- and mini-satellites.

In recent years small satellites have become more attractive due to lower development costs and shorter lead times. There is a natural trade-off to be made between spacecraft size and functionality, but advances in both miniaturization and integration technologies have diminished the scope of that trade-off.

Moreover, within the context of preparatory work for the next generation of the Copernicus space component, mission concepts will be developed by European industry based on mature Earth observation technologies and solutions.

Scope: The aim of this topic is to demonstrate, in a relevant environment, technologies, systems and sub-systems for Earth observation. Proposals should address and demonstrate significant improvements in such areas as miniaturisation, power reduction, efficiency, versatility, and/or increased functionality and should demonstrate complementarity to activities already funded by Member States and the European Space Agency.

Proposals that develop technologies targeting TRL 6, or lower TRLs, are welcome.

Proposals are sought with relevance in the domain of technology development for space in the fields of:

- Optical technologies for high precision sensing, including high stability structures, stable and lightweight mirrors, large focal planes, adaptive optics and wave front error (WFE) control techniques.
- Detector technology and complete detection chain enhancement in the domains of CMOS and Infrared for Earth observations in orbit aiming at higher spatial or spectral resolution and performance.
- Sensors and mission concepts delivering high accuracy parameters for emission measurements, particularly of climate change determining Greenhouse gases such as CO<sub>2</sub> and methane. High performance miniaturised optical and SAR sensors for Earth observation in support of the hydrological cycle modelling and prediction, and accurate weather forecast.
- Active antennas for radar - exploring lower (P and S) and higher (X and Ka) frequency ranges - Transmit/Receive Modules (TRMs), digital beam-forming and waveform generation, large deployable reflectors.
- Sensors, actuators and control technologies for high precision Attitude and Orbital Control Systems (AOCS), in particular for small satellites, and Guidance, Navigation and Control (GNC).

- Technologies to advance in fractionated systems and formation flying for Earth Observation.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 to 3 million would allow this specific topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- The proposals must describe how the proposed developments will contribute to strengthening Europe's position in industrial competitiveness in technologies for Earth observation payloads and mission, despite the target platform size and scalability.
- The technologies to be addressed in the proposals should represent significant improvements compared to existing Earth observation missions in terms of capability, precision, efficiency or other characteristics, opening new avenues for future space systems.
- Substantially improved in-depth state-of-the-art technologies in key areas such as optical and radar systems, sounders, lidars and detectors for Earth observation.
- Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry, including SMEs, and stronger take-up of research results.
- Fostering links between academia and industry, accelerating and broadening technology transfer.

Type of Action: Research and Innovation action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

**COMPET-3-2017: High speed data chain**

Specific Challenge: Satellite missions with higher productivity add growing data requirements on missions. As a result high speed data handling, processing and transfer are required. These growing requirements are shared among a variety of applications, with a main focus on Earth observation and Telecommunication systems, and with applications also in Science and Exploration. Data challenges have to be addressed within the data chain on-board the satellites (e.g. processing, storage, compression, optimisation), between the satellite and other terminals that can be located on ground or air-borne platforms, on-board other satellites, and mission ground segment. In particular, next generation Earth observation sensors pose the most challenging requirements for data links (in the Gbps range), including links from orbit to

ground and inter-satellite communications between different orbits and constellations, and including technology transfer related to very small LEO satellites (nano and cubesats), as well as direct ground link to very small LEO satellites (nanosat and below, including cubesats) considering optical technologies.

Faster processing, larger storage, and high bandwidth transmissions to users will be needed. Moreover, smart on-board data compression and optimisation will become a growing necessity. All these improvements will be required to efficiently support the next generation of data intensive missions. To support this future scenario, innovations must be brought to the payload data management system (including data optimisation processes), to inter-satellite links, to satellite-ground communication, and to the ground segment data handling system.

Moreover, within the context of preparatory work for the next generation of the Copernicus space component, mission concepts will be developed by European industry based on mature Earth observation technologies and solutions.

Scope: Activities shall aim at providing advanced on-board data handling and transfer for Earth observation and Telecommunication systems, and its management and exploitation in mission ground segment. These activities shall address the future challenge of high data rates transmission and significant improvements in data throughput:

- Re-configurable high data rate links including high frequency RF bands and optical communications: direct and interoperable links between LEO satellites and links to Earth and mobile or aerial platforms (including X band, Ka band and optical), or direct links between GEO satellites and Earth or mobile or aerial platforms, and inter-satellite links (beyond the specifications of the European Data Relay System – EDRS and its evolution in support to Copernicus).
- On-board data processing, implementation of complex data algorithms (e.g. by means of programmable Digital Signal Processors – DSPs).
- On-board data compression systems to improve on-board data storage (memory modules for new memory devices).
- High data rate image (optical and/or radar) and video processing, such as lossless compression, image enhancement techniques or on-board SAR image generation.
- Improved on-board data storage ensuring efficiency and reliability (management of memory modules for new memory devices).
- Anticipate how the ground segment will cope with higher data rates to improve the overall data throughput. In particular to address the required evolution of technologies, architectures, products, end-user expectations, including the challenges associated with optical ground stations for data uplink and downlink.

- Anticipate the need to link innovative ground segment architectures based on new ICT technologies, including cloud, in the “Big Data” domain and the rise in user demand for wide access to Near Real Time (NRT) and Quasi Real Time (QRT) data in social media and mobile applications.

A maximum of one proposal, exploiting NRT/QRT quality of data, with due regard to interoperability of interfaces to both innovative ICT dissemination architecture and applications, will be selected for funding.

In projects to be funded under this topic participation of industry, in particular SMEs, is encouraged.

The Commission considers that proposals addressing the full data chain (processing and compression, storage and transmission), or a coherent part of it, requesting a contribution from the EU of between EUR 5 to 7 million, and proposals addressing the rise in user demand of NRT/QRT data, requesting a contribution of between EUR 2 to 3 million would allow this specific topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- To provide elements for the high speed data chain management (including processing and compression, storage and transmission) and to support technologies for data intensive next generation of Telecommunications and Earth observation systems.
- Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry, including SMEs, and stronger take-up of research results including support to standardisation (CCSDS<sup>34</sup>).
- Fostering links between academia and industry, accelerating and broadening technology transfer.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

**COMPET-4-2017: Scientific data exploitation**

Specific Challenge: Support the data exploitation of European missions and instruments, in conjunction, when relevant, with international missions.

Scope: This topic will cover the exploitation of all acquired and available data provided by space missions in their operative, post-operative or data exploitation phase focusing on

---

<sup>34</sup> Consultative Committee for Space Data Systems.

astrophysics (including exoplanets), heliophysics and the Solar System exploration, including the Moon.

Projects selected under this call may rely on the data available through all the available ESA Space Science Archives when possible or other means (e.g. instrumentation teams). Combination and correlation of this data with international scientific mission data, as well as with relevant data produced by ground-based infrastructures all over the world, is encouraged to further increase the scientific return and to enable new research activities using existing data sets. These activities shall add scientific value through analysis of the data, leading to scientific publications and higher level data products. When possible, enhanced data products should be suitable for feeding back into the ESA archives. Resulting analyses should help preparing future European and international missions. International cooperation is encouraged in particular with countries active in space exploration and science, or where their participation is deemed essential for carrying out the activities of this topic.

The Commission considers that proposals requesting a contribution from the EU in the range of EUR 1.5 million would allow this specific challenge to be addressed appropriately, including through proposals from small teams. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: A higher number of scientific publications based on Europe's space data, high-level data products made available through appropriate archives, and tools developed for the advanced processing of data. Proposals are also expected to add value to existing activities on European and international levels, and to enhance and broaden research partnerships.

Type of Action: Research and Innovation action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

### **COMPET-5-2017: 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 Seventh Framework Programme 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. However there is a lack of understanding of the effects of space weather on space systems including spacecrafts, payloads and living organisms in space as well as on ground-based infrastructure.

Scope: Exploratory work studying space weather with a view to enhancing the understanding of space weather and its impact. Proposals can cover the full range of space weather phenomena from the solar cycle, flares and coronal mass ejections to the effects of the solar wind in the near-earth environment and the evolution in between. There is scope for cooperation with international partners with relevant expertise (entities from third countries could benefit from EU funding under this topic).

This activity shall address space weather and its effects, impacts and mitigation techniques with application to aerospace and ground systems.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 1.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals are expected to improve the understanding of Space Weather phenomena and their impact on space systems and terrestrial infrastructure, and are also expected to analyse viable mitigation strategies, and to demonstrate how these add value compared to existing mitigation strategies.

Type of Action: Research and Innovation action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

### **COMPET-6-2017: Space portal**

Specific Challenge: Provide a one stop-shop user-friendly and visually appealing knowledge oriented project (single space web portal) for space research in Europe to act as archive and outreach tool of research institutionally funded and promote European results and publications towards professionals and citizens alike.

Scope: The aim is for this space web portal to become the main reference and entry point for European citizens and professionals interested in space research activities. The call has two main incremental goals:

1. Implementation of an effective space web portal for Europe, able to point to relevant resources as required and depending on the type of queries.
2. Provide a repository of all relevant information regarding FP6, FP7, Horizon 2020 funded space projects (including public deliverables, data, software tools where possible).

The space portal should act as a platform to access appropriate information on research projects leading to personalised networks of projects with common interests. It should be complementary to initiatives of NCP networks. The proposal should present a realistic plan for the sustained operations of the portal after the end of the EU-funded project period.

The Commission considers that one proposal requesting a contribution from the EU in the range of EUR 0.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.



Expected Impact: The centralisation of projects will allow the easy search for projects that fall under a particular domain, cluster or theme and serve as archive from a scientific and technological angle. It will also allow to identify potential partners and showcase European results and publications. It would also provide European citizens and professionals with a single entry point for space research activities related information.

Type of Action: Coordination and support action

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

### **COMPET-7-2017: Technology transfer and business generators**

Specific Challenge: The number of space-related Business Incubation Centres (BICs) supporting space-related businesses is growing in Europe, led by national and ESA technology transfer initiatives. There is a need to continue to inspire entrepreneurs to turn space-related business ideas into commercial endeavours and to promote opportunities for new and existing start-ups coming from space and non-space sectors.

Scope: BICs, as part of their standard offer, routinely offer commercial/high-growth business support to high-tech start-ups. BICs supporting space-related companies should be supported in order to give entrepreneurs comprehensive space-specific commercial and technical assistance to help them start-up businesses that apply space technology to non-space industrial, scientific and commercial fields, and vice-versa. This activity will not support the establishment of additional BICs, but should assist entrepreneurs and other innovation agents overcoming financial, administrative and networking barriers to innovation. In particular, it should contribute to access public funding opportunities, such as the SME instrument of the European Union, as well as potentially other funding opportunities from Member States, ESA and regional authorities. The take up of applications developed in the context of Galileo, EGNOS and Copernicus is encouraged. This action should be complementary to the ESA BICs (that already offer space-specific support) and the European Enterprise Network (EEN) approach, and should encompass other incubation centres that support space-related companies, particularly those exploiting the applications of space data and services.

The Commission considers that one proposal requesting a contribution from the EU in the range of EUR 2.0 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Creating opportunities for new and existing start-ups coming from space and non-space sectors by:

- Facilitating access to finance through outreach and networking;
- Maximising opportunities offered by the SME instrument for space;

- Assisting the development of viable business cases;
- Accompanying start-ups in commercial phases.

Type of Action: Coordination and support action

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

## Conditions for the Call - Competitiveness of the European Space Sector: Technology and Science

Opening date(s), deadline(s), indicative budget(s):<sup>35</sup>

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2017	
Opening: 08 Nov 2016		
COMPET-1-2017 (RIA)	15.00	01 Mar 2017
COMPET-2-2017 (RIA)	7.00	
COMPET-3-2017 (RIA)	10.00	
COMPET-4-2017 (RIA)	6.00	
COMPET-5-2017 (RIA)	3.00	
COMPET-6-2017 (CSA)	0.50	
COMPET-7-2017 (CSA)	2.00	
Overall indicative budget	43.50	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme.. The following exceptions apply:

COMPET-1-2017, COMPET-2-2017,	Considering the nature and objectives of the actions, and in view of favouring wider competition and participation, the European
----------------------------------	--

<sup>35</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The budget amounts for the 2017 budget are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget 2017 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

*HORIZON 2020 - Work Programme 2016 - 2017*  
*Leadership in Enabling and Industrial Technologies - Space*

COMPET-3-2017, COMPET-4-2017, COMPET-5-2017, COMPET-6-2017, COMPET-7-2017	Space Agency will not participate in consortia of proposals submitted under this call for proposals
---	---

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

## **SME instrument**

Full details on the continuously open SME instrument call (*H2020-SMEInst-2016-2017*) are provided under the Horizon 2020 Work Programme Part – Innovation in SMEs (Part 7 of this Work Programme).

This Work Programme part contributes the following challenge of the SME instrument call:

SMEInst-04 -2016-2017: Engaging SMEs in space innovation

Specific challenge: To engage small and medium enterprises in space innovation, especially those not traditionally involved in it and reduce as much as possible the entry barriers to SMEs for Horizon 2020 funding. The actions under this topic could cover any aspect of the Specific Programme for **Space** (Horizon 2020 Framework programme and Specific programme). However, it is considered that actions in the areas of applications, especially in connection to Galileo and Copernicus, spinning-in/-out (i.e. application of terrestrial solutions to challenges in space and vice versa) and solutions in support of the commercialisation of space could be adequately suited for this call.

**Fast track to innovation - Pilot**

Full details on this pilot are provided in the separate call for proposals under the Horizon 2020 Work Programme Part - Fast Track to Innovation Pilot (Part 18 of this Work Programme).

## **Other actions<sup>36</sup>**

### **1. Galileo Evolution, Mission and Service related R&D activities**

While the first generation of Galileo is being deployed, it is essential to guarantee that Galileo will remain competitive and cost-effective in the long term. Therefore, new and innovative mission concepts are to be developed and studied in order to ensure that the second generation fulfils the evolving needs of users as analysed in the Galileo mission evolution process

Actions under this area will also serve to study and develop concepts for new Galileo services as well as for the evolution of the currently defined services. In particular, for 2016 the Actions related to EGNSS services will cover the following themes:

- Innovative concepts.
- Public Regulated Service.
- Search and Rescue.

Procurements affected by GNSS security aspects require restricted participation.

Type of Action: Public Procurement - Framework contracts and/or calls for tender.

Indicative timetable: Second quarter 2016

Indicative budget: EUR 3.30 million from the 2016 budget (indicative number of contracts: 3-7)

### **2. EGNOS, Mission and Service related R&D activities**

EGNOS is a fully operational System since 2011. Evolution of the currently provided services, namely the Open Service, Safety of Life and EGNOS Data Access Service (EDAS) are already being considered, such as extension of the service coverage area, and the extension of the Safety of Life service to other user communities than civil aviation. Furthermore, innovative concepts for new services are to be developed, for example looking into the exploitation of existing band-width, so that additional messages can be broadcast (in L1 and in the future in L5).

Finally, since EGNOS is a System developed in accordance to the international SBAS standards, it is necessary to make provisions for analyses of mission or service adaptations which may be needed due to changes on those international standards.

Procurements affected by GNSS security aspects require restricted participation.

---

<sup>36</sup> The budget amounts for the 2017 budget are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget 2017 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

Type of Action: Public Procurement - Framework contracts and/or calls for tender.

Indicative timetable: Second quarter 2016.

Indicative budget: EUR 0.90 million from the 2016 budget (indicative number of contracts: 1-3)

### **3. Horizon 2020: preparation, evaluation and project monitoring**

This action will support the use of independent experts for the implementation of Union research and innovation relating to Horizon 2020: Galileo and EGNOS Evolution, Mission and Services related R&D activities, and for the evaluation of proposals/tenders and monitoring of projects, where appropriate.

A special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest.

Type of Action: Expert Contracts

Indicative timetable: First, second, third and fourth quarters of 2016-2017.

Indicative budget: EUR 0.20 million from the 2016 budget and EUR 0.20 million from the 2017 budget

### **4. GNSS evolution, infrastructure-related R&D activities**

The GNSS infrastructure-related R&D activities under Horizon 2020 will be implemented by ESA in indirect management in accordance with Article 58(1)(c) of the Regulation (EU, Euratom) No 966/2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (the "Financial Regulation").

Consistency of the R&D actions implemented by ESA with the Galileo/EGNOS work programmes and the mission evolution targets is ensured by the Long Term Plan for Infrastructure related R&D activities.

The activities in 2016 will be implemented by ESA under a Delegation Agreement.

The following activities will be supported through funding by the Space theme in 2016:

- 1) EGNOS further evolution
- 2) Galileo 2<sup>nd</sup> generation phase A/B (system, satellite, payload and ground).
- 3) GNSS general research and technology.
- 4) GNSS System Studies and Validation Activities.
- 5) EGNSS R&D Management.



This activity will be implemented under the delegation agreement between the Commission and the European Space Agency.

Type of Action: Indirect Management by ESA

Indicative timetable: First quarter 2016.

Indicative budget: EUR 48.00 million from the 2016 budget (including ESA remuneration costs)

## **5. Framework Partnership Agreement on Space Surveillance and Tracking (SST)**

The Decision No 541/2014/EU of the European Parliament and of the Council of 16 April 2014 establishes a Framework for Space Surveillance and Tracking Support (OJ L 158 of 27 May 2014, p. 227–234). Horizon 2020 will contribute to the funding of the SST support framework and of the improvement of the performances of the SST at European level (hereinafter "the SST evolution"), since R&D activities for improved space surveillance are part of the Horizon 2020 Specific programme.

The Consortium resulting from the implementation of the support framework for the emergence of an SST capacity at European level has established its own dedicated implementation structure in order to handle directly EU support to SST activities. It is therefore through this entity that support to SST under Horizon 2020 and other funding programmes is channelled. Such new governance should lead to increased efficiency in management and lower administrative expenditure levels.

This action specifically aims (1) at supporting the pooling of national resources on the SST objectives outlined in the aforementioned Decision, as well as supporting the SST evolution needs in line with the objectives and challenges of Horizon 2020 related to protecting Europe's investment made in space infrastructure; and (2) at achieving significant economies of scale by joining related Horizon 2020 resources (LEIT/space and secure societies), European Satellite Navigation Programmes and Copernicus resources, in addition to the cumulative national investment of the Member States participating in the SST support framework, which largely exceeds the Union contribution through the aforementioned EU funding programmes.

Expected impact: To analyse, assess and undertake the necessary research, development and innovation activities for:

- (a) The establishment and operation of a sensor function consisting of a network of ground-based or space-based existing national sensors to survey and track space objects;
- (b) The establishment and operation of a processing function to process and analyse the SST data captured by the sensors, including the capacity to detect and identify space objects and to build and maintain a catalogue thereof;

(c) The setting up and operation of a service function to provide SST services to spacecraft operators and public authorities.

Legal entity: Consortium resulting from the implementation of the SST support framework within the meaning of Article 7(3) of Decision No 541/2014/EU comprising bodies designated by participating Member States under their responsibility and the EU SATCEN.

Type of Action: Framework Partnership Agreement with identified beneficiary

The standard evaluation criteria, thresholds and weighting for award criteria for this type of action are provided in parts D and H of the General Annexes.

Indicative timetable: 2016-2017.

## **6. Space surveillance and tracking (SST)**

The Decision No 541/2014/EU of the European Parliament and of the Council of 16 April 2014 establishes a Framework for Space Surveillance and Tracking Support (OJ L 158 of 27 May 2014, p. 227–234).

The Consortium resulting from the implementation of the support framework for the emergence of an SST capacity at European level has established its own dedicated implementation structure in order to handle directly EU support to SST activities. It is therefore through this entity that support to SST under Horizon 2020 and other funding programmes is channelled<sup>37</sup>. Such new governance should lead to increased efficiency in management and lower administrative expenditure levels.

This action specifically aims (1) at supporting the pooling of national resources on the SST objectives outlined in the aforementioned Decision 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 scale by joining related Horizon 2020 (LEIT/space and secure societies), European Satellite Navigation Programmes and Copernicus resources, in addition to the cumulative national investment of the Member States participating in the SST support framework, which largely exceeds the Union contribution through the aforementioned EU funding programmes.

Expected impact: To analyse, assess and undertake the necessary research, development and innovation activities for:

---

<sup>37</sup> In line with recital 24 of the Decision No 541/2014/EU, article 129 of the Financial Regulation (Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council) and article 193 of its Rules of Application (Commission Delegated Regulation (EU) No 1268/2012) this action may be financed jointly from separate source programmes, namely Horizon 2020 Framework Programme (Regulation (EU) No 1291/2013 of the European Parliament and of the Council), the Copernicus programme (Regulation (EU) No 377/2014 of the European Parliament and of the Council) and the European Satellite Navigation programmes (Regulation (EU) No 1285/2013 of the European Parliament and of the Council).

- a) The establishment and operation of a sensor function consisting of a network of ground-based or space-based existing national sensors to survey and track space objects;
- b) The establishment and operation of a processing function to process and analyse the SST data captured by the sensors, including the capacity to detect and identify space objects and to build and maintain a catalogue thereof;
- c) The setting up and operation of a service function to provide SST services to spacecraft operators and public authorities.

Legal entity: Consortium resulting from the implementation of the SST support framework within the meaning of Article 7(3) of Decision No 541/2014/EU comprising bodies designated by participating Member States under their responsibility and the EU SATCEN.

Type of Action: Specific Grant Agreement

Specific grant awarded under the Framework Partnership Agreement on Space Surveillance and Tracking for Research and Innovation Action.

The standard evaluation criteria, thresholds, weighting for award criteria and the maximum rate of co-financing for this type of action are provided in parts D and H of the General Annexes.

Indicative timetable: Fourth quarter 2016.

Indicative budget: EUR 1.20 million from the 2016 budget

## **7. Improving the Performances of the SST at European Level**

The EU is ready to support the emergence of a European SST service built on a network of existing SST assets, mainly sensors (radars and telescopes) owned by Member States. This will require the commitment of Member States owning relevant assets to cooperate and provide an anti-collision service at European level.

The Consortium resulting from the implementation of the support framework for the emergence of an SST capacity at European level has established its own dedicated implementation structure in order to handle directly EU support to SST activities. It is therefore through this entity that support to SST under Horizon 2020 and other funding programmes is channelled<sup>38</sup>. Such new governance should lead to increased efficiency in management and lower administrative expenditure levels.

---

<sup>38</sup> In line with recital 24 of the Decision No 541/2014/EU, article 129 of the Financial Regulation (Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council) and article 193 of its Rules of Application (Commission Delegated Regulation (EU) No 1268/2012) this action may be financed jointly from separate source programmes, namely Horizon 2020 Framework Programme (Regulation (EU) No 1291/2013 of the European Parliament and of the Council), the Copernicus programme (Regulation (EU) No 377/2014 of the European Parliament and of the Council) and the European Satellite Navigation programmes (Regulation (EU) No 1285/2013 of the European Parliament and of the Council).

The Union contribution for this activity is in addition to the cumulative national investment of the Member States participating in the SST support framework and is largely exceeded by the latter.

This activity will support for the year 2016 the priority upgrading and development of assets, in particular radars and telescopes, operated by Member States participating in the SST support Framework to improve the overall performances of the SST services and possible impact on the architecture of the European SST functions necessary to ensure, in the long-term, a high level of performance of this European service.

This activity may involve the use of classified background information (EU or national) or the production of security sensitive foreground information. As such, certain proposal deliverables may require security classification. The final decision on the classification of proposals is subject to the security evaluation.

Legal entity: Consortium resulting from the implementation of the SST support framework within the meaning of Article 7(3) of Decision No 541/2014/EU comprising bodies designated by participating Member States under their responsibility and where necessary the EU SATCEN.

Type of Action: Specific Grant Agreement

Specific grant awarded under the Framework Partnership Agreement on Space Surveillance and Tracking for Research and Innovation Action.

The standard evaluation criteria, thresholds, weighting for award criteria and the maximum rate of co-financing for this type of action are provided in parts D and H of the General Annexes.

Indicative timetable: Fourth quarter 2016

Indicative budget: EUR 8.00 million from the 2016 budget

## **8. Engineering support by ESA**

ESA's technical support to the Horizon 2020 Space work programme is relevant, in particular to implement the call COMPET-7-2014: Space exploration – Life support and initiate the preparation for the call COMPET-4-2015: Space exploration – Habitat management. This, or any other ESA technical support, will be analysed technically. Implementation will be subject to future decisions.

ESA is responsible for the preparation, integration and operation of all payloads using European resources for ISS operations. ESA will, during the ISS demonstrator development phase, contribute to the definition of the operational and interface requirements to ensure that the most suitable project from COMPET-7-2014: Space exploration – Life support is efficiently prepared to be operable on-board the ISS. ESA will assess the resources required for the performance of the experiment as crew time, up-, down-mass, cold stowage. In

particular ESA, supported as needed by the IOT and the USOC that has the responsibility of preparing the operations and the necessary operational products (e.g. procedures), will participate to the major project reviews (e.g. requirements review (before development), design review (during development), final readiness review, crew review (for payloads operated by astronauts). ESA will also monitor that the project is fulfilling all interface requirements, develop all products required for payload operations of the experiment on-board ISS to ensure that it is safe to operate. ESA will also initiate the preparation for the call COMPET-4-2015: Space exploration – Habitat management.

To ensure the continuity of this activity or any other selected activity, and without prejudice to any future decision, additional support could be included in future space work programmes for the implementation phase.

Type of Action: Indirect Management by ESA

Indicative timetable: Fourth quarter 2016

Indicative budget: EUR 1.00 million from the 2016 budget

## **9. Studies & Communication**

During 2016 it is envisaged to conduct public procurement activities for the 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.

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. Cooperation with the presidencies of the Council of the European Union in 2016 is envisaged.

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

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.

Type of Action: Public Procurement - Framework contracts and/or calls for tender.

Indicative timetable: First, second, third and fourth quarters of 2016.

Indicative budget: EUR 0.30 million from the 2016 budget (indicative number of contracts: 1-3)

## **10. Horizon 2020 project monitoring**

This action will support the use of appointed independent experts by REA for the monitoring of running projects, where appropriate.

A special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest.

Type of Action: Expert Contracts

Indicative budget: EUR 0.50 million from the 2016 budget

## **11. Horizon prize for low cost access to space**

Objectives pursued: The objective of this announced inducement prize is to provide innovative yet implementable, affordable and financially sustainable European solutions enabling the delivery of nano- and micro- satellites to Low Earth orbit (LEO).

The prize aims at unlocking the expected capacity crunch of access to space for these class of payloads with the demises of several existing launchers and limited opportunities aboard available launchers for secondary payload launches (orbit suitability, responsiveness, primary mission constraints) as well as the prospective mandatory application of the Inter-Agency Space Debris Coordination Committee (IADC) guidance for debris mitigation (limiting the LEO orbit belt permitted for small satellites with no-de-orbiting systems).

The prize will reward a European solution which presents one or several innovative development of a launch system dedicated to nano- and micro-satellites in order to improve cost-effectiveness and launch flexibility for this class of payloads. The indicative budget for the prize will be EUR 4.0 million, from the 2020 budget<sup>39</sup>.

Expected results: The launch system shall provide affordable, sustainable and innovative design-to-cost solutions towards complete European launch systems dedicated to the delivery of nano- and micro-satellites, with a launcher performance of payloads up to 500 kg to LEO orbit<sup>40</sup>, operational as soon as possible and economically viable when considering mid-term (i.e. the year 2025) commercial nano- and micro- satellite launch market predictions.

Eligibility criteria: The contest will be open to any legal entity (including natural persons) or groups of legal entities from Member States and countries associated to Horizon 2020.

Essential award criteria: The prize will be awarded, after closure of the contest, to the contestants who in the opinion of the jury demonstrate a solution (which is at least a subsystem prototype demonstrated in an operational environment) that best addresses the following cumulative criteria:

---

<sup>39</sup> The budget amount for the 2020 budget is indicative and will be subject to a separate financing decision to cover the amount to be allocated for 2020.

<sup>40</sup> Performance expressed for a 600 km LEO orbit

- Technical achievements: demonstrated applicability of the proposed solution in relevant environment (in a scale that includes subsystem ground testing, significant system demonstrator testing, suborbital launch or orbital LEO launch up to 600 km Sun-synchronous orbit (SSO), with higher achievements scoring higher), expected/demonstrated performances and flexibility in terms of payload mass and available target orbits.
- Economic viability: business plan for sustained operations, recurring launch costs performance (including manufacturing and operational models), capability to launch repeatedly with the lowest idle time.

The specific award criteria will be detailed in the rules of the contest to be published on the participant portal.

The contest is expected to be published by 2017.

Indicative timetable of contest:

Stages	Date and time or indicative period
Opening of the contest	1st quarter of 2017
Deadline for submission of application	4th quarter of 2019
Evaluation and solutions demonstration (if applicable)	1st quarter of 2020
Award of the prize	2nd quarter of 2020

Type of Action: Inducement prize

For the common Rules of Contest for Prizes please see General Annex F of the work programme

Indicative timetable: 2017-2020

## **12. Galileo Evolution, Mission and Services related R&D activities**

While the first generation of Galileo is being deployed, it is essential to guarantee that Galileo will remain competitive and cost-effective in the long term. Therefore, new and innovative mission concepts are to be developed and studied in order to ensure that the second generation fulfils the evolving needs of users as analysed in the Galileo mission evolution process

Actions under this area will also serve to study and develop concepts for new Galileo services as well as for the evolution of the currently defined services. In particular, for 2017 the Actions related to EGNSS services will cover the following themes:

- Innovative Concepts.

- Commercial Service.
- Signals evolutions.

Procurements affected by GNSS security aspects require restricted participation.

Type of Action: Public Procurement - Framework contracts and/or calls for tender.

Indicative timetable: Second quarter 2017.

Indicative budget: EUR 3.20 million from the 2017 budget (indicative number of contracts: 3-7)

### **13. EGNOS, Mission and Service related R&D activities**

EGNOS is a fully operational System since 2011. Evolution of the currently provided services, namely the Open Service, Safety of Life and EGNOS Data Access Service (EDAS) are already being considered, such as the extension of the Safety of Life service to other user communities than civil aviation. Furthermore, innovative concepts for new services are to be developed, for example looking into the exploitation of existing band-width, so that additional messages can be broadcast (in L1 and in the future in L5).

Finally, since EGNOS is a System developed in accordance to the international SBAS standards, it is necessary to make provisions for analyses of mission or service adaptations which may be needed due to changes on those international standards.

Procurements affected by GNSS security aspects require restricted participation.

Type of Action: Public Procurement - Framework contracts and/or calls for tender.

Indicative timetable: Second quarter 2017.

Indicative budget: EUR 0.70 million from the 2017 budget (indicative number of contracts: 1-3)

### **14. Horizon 2020 project monitoring and audits (EGNSS)**

During 2017 it is envisaged to support the implementation of Horizon 2020 through appointment of independent experts for the monitoring of projects.

A special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest.

Type of Action: Expert Contracts

Indicative timetable: Second quarter 2017.



Indicative budget: EUR 1.15 million from the 2017 budget (this amount will be entrusted to the European GNSS Agency in addition to the budget entrusted to the Agency for the implementation of the Galileo Applications Call for Proposals)

### **15. GNSS evolution, infrastructure-related R&D activities**

The GNSS infrastructure-related R&D activities under Horizon 2020 will be implemented by ESA in indirect management in accordance with Article 58(1)(c) of the Regulation (EU, Euratom) No 966/2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (the "Financial Regulation").

Consistency of the R&D actions implemented by ESA with the Galileo/EGNOS work programmes and the mission evolution targets is ensured by the Long Term Plan for Infrastructure related R&D activities.

The activities in 2017 will be implemented by ESA under a Delegation Agreement.

The following activities will be supported through funding by the Space theme in 2016:

1. EGNOS further evolution
2. Galileo 2nd generation phase A/B (system, satellite, payload and ground).
3. GNSS general research and technology.
4. GNSS System Studies and Validation Activities.
5. EGNSS R&D Management.

This activity will be implemented under the delegation agreement between the Commission and the European Space Agency.

Type of Action: Indirect Management by ESA

Indicative timetable: First quarter 2017.

Indicative budget: EUR 48.50 million from the 2017 budget

### **16. Space surveillance and tracking (SST)**

The Decision No 541/2014/EU of the European Parliament and of the Council of 16 April 2014 establishes a Framework for Space Surveillance and Tracking Support (OJ L 158 of 27 May 2014, p. 227–234).

The Consortium resulting from the implementation of the support framework for the emergence of an SST capacity at European level has established its own dedicated implementation structure in order to handle directly EU support to SST activities. It is therefore through this entity that support to SST under Horizon 2020 and other funding

programmes is channelled<sup>41</sup>. Such new governance should lead to increased efficiency in management and lower administrative expenditure levels.

This action specifically aims (1) at supporting the pooling of national resources on the SST objectives outlined in the aforementioned Decision 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 scale by joining related Horizon 2020 (LEIT/space and secure societies), European Satellite Navigation Programmes and Copernicus resources, in addition to the cumulative national investment of the Member States participating in the SST support framework, which largely exceeds the Union contribution through the aforementioned EU funding programmes.

Expected impact: To analyse, assess and undertake the necessary research, development and innovation activities for:

- a) The establishment and operation of a sensor function consisting of a network of ground-based or space-based existing national sensors to survey and track space objects;
- b) The establishment and operation of a processing function to process and analyse the SST data captured by the sensors, including the capacity to detect and identify space objects and to build and maintain a catalogue thereof;
- c) The setting up and operation of a service function to provide SST services to spacecraft operators and public authorities.

Legal entity: Consortium resulting from the implementation of the SST support framework within the meaning of Article 7(3) of Decision No 541/2014/EU comprising bodies designated by participating Member States under their responsibility and the EU SATCEN.

Type of Action: Specific Grant Agreement

Specific grant awarded under the Framework Partnership Agreement on Space Surveillance and Tracking for Research and Innovation Action.

The standard evaluation criteria, thresholds, weighting for award criteria and the maximum rate of co-financing for this type of action are provided in parts D and H of the General Annexes.

Indicative timetable: Third quarter 2017.

---

<sup>41</sup> In line with recital 24 of the Decision No 541/2014/EU, article 129 of the Financial Regulation (Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council) and article 193 of its Rules of Application (Commission Delegated Regulation (EU) No 1268/2012) this action may be financed jointly from separate source programmes, namely Horizon 2020 Framework Programme (Regulation (EU) No 1291/2013 of the European Parliament and of the Council), the Copernicus programme (Regulation (EU) No 377/2014 of the European Parliament and of the Council) and the European Satellite Navigation programmes (Regulation (EU) No 1285/2013 of the European Parliament and of the Council).

Indicative budget: EUR 1.60 million from the 2017 budget

## **17. Improving the Performances of the SST at European Level**

The EU is ready to support the emergence of a European SST service built on a network of existing SST assets, mainly sensors (radars and telescopes) owned by Member States. This will require the commitment of Member States owning relevant assets to cooperate and provide an anti-collision service at European level.

The Consortium resulting from the implementation of the support framework for the emergence of an SST capacity at European level has established its own dedicated implementation structure in order to handle directly EU support to SST activities. It is therefore through this entity that support to SST under Horizon 2020 and other funding programmes is channelled<sup>42</sup>. Such new governance should lead to increased efficiency in management and lower administrative expenditure levels.

The Union contribution for this activity is in addition to the cumulative national investment of the Member States participating in the SST support framework and is largely exceeded by the latter.

This activity will support for the year 2017 the priority upgrading and development of assets, in particular radars and telescopes, operated by Member States participating in the SST support Framework to improve the overall performances of the SST services and possible impact on the architecture of the European SST functions necessary to ensure, in the long-term, a high level of performance of this European service.

This activity may involve the use of classified background information (EU or national) or the production of security sensitive foreground information. As such, certain proposal deliverables may require security classification. The final decision on the classification of proposals is subject to the security evaluation.

Legal entity: Consortium resulting from the implementation of the SST support framework within the meaning of Article 7(3) of Decision No 541/2014/EU comprising bodies designated by participating Member States under their responsibility and where necessary the EU SATCEN.

Type of Action: Specific Grant Agreement

---

<sup>42</sup> In line with recital 24 of the Decision No 541/2014/EU, article 129 of the Financial Regulation (Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council) and article 193 of its Rules of Application (Commission Delegated Regulation (EU) No 1268/2012) this action may be financed jointly from separate source programmes, namely Horizon 2020 Framework Programme (Regulation (EU) No 1291/2013 of the European Parliament and of the Council), the Copernicus programme (Regulation (EU) No 377/2014 of the European Parliament and of the Council) and the European Satellite Navigation programmes (Regulation (EU) No 1285/2013 of the European Parliament and of the Council).

Specific grant awarded under the Framework Partnership Agreement on Space Surveillance and Tracking for Research and Innovation Action.

The standard evaluation criteria, thresholds, weighting for award criteria and the maximum rate of co-financing for this type of action are provided in parts D and H of the General Annexes.

Indicative timetable: Fourth quarter 2017.

Indicative budget: EUR 15.00 million from the 2017 budget

## **18. Engineering support by ESA**

ESA's technical support to the Horizon 2020 Space work programme is essential, in particular to implement the call COMPET-4-2015: Space exploration – Habitat management. This, or any other ESA technical support, will be analysed technically. Implementation will be subject to future decisions.

ESA is responsible for the preparation, integration and operation of all payloads using European resources for ISS operations. ESA will, during the ISS demonstrator development phase, contribute to the definition of the operational and interface requirements to ensure that the most suitable project selected from COMPET-4-2015: Space exploration – Habitat management is efficiently prepared to be operable on-board the ISS. It will assess the resources required for the performance of the experiment as crew time, up-, down-mass, cold stowage. In particular ESA, supported as needed by the IOT and the USOC that has the responsibility of preparing the operations and the necessary operational products (e.g. procedures), will participate to the major project reviews (e.g. requirements review (before development), design review (during development), final readiness review, crew review (for payloads operated by astronauts). ESA will also monitor that the project is fulfilling all interface requirements, develop all products required for payload operations of the experiment on-board ISS to ensure that it is safe to operate.

To ensure the continuity of this activity or any other selected activity, and without prejudice to any future decision, additional support could be included in future space work programmes for the implementation phase.

Type of Action: Indirect Management by ESA

Indicative timetable: First quarter 2017

Indicative budget: EUR 1.00 million from the 2017 budget

## **19. Studies & Communication**

During 2017 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 the 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.

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. Co-operation with the presidencies of the Council of the European Union in 2017 is envisaged.

Furthermore, procurement will be necessary of actions such as studies (for example in the area of technologies for access to space), preparation of roadmaps to underpin planning for the remainder of Horizon 2020 (for example in the area of Space Weather research and forecasting services), or actions to evaluate the outcomes of R&D actions.

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.

Type of Action: Public Procurement - Framework contracts and/or calls for tender.

Indicative timetable: First, second, third and fourth quarters of 2017.

Indicative budget: EUR 0.90 million from the 2017 budget (indicative number of contracts: 3-6)

## **20. Horizon 2020 project monitoring**

This action will support the use of appointed independent experts for the monitoring of running projects.

A special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest.

Type of Action: Expert Contracts

Indicative timetable: First quarter 2017.

Indicative budget: EUR 0.50 million from the 2017 budget

**HORIZON 2020 - Work Programme 2016 - 2017**  
**Leadership in Enabling and Industrial Technologies - Space**

**Budget<sup>43</sup>**

	Budget line(s)	2016 Budget (EUR million)	2017 Budget (EUR million)
<b>Calls</b>			
H2020-EO-2016		23.03	
	<i>from 02.040201</i>	23.03	
H2020-COMPET-2016		65.85	
	<i>from 02.040201</i>	65.85	
H2020-GALILEO-GSA-2017			33.00
	<i>from 02.040201</i>		33.00
H2020-EO-2017			22.00
	<i>from 02.040201</i>		22.00
H2020-COMPET-2017			43.50
	<i>from 02.040201</i>		43.50
Contribution from this part to call H2020-FTIPilot-2016 under Part 18 of the work programme		3.40	
	<i>from 02.040201</i>	3.40	
Contribution from this part to call H2020-SMEInst-2016-2017 under Part 7 of the work programme		11.37	12.60
	<i>from 02.040201</i>	11.37	12.60
<b>Other actions</b>			
Expert Contracts		0.70	1.85
	<i>from 02.040201</i>	0.70	1.85
Indirect Management by		49.00	49.50

<sup>43</sup> The budget figures given in this table are rounded to two decimal places.

The budget amounts for the 2017 budget are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget 2017 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

***HORIZON 2020 - Work Programme 2016 - 2017***  
***Leadership in Enabling and Industrial Technologies - Space***

ESA	<i>from 02.040201</i>	49.00	49.50
Public Procurement		4.50	4.80
	<i>from 02.040201</i>	4.50	4.80
Specific Grant Agreement		9.20	16.60
	<i>from 02.040201</i>	9.20	16.60
<b>Estimated total budget</b>		<b>167.06</b>	<b>183.85</b>