EUROPEAN
COMMISSION

Brussels, 6.6.2018
SWD(2018) 327 final

PART 1/2

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

PROPOSAL FOR A REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

establishing the space programme of the Union and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013, (EU) No 377/2014 and Decision 541/2014/EU

{COM(2018) 447 final} - {SWD(2018) 328 final}

Table of Contents

Glossary

Term or acronym	*Meaning or definition*
APV	Approach with Vertical Guidance
Beidou	Chinese satellite navigation system.
COPERNICUS	European Earth Observation Programme
DIAS	Data and Information Access Services
EEA	European Environment Agency
EGNOS	European Global Navigation Overlay System
EGNSS	European Global Navigation Satellite System
ELV	European Launch Vehicle
EMSA	European Maritime Safety Agency
ESA	European Space Agency
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FRONTEX	European Border and Coast Guard Agency
GALILEO	European Global Navigation Satellite System
GEO	Geo-stationary earth orbit
GNSS	Global Navigation Satellite System
GOVSATCOM	Governmental Satellite Communication
Glonass	Russian satellite navigation system (Globalnaya navigatsionnaya sputnikovaya Sistema)
GPS	Global Positioning System
GSA	Global Navigation Satellite System Agency
H2020	Horizon 2020 (Eighth Framework programme for Research and Innovation)
Horizon Europe	Ninth Framework Programme for Research and Innovation (FP9)
LEO	Low Earth Orbit
LPV	Localiser Performance with Vertical guidance
MFF	Multi-annual Financial Framework
MS	Member State
NEO	Near Earth Object
OS	Open Service
PNT	Positioning Navigation and Timing

PRS	Public Regulated Service
R&D	Research & Development
SAB	Security Accreditation Board
SatCen	European Union Satellite Centre
SAR	Search and Rescue
SBAS	Space-Based Augmentation System
Sentinels	Copernicus satellites
SSA	Space Situational Awareness
SST	Space Surveillance and Tracking
SWE	Space Weather

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1. Scope and context

Space technologies, data and services have become indispensable in the daily lives of European citizens: when using mobile phones and car navigation systems, watching satellite TV or withdrawing cash. Satellites provide backup communications and near-real time imagery when disasters, such as earthquakes, forest fires or floods strike, allowing emergency and rescue teams to better coordinate their efforts. Agriculture and the environment benefit from improved land monitoring and use. Transportation and energy infrastructure are safer and can be more efficiently managed thanks to satellite technologies. The EU's borders and immediate neighbourhood are better monitored. New space technologies and innovative services are emerging, further reinforcing the importance of state-of-the-art space infrastructures. Today about 10% of the EU's GDP – more than € 1 100 billion – are enabled by satellite navigation signals.

Global challenges due to growing populations, increased demand for natural resources and climate change require accurate and timely information about our planet which only space-based solutions can provide. Space is a perfect example of public investment that underpin major priorities such as monitoring the sustainable management of natural resources, fighting climate change, supporting emergency response for Copernicus (Earth Observation) or enabling smart transport systems and precision agriculture for Global Navigation Satellite Systems (EGNOS and Galileo). Secure satellite communications are indispensable for public security actors. Last, but certainly not least, Europe needs to protect its vital space infrastructure against space debris and space weather events, for which a Space Situational Awareness programme is indispensable.

Existing EU space programmes and initiatives

Galileo and EGNOS (GNSS)[1]

Galileo is the European Union's Global Satellite Navigation System (GNSS) providing free of charge accurate positioning and timing information. Galileo aims to ensure Europe's strategic autonomy in satellite navigation, which is key for the future of the European economy and security, reinforce the role of Europe as a global player and support emerging applications, especially automated cars and the internet of things.

The Galileo infrastructure consists of a space segment of 30 satellites (currently 22 in orbit) which generate and transmit Galileo signals, and a ground segment (various stations and control centres), which monitor the satellites and generate the navigation data for users. Users have already been benefiting from Galileo initial free of charge services, in combination with other satellite navigation systems, since December 2016.

EGNOS is a fully operational regional satellite navigation system which monitors and improves in Europe the accuracy of the USA's GPS – and in future also Galileo – signals. The number of users of this operational system is growing, notably in aviation (more than 250 airports in Europe use EGNOS based landing approaches) and in precision farming.

The EU is fully financing Galileo and EGNOS and is the owner of all tangible and intangible assets developed as part their implementation. The European Commission, on behalf of the EU, is responsible for the management and for the security of both Galileo and EGNOS, and for the supervision of the two entities responsible for the implementation of the activities: the European

[1] Regulation (EC) No 683/2008 and Regulation (EU) No 1285/2013

Space Agency (ESA) [an inter-governmental agency] and the European GNSS Agency (GSA) [a decentralised agency of the European Union].

The tasks delegated to the ESA relate mainly to system design and procurement, system maintenance and improvement, and research and development for system evolution. The tasks delegated to the GSA relate mainly to the system exploitation and security accreditation together with market development, and research and development for applications.

Past investments for Galileo and EGNOS were financed under two Multiannual Financial Frameworks (MFF) and amount to about € 10.3 billion and € 2.5 billion for each programme respectively.

Copernicus[2]

Copernicus is the European Union's Earth Observation Programme aimed at developing European information services using global data from satellites in combination with ground-based, airborne and seaborne measurement systems, and ancillary data. The data and information provided by Copernicus services is freely and openly accessible to users (with a few exceptions for security-related applications).

Copernicus includes:

- A space infrastructure with a space segment of families of satellites and instruments called "Sentinels", a corresponding ground infrastructure and related operations (7 EU owned satellites are in orbit and 6 more satellites and several instruments are under development);
- Six services (Marine, Atmosphere, Land, Climate Change, Emergency and Security) providing information and services to a wide variety of users.

The Copernicus services are operational since 2014 and support policies such as environment, transport, energy, agriculture and forestry, migration, border security, maritime safety, disaster management, urban planning, development, energy and fight against climate change among others.

The European Commission, on behalf of the EU, is responsible for the implementation, the management and the security of Copernicus. The development of the space infrastructure is implemented through two delegation agreements, the major one being with ESA. Most services are implemented through delegation agreements with competent service operators including EU agencies (EMSA, FRONTEX, EEA). The European Environment Agency has been delegated the task of coordinating the in-situ component activities.

The budget currently allocated to Copernicus for 2014-2020 amounts to € 4.3 billion.

The Space Surveillance and Tracking (SST) support framework

SST consists of monitoring, surveillance and tracking of active and inactive satellites, discarded launchers stages and debris fragments that orbit around the Earth. Knowing their exact orbits is crucial in order to avoid collisions with active satellites.

The SST initiative started in 2004 with the Decision of the Council and European Parliament 541/2014 of 16/4/2014 establishing the SST support framework and is supported by a budget of € 70 million from Copernicus, GNSS and Horizon 2020 (in addition to research and development activities financed by Horizon 2020 with a budget of € 97.2 million).

[2] Regulation (EU) No 377/2014

The first SST services are delivered to public and private users (Member States, the Council, the Commission, the EEAS, public and private spacecraft owners and operators, and public authorities concerned with civil protection) since July 2016. The support framework facilitated pooling participating Member States' SST capabilities, to provide free of charge SST services to users as well as the networking and upgrading of national SST assets. The European Union Satellite Centre (SatCen) acts as a front desk and facilitates the delivery of the SST services through a single portal.

Towards a future EU Space Programme

The future EU Space Programme will consolidate all space-related activities to provide greater coherence, visibility and budgetary flexibility. It will include the on-going actions Galileo, EGNOS and Copernicus, and the following new ones:

Space Situational Awareness (SSA)

SSA aims at covering the main space hazards: collision between satellites, space debris, space weather phenomena and near earth objects. It therefore encompasses Space Surveillance and Tracking (SST), Space Weather (SWE) and Near Earth Objects (NEO). Space Weather and Near Earth Objects are new activities proposed for the next MFF in addition to an enhanced SST activity.

Governmental Satellite Communication (GOVSATCOM)

GOVSATCOM is an initiative that aims to ensure the availability of reliable, secured and cost-effective satellite communications, indispensable namely when ground infrastructure is inexistent (maritime, air, remote areas), unreliable, disrupted or destroyed (natural disasters, crisis situations, conflicts). In addition, the transmission of security critical information requires guaranteed access and a level of protection against interference, interception, intrusion, and cyber-security risks. It is a new action proposed for the future MFF. The impact assessment report for GOVSATCOM was already presented to the Regulatory Scrutiny Board on September 27th 2017 and received a positive opinion with reservations.

More information on the existing and proposed EU space actions are provided in Annex 4 and examples of existing applications in Annex 6.

Policy context – a Space Strategy for Europe

The Space Strategy for Europe[3] which was endorsed by the Parliament and the Council[4] recognises the need for public investment in space as an enabler for numerous key Union priorities. Space supports European industrial competitiveness by boosting innovation. Recent developments show, for instance, that the EU is becoming a global leader in big data provision as a result of Copernicus. The combination of space data with digital technologies and other sources of data opens up many new business opportunities in all Member States.

Based on Article 189 TFEU, which calls upon the Union to draw up a European space policy *"to promote scientific and technical progress, industrial competitiveness and the implementation of its policies",* the Union has established: the European Global Navigation Satellite Systems (Galileo and EGNOS) and Copernicus.

[3] COM(2016) 705 final, 26.10.2016
[4] European Parliament Resolution P8_TA-PROV(2017)0323 and Council conclusions (9817/17)

The Union has made significant investments in these actions (€ 5 billion for 2007-2013 and € 11 billion for 2014-2020) in addition to investments made by Member States at national level and through the European Space Agency[5]. The Union is the owner of the assets developed under Galileo, EGNOS and Copernicus and guarantees the long-term planning, required to ensure continuity of services. In view of the complex and long investment cycles, the Union's commitment provides a stable and predictable environment that the private sector needs in order to use and invest in space solutions: it needs certainty that the data and services provided will continue in the future.

The Union also invests in space research to support the development needs of its space activities and to stimulate their use. The Union invested approximately € 1.9 billion during 2007-2013 and €1.5 billion during 2014-2020 through dedicated priorities in specific research programmes.

The 2016 Space Strategy for Europe confirmed the Union's political commitment for an ambitious space policy in Europe to (1) maximise the benefits of space for Europe' society and economy; (2) foster a globally competitive and innovative European space sector; (3) reinforce Europe's autonomy in accessing and using space in a secure and safe environment; (4) strengthen Europe's role as a global actor and promoting international cooperation.

Economic context

Space is a strategic tool supporting a number of economic activities. The European space industry, including manufacturing and services, employs over 230 000 professionals and its turnover was estimated between 46 and 54 billion EUR in 2014[6].

In particular, the overall benefits of EU GNSS to EU industry, citizens and Member States were estimated to reach between € 55 billion and € 63 billion over the next 20 years, with the most important benefits arising from indirect revenues in the downstream industry (between €37 billion and € 45 billion)[7].

Similarly Copernicus is expected to generate € 67 billion to 131 billion of benefits to the European society between 2017 and 2035, the vast majority of which will be generated in the downstream sector and end user segments. Ensuring the continuation of the programme after 2021 is expected to generate benefits 10 to 20 times bigger than the costs, and would support about 4000 jobs every year.

The entire European economy relies heavily on space infrastructures for public sector services (meteorology agencies, emergency services, forestry offices and civil protection departments), businesses (fishing industry, transport/logistics companies, insurers and oil & gas companies, agriculture), and citizens (pollution alerts, geo-localisation, or satellite TV). Space is an enabler for a wide range of industrial and technological activities; spill-over from space activities supports developments in other sectors (e.g. financial transactions use satellite navigation time-stamps, digital image sensors used today in our mobiles phones have initially been developed for space application).

These direct and indirect benefits are in line with the objectives set in the "reflection paper on the future of EU Finances"[8] which emphasises the added value of the EU budget when it comes to "public goods of a European Dimension". The document specifically mentions Galileo and

[5] For Copernicus, in 2007-2013, investment of €2.4 billion by MSs through ESA
[6] Socioeconomic impacts from space activities in the EU in 2015 and beyond, PwC study, June 2016
[7] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - Action Plan on Global Navigation Satellite System (GNSS) Applications, COM(2010)308 final, p. 3.
[8] https://myintracomm.ec.europa.eu/dg/budg/Communication/futureOfEurope/Documents/reflection-paper-eu-finances_en.pdf

Copernicus as notable examples of projects whose funding by the EU is an essential condition since they: “are too big to complete without public investment.”

Strategic Context

All major countries have made space a priority in order to acquire and maintain their autonomy of action, to increase their influence on the international scene and strengthen their competitiveness. This autonomy covers the whole space industrial and operational chain from space research to satellite production, protection and exploitation, including also the key aspect of access to space, in a context of increased competition with new institutional (e.g. China) and private players (e.g. Space X).

Existing synergies between space and security/defence partly substantiate the importance given to the space sector, notably in the current global security context, which was reaffirmed by the Commission European Defence Action Plan and supported by the European Council.[9]

Practically, EGNOS has been operational since 2013, Copernicus since 2014 and Galileo since 2016. In view of these achievements, it is key that the EU remains a major player in the space sector and takes a global leadership including its participation in international organisations and bodies.

With 29 satellites currently in orbit and over 30 institutional launches planned in the next 10-15 years, the EU is the largest institutional customer for launch services in Europe. In this context, it is important for the Union to support innovative efforts to remain competitive in the sector of launchers. Furthermore, the number and criticality of European space assets has been increasing steadily, as have space hazards. Space assets and services have become indispensable to our economy and society, and therefore their long-term availability and protection is essential for Europe’s safety and security.

The emergence of new national and commercial players and the rapid evolution of disruptive technologies are revolutionising traditional industrial models, which put at risk the competitiveness of the EU industry. Europe shall promote its position as a leader in space, increase its share on the world space markets, and seize the benefits and opportunities offered by space including for its security and the safety of its citizens. President Juncker highlighted the crucial role of space, stressing the "need to maintain and reinforce a strong and high-performing industrial base for our internal market which would ensure that Europe maintains its global leadership in strategic sectors such as space"[10].

Support of Space to EU policies

The EU space activities directly support many EU policies as further described in Annex 5.

The volume, quality and diversity of data that are provided by the Copernicus Services benefit EU policies in domains such as Climate Change Monitoring, Environment Policy or Agriculture for instance. Indeed, many EU policies need precise and reliable data to set-up long term datasets, precise mappings etc. which eventually allow the long term monitoring of key indicators in their domains and ensure an effective implementation of their policy. Combined with navigation services, new EU policies can also be developed in domains such as Smart farming or Intelligent Transport where the highest accuracy of positioning is required.

[9] Communication from the Commission to the European Parliament, the European Council, the European Economic and Social Committee and the Committee of the Regions - European Defence Action Plan COM(2016) 950

[10] President Juncker's Political Guidelines, July 2014

Scope of the impact assessment

On 2 May 2018, the European Commission adopted its proposals for a new Multiannual Financial Framework (MFF) for 2021-2027. Under these proposals, the Space Programme will have a budget of EUR 16 Billion over this period.

This impact assessment report reflects the decisions of the MFF proposals and focuses on the changes and policy choices which are specific to this instrument.

This impact assessment supports the legislative proposal for the EU budgetary funding of the Space Programme 2021-2027 which includes Galileo, EGNOS, Copernicus, SSA and GOVSATCOM. Regarding GOVSATCOM, details are covered by a dedicated impact assessment and thus will not be repeated here. The present impact assessment does not cover research and development for Space as it will be part of the EU ninth Framework Programme for Research and Innovation (Horizon Europe).

The EU Space Programme regulation will define and establish the general common objectives of the European space actions, budgetary matters, governance principles, common rules and procedures, as well as horizontal actions in support of access to space, international cooperation and space economy. The specificities of Galileo, EGNOS, Copernicus, SSA and GOVSATCOM will also be addressed in the regulation.

In terms of governance, the role of the GSA will evolve in the next MFF which will be clarified as well in the regulation; this agency will become the European Union Agency for the Space Programme.

Hence this impact assessment covers both existing and new actions: Copernicus, Galileo and EGNOS are proposed to be continued and enhanced; Space Situational Awareness (SSA) is an extension of an existing activity (SST); and Governmental Satellites Communication (GOVSATCOM) is a new initiative.

The Impact Assessment satisfies the requirements of the Financial Regulation in respect of preparing an ex-ante evaluation[11].

1.2. Lessons learned from previous programmes

1.2.1. Achievements and lessons learned from GNSS and Copernicus

Achievements and importance of GNSS and Copernicus

Overall, the European Commission has demonstrated its ability to implement the existing GNSS and Copernicus actions with the support of key stakeholders, such as ESA, and a strong European industrial base.

The mid-term evaluations of EGNOS, Galileo and Copernicus as well as an evaluation of the European GNSS Agency (GSA) have emphasised the importance of these investments for the EU and have confirmed their major achievements so far.

The report on GNSS[12] highlighted its importance for the EU, stating that "*the European dimension of the programme has brought additional value by enabling shared funding and risks, access to*

[11] Note that a specific Impact Assessment for the future GOVSATCOM programme has already been undertaken in 2017

European expertise, technology cooperation, the creation of a single European market and guaranteed and equal access for all EU Member States to the signal and services provided by Galileo and EGNOS". Comments on Galileo emphasised the "achievements of Galileo's space segment", "the declaration of the initial global provision of the Open service, Search and Rescue (SAR) services and pilot Public Regulated Service (PRS)" and, more globally, "the effectiveness of the programme" which is described as "particularly evident". Similarly, EGNOS is confirmed to have "consolidated the stability and high performance of service provision".

The report on Copernicus[13] similarly asserted that "*the development of space infrastructure along lines agreed with delegated bodies and the promotion of interoperability of data and systems both clearly need to be managed at EU level, to pool financial risks and ensure coordination*". The Copernicus programme was described as "on track, having already met some major expectations to support the autonomy of Europe in the provision of quality and useful data and its exploitation by a large number of users, for both institutional and commercial purposes". Other strong assets of Copernicus were highlighted such as the open data policy, the actions stimulating uptake by the private sector, the tangible economic benefits, the good level of coherence internally and with other EU actions, the excellent budget implementation with no significant costs overruns, and a good cooperation internally within the Commission and with Member States. The users' satisfaction was also pointed out regarding product relevance, timeliness and availability. The management at EU level enables higher visibility within international initiatives compared to what could have been achieved by single Member States especially for global issues (such as climate change environment, land use or maritime security).

Common lessons learned from GNSS and Copernicus

One of the common features between the two actions is linked to access to space since the development of both space infrastructures requires ordering launchers (rockets).

Autonomous access to space is crucial for the deployment of the Union space infrastructure. So far launch services have been implemented following different delivery mechanisms. Lessons learnt from the mid-term evaluations show the need to harmonise the delivery mechanism through an aggregation of demand for GNSS and Copernicus. Such an approach is expected to reduce administrative burden and reduce industrial costs. Studies performed by ESA demonstrate that aggregation of launch service demand will achieve economies of scale.

More specifically, in its midterm evaluation of the Copernicus programme, the Commission reported that the shift from a Russian launcher (Rockot) to the European launcher Vega allowed for the successful launch of Sentinel 2B which would have been otherwise delayed to an indefinite date due to the deterioration of the Russian political context and the subsequent impact on the supply chain which affected the launch schedule.

Likewise, in its midterm evaluation of the Galileo programme[14], the Commission reported on the use of launchers for the deployment of the programme which was overall successful despite a delay in the launch schedule resulting from an incorrect orbit injection in 2014: the Galileo Initial Services were declared operational in December 2016. The Galileo interim evaluation highlights that the "*usage of Ariane 5 launcher is seen as a major achievement reached during the evaluation period, especially among the European GNSS committee representatives and upstream industry*

[12] Interim evaluation of Galileo and EGNOS programmes and evaluation of the European GNSS Agency SWD(2017) 346 final
[13] Mid-term evaluation of the Copernicus programme (2014-2020) COM(2017) 617 final and SWD(2017) 347 final
[14] Interim evaluation of Galileo and EGNOS programmes and evaluation of the European GNSS Agency SWD(2017) 346 final

representatives, who see a great value in utilisation of the European launcher. Indeed, the qualification and utilisation of Ariane 5 is perceived as a positive factor despite the fact that it was delayed by two years"[15].

These past experiences with Copernicus and Galileo show that it is crucial to ensure an autonomous access to space for EU space activities. As the EU will act as the prime institutional customer of launch services, the Commission should ensure that its needs are fulfilled both in terms of schedule and in terms of technical requirements by establishing an aggregation of demand for European space actions.

Lessons learned from GNSS

The European GNSS mid-term review has identified a number of challenges related to i) governance and ii) security governance.

i) Governance

The governance set-up has revealed some inefficiency in terms of low reactivity of the decision-making process due to the number of actors involved but also due to a different governance set-up between deployment (delegation agreement between EC and ESA) and exploitation (delegation agreement between EC and GSA and working arrangement between GSA and ESA).

ii) Security Governance

As regards security governance, the launch of initial services and the transition from the deployment to the exploitation phase have raised challenges that need to be properly addressed in order to maintain and improve the appropriate level of security for the operation of the EGNSS systems.

Lessons learned from Copernicus

Regarding Copernicus, the unprecedented success of the programme and its volume of data led to the following findings[16]:

i) Need to improve the distribution and access to data

Due to the very high number of user registrations, the communication aspects, the data distribution and access, and data download need to be improved. The new Data and Information Access Services (DIAS) currently being set up are meant to address this issue specifically but need to be further developed in the next MFF. There is a need to effectively make available and allow for combination with other data of massive volumes of satellite data and information (10 pB[17] per year generated with a distribution and access system needing to deliver 10 times this volume as the generation of data implies 10 times more in download);

ii) Need to strengthen the integration of space data into other policy areas and economic sectors through increased focus on user uptake

Copernicus is reaching user constituencies from the traditional space area but so far did not sufficiently manage to reach other potential users outside space.

[15] Interim evaluation of Galileo and EGNOS programmes and evaluation of the European GNSS Agency SWD(2017) 346 final, p.14.
[16] Since the security services were not fully operational at the time of the review, the findings focussed on the functioning of the other Copernicus services.
[17] 1pB=1.000 terabytes

Recommendations

Both mid-term reviews recommended to pursue the efforts on i) maximising benefits resulting from the EU investments in space infrastructures and services (maximise the return on investment), ii) optimising the implementation of the on-going actions (governance and data access) where necessary and iii) continuing the support and development of activities in line with the EU Space Strategy.

The Commission reports, adopted on October 2017[18], were endorsed by Council conclusions last December, emphasising the importance to continue the programmes and reinforce their uptake to maximise benefits.

GNSS

As far as Galileo and EGNOS are concerned, the Commission report on the mid-term review recommended efficiency improvements for the decision-making process for these operational activities driven by services and users' needs. In that context, the interaction between the European Space Agency (ESA), responsible for the deployment of the satellites and the entity in charge of operations (GSA) should be re-examined. Reducing the administrative burden for the main actors, as well as the complexity and length of the decision making process are also key elements.

Concerning Galileo's security governance, the mid-term review recommended re-assessing the allocation of responsibilities between the Commission and the GSA, the role of Member States, the role of the Council, the HR and the EEAS, as well as the Security Accreditation Board (SAB) independence and autonomy with respect to the GSA and the choice of legal instruments for technical security matters (delegated acts vs. implementing acts).

Copernicus

The full potential of Copernicus for the EU society and economy is yet to be fully unleashed among user constituencies beyond space by means of an intensification of user uptake measures. There is a need to develop the downstream ecosystem, to combine the three elements of space, ICT and thematic competencies and then to render the data usable by non-specialists.

For Copernicus, the mid-term evaluation report recommends pursuing efforts on i) the Copernicus data access and distribution: a unified access needs to be implemented ii) the combination of data with other sources to be improved in the frame of the DIAS evolution, iii) awareness to be raised and networks developed, iv) more attention to be paid to in-situ data access (also through an improved cooperation of Member States) and v) a consolidation of data access that should also consider the security aspects with proper mechanisms to control access to data in exceptional circumstances and for limited periods of time.

Reporting methods should be harmonised and communications and user uptake activities should be expanded beyond specialist communities. A stronger awareness of the development of the market at local level is also required. Finally, new services should be developed and existing services reinforced (e.g. in relation to global issues like CO2 emissions, Polar Regions observation, cultural heritage protection etc.).

[18] COM(2017) 616 final and COM(2017) 617 final

1.2.2 Achievements and lessons learned from the SST support framework

The implementation report on the EU SST framework[19] showed that it delivered results for all required actions and the three services foreseen in the SST decision, and created clear EU added value. However, implementation needs to be stepped up in the next phase and the EU SST support framework needs to evolve further to improve its effectiveness.

Achievements

The implementation report on the SST support framework highlighted the results in establishing and operating all three functions (sensor, processing and service), taking into account the relatively short timeframe since EU SST service are available for European users. The delivery of three initial services is provided since 1 July 2016 to all European institutional users and spacecraft owners and operators, free of charge and operational 24/7 through the EU SST Portal. In April 2018, there were 35 user organisations and 111 registered spacecrafts and those numbers are continuously increasing. Important work regarding the mapping and pooling of European assets, networking and exchange of information has been developed and upgrades of assets have started. The establishment of services has triggered the mapping and pooling of European assets (telescopes and radars).

Lessons learned from existing SST support framework

The feedbacks coming from the ongoing implementation report and the reports sent by external experts involved in the grants' management underlined 4 issues, presented by order of importance:

i- Lack of European dimension

Despite the significant achievements during the period 2014-1016, the services lack for the moment a certain level of European dimension due to a low collaboration between Member States involved in the development of the current SST services. Even if several mechanisms and fora to exchange information have been introduced, National Operation Centres are still acting more often in silo instead of developing a coordinated approach.

ii- Lack of European independence

A true independence of the EU Services does not exist. Indeed, the alert messages are sent to the EU SST Consortium which relies on these data to provide the collision avoidance services. The added value of the Consortium regarding the data remains limited since it currently relies, not only but mainly, on their capabilities in terms of processing and refinement of data provided by the US.

iii– Issue on Governance

Governance issue hinder the improvement regarding performance and handling of users' allocation. The current governance of the SST Framework has been chosen in order to accommodate the security element attached to SST and the fact that all the assets and processing capabilities are nationally owned. However, the current rule of consensus creates complications in the day to day management for the decision making process.

iv- Complexity of funding mechanism,

The funding mechanism through different grants has proved to be difficult to handle. The multiplication of the calls, nearly one per year, has proved to be technically and administratively burdensome.

[19] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:256:FIN

Recommendations

There is a need to optimise the use of EU Member States national capabilities and service delivery arrangements and to invest in SST assets. This will enhance the protection of European space assets and ground infrastructure. In addition, this will allow a higher degree of EU autonomy in this domain and will offer the opportunity to develop a true collaboration with the United States contrary to the current situation where EU SST services are still largely dependent on US data.

1.2.3. Key messages from stakeholders

Consultations

The preparation of the Space Strategy for Europe led to extensive consultations from various stakeholders that concluded on the importance of space for the European economy and the need to pursue the efforts at EU level due to the importance of the space actions. Additional specific consultation were launched and analysed to complement these findings. The major ones are listed in Annex 2.

Key messages from the consultation for the Space Strategy for Europe

Copernicus

The open data policy is considered one of the strongest assets of the programme and the programme management is assessed as working efficiently. The majority of stakeholders consulted (incl. national representatives at the Copernicus Committee and User Forum; all entrusted entities; space infrastructure manufacturers; space data providers; service providers, and users) is globally satisfied with the governance of the programme and its implementation. The Copernicus space component has been deployed according to plan, and the data dissemination system needs to be scaled up. The Copernicus services are appreciated regarding product relevance, timeliness of delivery and availability of products. Cohesion can be improved through awareness-raising and the development of networks. The user requirements gathering process could be made more robust with a stronger involvement of targeted communities. Communication and user uptake activities need to be expanded beyond specialist communities. A greater coordination among entrusted entities is needed to better communicate about Copernicus services and foster user uptake. Stronger awareness of the development of the downstream market and applications at national and regional level could also be beneficial. EU action is providing considerable added value above what could be achieved at national level.

Galileo and EGNOS

The importance of European satellite navigation services for the European economy and security was recognised by all stakeholders[20].

Considering the difficulties faced by the European GNSS as a “first of a kind” project for the EU, and thus as the first complex industrial programme implemented by the EU, the programme has shown a satisfactory level of effectiveness. Sufficient level of satisfaction from stakeholders

[20] Mid-term review of the Galileo and EGNOS programmes and the European GNSS Agency, PwC France study, June 2017, EU Bookshop: https://publications.europa.eu/en/publication-detail/-/publication/56b722ee-b9f8-11e7-a7f8-01aa75ed71a1

regarding the implementation of the EU intervention logic (i.e. identification of problems and needs, definition and establishment of objectives, identification and implementation of actions, achievement of expected impacts) and the achievements so far; stakeholders are also confident about the planned developments in the coming phases.

Concerning Galileo, the majority of the consulted stakeholders recognised the declaration of initial services as the major programme's achievements. However, representatives from the downstream industry expressed concerns about the current limitation in the service and applications' development and the delays in Galileo's schedule. The effectiveness of the programme has been particularly evident in the achievements of Galileo's space segment.

As for EGNOS, the programme has consolidated the stability and high performance of service provision with the declaration of the LPV[21]-200 service and the provision of APV[22]-I services over 98,98% of the land mass of the EU Member States plus Norway and Switzerland. Stakeholders utilising EGNOS, expressed an extremely high level of satisfaction concerning the maturity of EGNOS system and performance. However, representatives from the European Parliament, the Member States and Eurocontrol, expressed their concern for non-coverage of the whole EU territory. Stakeholders also consider that the effectiveness of the governance of the programmes could benefit from a reduction in their complexity often duplication of effort and delays.

Stakeholders with a direct involvement and a visibility on the internal mechanisms (governance actors, GNSS Committee, upstream industry) underlined that there is a conflict between the three governing actors, which affects the overall effectiveness of the decision-making procedure and of the programme itself. Representatives from the downstream industry and users have expressed their concerns about the complexity of the system, from a technical point of view, although recognising that this has not affected the achievement of final milestones.

Representatives from the European Parliament, the GNSS Committee and Programme Management recognise that Galileo and EGNOS show a high degree of coherence with other EU policies, within the programmes themselves, and with other GNSS programmes. Regarding security, interviewed stakeholders (members of SAB and GNSS Committee) indicated that the current security framework based on best practices does not ensure an unbiased evaluation of the security issues. In addition, the sensitivity of the sector when we come to national sovereignty limits the margin of manoeuvre and contributes to the complexity of the system.

The EU added-value of the Galileo and EGNOS was assessed as high. According to stakeholders, stopping or withdrawing the existing EU intervention would have such severe consequences for Galileo and EGNOS that the entire programme would be jeopardised. Ending EU intervention would entail a considerable waste of public funding and would impact the outcome of efforts supported by private investments. Stopping or withdrawing EU intervention would severely damage the image of the EU, as such a decision would reflect badly on the Union's reputation for leading programmes as complex and challenging as Galileo and EGNOS.

The GSA's overall evaluation was positive. It achieved important objectives for the progress of Galileo and EGNOS and for the development of GNSS downstream markets in the period 2014-2016 through an effective implementation of both its core and delegated tasks. Hence, the Agency's results have been in line with expectations. In particular, representatives of the downstream industry emphasised the positive impact of the GSA on market development during the reporting period.

[21] Localiser Performance with Vertical guidance
[22] Approach with Vertical Guidance

Through the achievement of all the milestones set for the period, as well as the feedback from stakeholders, it can be concluded that Galileo & EGNOS are on track to reach the long-term objectives set by the GNSS Regulation for 2020.

GOVSATCOM

Civilian and military users stressed the multiple operational benefits in terms of security and guarantee of access of the GOVSATCOM initiative, in particular for the many civilian user communities which today have no access to secure satellite communication. Such an access, as primary or back-up system, is indispensable to carry out security critical missions and operations, to tackle new risks and threats, and to seize the opportunities provided by new applications (drones, internet of things) and geographic areas (Arctic). Industry, too, is largely supportive of the planned programme, and underlines in particular the multiple benefits of a) overcoming the current market fragmentation on the user side; b) having the EU as a stable and predictable anchor client, comparable with the processes and mechanisms in place in third countries like the US, and c) having a single set of EU-wide security and accreditation standards. This will also generate a positive impact on R&D, and enhance the competitiveness of European businesses in the global market.

Space Situational Awareness

Following the organisation of the user workshop on 23 February 2018 and a user campaign (June 2017), users have clearly indicated the necessity to establish an SSA programme.

In the field of SST, users have encouraged the Commission to push towards more ambitious EU services in order to cope with the existing and upcoming needs. Moreover, the users have clearly highlighted the necessity to develop EU SST capabilities in order to work in complementarity with the US. This involves the development of new assets and a significant investment in new capabilities.

For Space Weather the intended approach of the Commission, i.e. selecting the future services according to users' needs, has been well-received. There was a clear demand regarding European continuous operational space weather services..

Public consultation 2018

An open public consultation was launched in the beginning of January 2018 within the framework of the preparation of the next MFF, which ran for 8 weeks. The consultation covered the broader policy area of strategic infrastructures, which among other policies also covered space. Of the 441 responses received, 33 were related to space. It should be noted that this public consultation triggered a much smaller number of replies relevant to the space programme than the consultation for the preparation of the Space Strategy.

Respondents confirmed the long-term sustainability of Europe’s space capability to be a very important challenge, as well as the importance of promoting economic growth and jobs, which was a key consideration for the business representatives. The respondents confirmed the EU added value of the current space programmes and highlighted their strategic dimension and the need for adequate funding. Stakeholders supported simplification efforts and while many see the current programme design and governance as adequate, others see scope for better coordination between the various actors and potential for further synergies. Business stakeholders and public authorities share similar views regarding the challenges and EU added value. Both groups point out the

importance of flexibility to react to unforeseen circumstances and to new user needs. Both also support most suggestions to simplify and reduce administrative burden. NGOs on the other hand have less clear positions except for the unanimous support to address environmental and climate issues.

The findings of the consultation also included a certain number of elements considered as obstacles to achieve the programme's objectives. They were mainly linked to administrative capacity to manage programmes, lack of flexibility to react to unforeseen circumstances and to new user needs, as well as difficulty to ensure the sustainability of projects when the financing period ends.

2. THE OBJECTIVES

2.1. Challenges for the EU Space Programme

In the next MFF period, the EU Space Programme will have to deal on one hand with global evolutions at environmental, economic, security and geopolitical levels, and on the other hand with challenges directly linked to programme implementation. The key challenges are provided here below.

Challenges coming from political and global developments

Climate change has become obvious and major initiatives have been taken at national, EU and global level to ensure a more effective fight against global warming and future ecologic disasters. In particular, the commitments signed by a vast majority of countries during the COP21 will make the data provided by the independent Earth Observation of Copernicus more and more crucial and will enable Europe to take global leadership in this effort. The **digitalisation** and the **new economy** have now taken over more and more sectors, leading to a need for immediately available data and communications.

Security and safety of people and goods remain a major concern of European citizens, which can be addressed with the evolution of security services supported by the EU Space Programme. The importance of security and safety was highlighted in the Rome Declaration of 25 March 2017, signed by the leaders of the 27 Member States, European Council, the European Parliament and the European Commission. The **security of infrastructures** is crucial for both the private and public sectors which both need assurance against critical events that could jeopardise their assets (for instance satellites) and, as a consequence, their activity. With an evolving geopolitical context and new competition (and possible threats) from third countries, the **Union's autonomy** of action becomes even more critical, in all areas that are key for security and defence, and in particular in space.

In terms of **competitiveness**, the European space industry is facing tough competition from traditional, emerging and new space powers and industrial actors. Moreover the business environment is shifting focus from infrastructure to applications and services. This puts the European industry under pressure (from launchers to satellites to downstream service providers). These economic and business shifts constitute a major driver of change for the sector which calls for the need for EU-level intervention in order to accompany this transition and allows a smooth and balanced transformation of the sector.

Challenges based on lessons learned from existing activities

i) **Governance** (including security governance)

The cross-cutting elements such as simplification, flexibility, coherence, and performance focus are existing challenges as indicated in the mid-term review recommendations and will be a keystone of the proposal for the next MFF. Indeed the current EU space programmes are already operational and their general organisation needs to be streamlined to be even more efficient than they are already today. As mentioned in the "lessons learned" section, a simplification and a more coherent approach needs to be implemented, notably for security management, the GNSS governance and the SST governance.

ii) **Data distribution and access**

The success and quality of data, in particular from Copernicus, happened to be higher than expected. The quality and volume of available data make it necessary to specifically work on the means to enhance the distribution of and access to these data to the different economic operators using them.

iii) **Linking space data with other policy areas and economic sectors by increasing user uptake**

As both the space strategy and the mid-term review underlined the need to strengthen the integration of space data across society and the economy, measures are needed to facilitate the uptake of Copernicus data in: i) different public policy areas; ii) a large variety of economic sectors; iii) in the emerging downstream ecosystem; iv) in the research community; v) by third party actors (NGOs, international etc.).

2.2. Objectives of the EU Space Programme

General Objectives

The Space Strategy for Europe proposes the following four strategic goals:

(1) Maximising the benefits of space for society and the EU economy;

(2) Fostering a globally competitive and innovative European space sector;

(3) Reinforcing Europe's autonomy in accessing and using space in a secure and safe environment;

(4) Strengthening Europe's role as a global actor and promoting international cooperation.

These goals were endorsed in 2016 and are still in line with the subsequent lessons learned from the programmes during the mid-term reviews and the general context: importance of the security of the infrastructure (and, as consequence, of the security governance), importance of the space sector as an economic enabler and of a strong independent EU space industry, importance of continuity in providing information, data and services leading to benefits for society.

In line with these strategic goals, the general objectives of the Programme shall be to support the competitiveness of the Union industry and ensure the freedom of action of the Union and its strategic autonomy, including by enabling technological and evidence-based decision-making, notably by:

(a) providing, or contributing to the provision of, high-quality and up-to-date and, where appropriate, secure, space-related data, information and services without interruption and wherever possible at global level,

(b) ensuring the Programme's components remain at the most modern stage of technological development, provide services that meet existing and future needs and are able to meet the Union's political priorities, including as regards climate change and security and defence;

(c) maximising the socio-economic benefits from the Programme, including by promoting the widest possible use of the data, information and services offered by the Programme;

(d) promoting the role of the Union in the international arena as a leading stakeholder in the space sector and strengthening its role in tackling global challenges and supporting global initiatives, including as regards climate change and sustainable development.

Specific objectives:

The Space Programme needs to ensure, through simplification and streamlining, that the EU fully exploits the economic and societal potential that space can bring by achieving the following specific objectives:

- **Ensure the continuity of the existing space infrastructures and services, and the development of new or enhanced ones**. In order to continue providing high quality data and deploy innovative services for Galileo, EGNOS and Copernicus as compared to global competitors, new satellites have to be launched (as satellites have a limited lifetime and need to be replaced after several years) and the infrastructures on the ground need maintenance, upgrade and security improvements. In order to avoid obsolescence and remain at cutting edge of technology, it is important to upgrade the existing space infrastructure, as done by other space nations. In particular, there is a need (1) to provide state-of-the-art and, where appropriate, secure positioning, navigation and timing services and (2) to deliver accurate and reliable Earth Observation data and information to support the implementation and monitoring of policies of the Union and its Member States in the fields of the environment, climate change, agriculture and rural development, civil protection, safety and security, as well as the digital economy.

- **Foster an innovative European space sector that can compete globally**. The programme should continue to support and reinforce the competitiveness, entrepreneurship, skills and capacity to innovate, with particular regard to the position and needs of small and medium-sized enterprises and start-ups. At the same time, it encourages the transfer and cross-fertilisation of technology with non-space sectors. The Programme should promote the role of the Union in the international arena, as a leader in the space sector and strengthen its role in tackling global challenges and supporting global initiatives. Through the strengthening of international cooperation, European position will be reinforced at global level which will support, through economic diplomacy, EU industry and technology.

- **Maintain the EU's capacity to have autonomous access to space relying on a EU independent industry, guaranteed access to EU space data and services and use them safely and securely**. Space capacities shall contribute to an autonomous, secure and cost-efficient capability to access space; therefore it must mitigate dependence on external actors to build, launch and operate satellites. The Space Programme shall (1) enhance SST capabilities to monitor, track and identify space objects; monitor space weather; and map and network Union Near Earth Object capacities; and (2) ensure the long-term availability of reliable, secure and cost-effective satellite communications services, with an appropriate guarantee of access and robustness to withstand ill-intentioned acts.

The above objective of **continuity of services** will support the user uptake of Galileo, EGNOS and Copernicus space-based applications. Developing enhanced services is needed in order to respond to major political and global challenges linked to climate change and security of people and goods for Copernicus and to develop new markets for GNSS.

The cross-cutting objective of **fostering an innovative space sector and its competitiveness** will to be supported by activities of the new programme to accompany the development of the new economy, digitalisation and internationalisation of the European space industry.

The objective of **maintaining autonomy and security** responds to the challenges regarding the Union's autonomy and ensuring the security of space infrastructure ("security for space"). The security of the EU and its citizens will benefit from the development of space services ("space for security"): Galileo-PRS, Copernicus security services, GOVSATCOM. In order to increase the safety and security of EU citizens a secured access to telecommunications in case of major crisis is needed.

To face the cross-cutting challenges of flexibility, simplification, synergies and performance, the Space Programme need to address the weaknesses related, to some extent, to the governance, by streamlining the programme organisation and by looking for synergies in particular in the security management and user uptake/market development aspects. The role of the GSA will be reassessed in this context as further explained in Chapter 4.

Baseline scenario (EU 27 reflecting UK's withdrawal from the EU)

The current budget for Galileo and EGNOS amounts to € 6.8 billion and for Copernicus to € 4.3 billion, leading to a total amount € 11.1 billion for 2014-2020. This current budget, taking into account the inflation, would amount to € 12.5 billion at 2021-27 prices. The baseline scenario would amount to € 10.6 billion, a reduction of 4% compared to the current budget of € 11.1 billion but a reduction of 15% compared to the inflated current budget of € 12.5 billion. Since GNSS and Copernicus activities are financed by the EU budget[23] and they do not deliver revenues, as decided by Member States, the EU budget should cover all the necessary expenditures to develop and maintain the infrastructures and associated services.

The baseline scenario, corresponding to a decrease by 15% of the current budget, would be as follows:

Activities	**Current MFF** (in € billion) 2014-20 price	**Current MFF** (in € billion) Equivalent in 2021-27 price	**Baseline scenario** (in € billion) 2021-27 price
Galileo + EGNOS	6.8	7.7	6.5
Copernicus	4.3	4.8	4.1
Total	**11.1**	**12.5**	**10.6**

The baseline scenario would severely jeopardise the objectives of an EU Space policy as highlighted in the Space Strategy for Europe. A cut in the current budget to reflect EU-27 Member States' contribution would not allow addressing the specific threats, challenges and opportunities previously described.

[23] Except the first satellites partially paid by ESA for Copernicus for € 2.4 billion and for Galileo for € 1 billion

GNSS

In particular, the baseline scenario might allow EGNOS to remain operational but could not sustain the provision of Galileo services: a cut by 15% of the inflated current budget would mean that the Galileo programme would be stopped in the coming decade. The final constellation of 30 satellites with infrastructure operations, to be achieved by 2020, could not last due to a lack of budget to invest in satellites and launchers. This would put at risk the delivery of Galileo services, as investments in infrastructure are needed to be planned several years in advance. It would mean that the accuracy and availability of the services will degrade drastically after 2025/2026 and will cease in 2030 as further replenishment of satellites and associated launchers cannot be afforded between 2021 and 2027. The gradual derived obsolescence and the lack of technological evolution, due to this absence of investment would also put at risk the services adoption by the users and lead to a steady decline of the programme since existing satellites could not be renewed.

Without the evolution of the technology and services, and just with a mere extension of constellation life time using current technologies, the service performances would decrease with respect to the other competing GNSS constellations (GPS, Glonass, Beidou). In parallel, industries and developers would lose confidence in developing and investing in user segments elements and applications compatible with Galileo.

Consequently, stopping the implementation of Galileo and EGNOS would have severe political, economic and social consequences. The EU would lose its credibility as a strategic partner providing global satellite navigation services for its own citizens, industries and international partners. The overall investment into Galileo and EGNOS (of more than 12 billion EUR since 2007) and expected indirect economic impacts would be lost, together with the potential for innovation and building up a high-tech knowledge base in Europe. From the global perspective, the position of Galileo as a global satellite navigation system would be lost.

Copernicus

Similar consequences can be expected for Copernicus since the whole Copernicus architecture could barely continue, let alone making any improvement possible, by preventing the full replacement of the existing satellites when they would reach their end of life in orbit. Any competitive advantage acquired in the last three years of data supply for business applications development would be also quickly lost. Moreover, no response to acknowledged political challenges regarding greenhouse gases monitoring and security would be possible.

New services

In addition to the decline of the existing EU space activities, security-related services already politically affirmed such as GOVSATCOM and SSA could not be initiated. The SST for instance would remain a mere intra-state coordination with very limited results at EU level whereas the other SSA components – Space Weather and Near Earth Object - would never start.

Globally this situation would severely reduce the broader investments in the space sector and significantly impact the industry and all the European SMEs in the space domain and beyond.

3. PROGRAMME STRUCTURE AND PRIORITIES

3.1. Structure of the EU Space Programme

The EU Space Programme regulation will cover the general common objectives and horizontal activities (actions in support of access to space, international cooperation and space economy). The specificities of the different EU space actions will also be described in this regulation.

The EU space actions are:

- Global Navigation Satellite Systems (Galileo and EGNOS)
- Earth Observation (Copernicus)
- Space Situational Awareness (SSA)
- Governmental Satellites Communication (GOVSATCOM)

The proposed scenario corresponds to a budget of € 16 billion as detailed below:

Activities	**Current MFF** (in € billion) 2014-20 price	**Current MFF** (in € billion) Equivalent in 2021-27 price	**MFF Proposal** (in € billion) Current price
Galileo + EGNOS	6.8	7.7	9.7
Copernicus	4.3	4.8	5.8
SSA/GOVSATCOM			0.5
Total	**11.1**	**12.5**	**16**

GNSS (60% of the total allocated budget: continuity 59%, evolution 1%)

A sustained level of funding for GNSS would ensure continuity in the operations and service provision. To continue to deliver the existing services includes the investment in launchers and satellites to sustain a Galileo constellation of 30 satellites. It is worth noting that past investments on Galileo were done over two MFFs for a total of more than € 10 billion.

A proper funding would also ensure technological evolution of the GNSS systems (representing approximately 1% of the allocated budget). Technology evolution will be the cornerstone of Galileo second generation deployment. The system needs to keep up with competing GNSS systems, attracting the interest of the user segment and application developers on one side, and of receiver integrators and final users on the other. A second generation of satellites based on the very same technology of the first generation, or less performing than competing GNSS constellations, would be less attractive to industries, developers and users; it would most probably lead users to reorient towards the competing constellations.

The flourish of the applications markets, based on European independent GNSS capability, shall be ensured through the continuous operations of Galileo and EGNOS. This would be in line with the intentions laid out in the Space Strategy and would satisfy the needs of the most demanding applications in the civil and security domains, as well as in the new and emerging applications markets (such as connected and automated driving). This scenario requires the procurement of a sufficient number of new generation satellites and launchers to guarantee the provision of high quality services.

Copernicus (36% of the total allocated budget: continuity 33.5% and new missions 2.5%)

A sustained level of funding of Copernicus would allow the EU to maintain its autonomy and leadership in environmental monitoring, emergency management and support to border and maritime security and establish a level of confidence for the downstream sector to use and integrate Copernicus data and information based on the existing Copernicus infrastructure and services. This would represent an increase compared to the current Copernicus budget (+11%) to take into account notably the inflation of prices.

An increased effort (of about 2.5% of the allocated funds) would partially allow to enhance services and to respond to emerging needs to include new observation capacities in support of:

- Environmental needs, focusing on climate change (such as CO2 emission monitoring supporting the objectives of the COP21 Paris agreement), land use including support to agriculture, and observations of the Polar areas;
- Security needs by strengthening current missions and developing new capacities, for example to improve detection of small objects (e.g. vessels) and revisit time in support of the fight against illegal trafficking or needs for external actions.

Other actions (3% of the total allocated budget)

- A dedicated SSA (representing 1.5% of the proposed budget) with a strong SST component would allow the protection of the current EU assets. In addition, it will reinforce the EU institutional leadership in this area, progressing towards less dependence vis-à-vis the US, whilst protection against two other space hazards (SWE and NEO) would not be affordable with the allocated budget.
- A dedicated GOVSATCOM, (representing 1.5% of the proposed budget) would allow providing essential capabilities – guaranteed access to secure satellite communications – to security actors. In Member States, it will support national police, defence and border protection forces, as well as maritime communities. At EU level, it will facilitate the work of EU Agencies and Services, such as FRONTEX, EMSA and ECHO, and enhance the effectiveness of civil protection and humanitarian interventions in the EU and globally. This represents the first activities of the scenario 3 presented in the GOVSATCOM impact assessment.

The *horizontal activities* will be financed through the budget allocated to Galileo, EGNOS and Copernicus. They do not represent any major change with respect to activities already pursued in this MFF which are:

- Support to access to space to cover the launch services needs of the EU programmes and the incremental technical developments and modifications of ground infrastructure in relation to launch needed for the EU activities (with a focus on the first action proposed in the Space Strategy: “aggregating the demand for launch services”).
- Support to space economy (start-ups) in the form of soft measures; for example, facilitate the establishment of space hubs across Europe building on existing capacities and the deployment of a common toolbox of measures such as incubators, accelerators, summer schools in full coherence and synergies with other Union programmes such as InvestEU and Horizon Europe.

- Support to the international dimension of space such as continuing activities to favour the exchange of data, ensuring the presence of the Commission in major international organisations linked to the use of space signal or data.

3.2. Expected impact

Copernicus

The economic, environmental and societal impact of Copernicus has been analysed in a detailed cost-benefit study[24]. The main outcome is that Copernicus is expected to generate € 67 billion to € 131 billion of benefits to the European society between 2017 and 2035. About 84% of the benefits will be generated in the downstream sector and end user segments (the rest in the upstream and midstream). Ensuring the continuation of the programme after 2021 would generate benefits 10 to 20 times the costs.

60% of the European Earth observation downstream companies use Copernicus Sentinel data and 32% use products from the Copernicus services. Copernicus already enables more than 10% of the income of European Earth observation downstream companies. Already now downstream and end user benefits from:

Economic benefits, e.g.

- Increased revenue in the Earth observation downstream sector
- Improved agricultural productivity thanks to smart and precision farming

Environmental benefits, e.g.

- CO_2 emissions saved thanks to increased renewable energy production
- Hectares of forest saved thanks to improved fire prevention
- Biodiversity preserved thanks to land cover-use monitoring

Societal benefits, e.g.

- Life saved thanks to faster response to natural disasters
- Reduced trafficking thanks to improved border surveillance

In the upstream sector the creation of about 12,000 job-years are expected, which represents an average of 1,700 permanent jobs between 2021 and 2027. This comes on top of the 18,000 job-years supported between 2008 and 2020. In the downstream sector the creation of 27,000 to 37,000 job-years are expected.

Additional benefits are non-quantifiable (due to lack of data or high uncertainty) but are extremely important for political decisions:

- The value of European autonomy (non-dependence on third country data sources).
- Very long-term benefits (30-50 years) of observing planet Earth on a sustained and regular basis (with growing important of sustainable development and fight against climate change)
- Cost-savings of having a single EU programme and co-ordinating national initiatives
- Benefits associated with external actions.

[24] Copernicus ex-ante benefits assessment, PwC, Dec. 2017 (not published)

Galileo and EGNOS

According to a the detailed survey by the GSA's GNSS Market Monitor[25], the global market for satellite-based navigation products and services will continue its strong growth, reaching about €250 billion by 2030.

The added value of the European GNSS lies not only in ensuring Europe's independence with regard to a critical technology but also in securing important macro-economic benefits for the European Union, catalysing the development of new services and products based on GNSS and generating technological spin-offs beneficial for research, development and innovation.

Just a few months after declaring Galileo services operational a number of Galileo-ready devices such as smartphones and car navigations hit the mass market. All main chipsets (sold by 17 major suppliers worldwide, representing 95% of the market) that are used in smartphones, tablets, cars, professional survey equipment, etc. use Galileo.

Today more than 100 million user devices enabled for EGNOS and/or Galileo services are in the hands of European citizens, while the shipments of GNSS devices in the European Union is expected to reach the 290 million in 2027, representing a much larger base of users for EGNOS and Galileo. In addition to that, as of April 2018, all new car models submitted to type-approval will have to include an e-call system that is compatible with Galileo.

With transports, telecoms, agriculture and safety being the most affected sectors, it is expected that end users will benefit from:

- a number of new GNSS applications;
- 3,000 jobs in the upstream industry and 50,000 jobs in the downstream industry;
- improved transport services and better traffic management, which will benefit a broader range of areas;
- more efficient and easily accessible emergency services;
- environmental benefits, such as reduction of the CO_2 emissions; and
- improved crop management and sustainable food availability.

Secured satellite telecommunication (GOVSATCOM)

The EU GOVSATCOM will provide crucial capabilities to security actors at EU and national level through guaranteed access to secure satellite communications. It contributes directly to the EU's priorities on security and defence. In Member States, it will support for example national police, defence, border guard and civil protection forces, as well as maritime communities. At EU level, it will facilitate the work of EU agencies, such as FRONTEX and EMSA, and enhance the effectiveness of civil protection and humanitarian interventions in the EU and globally. The impact assessment report for GOVSATCOM was already presented to the Regulatory Scrutiny Board on September 27th 2017 and received a positive opinion.

Space Situational Awareness (SSA)

SSA is a major action to ensure the security of the Space Assets. Indeed, following the steep increase of launches, there has been an exponential proliferation of space debris. According to the data provided by the United States more than 500,000 pieces of debris, or "space junk," are orbiting the Earth and represent a very important threat to the satellites in orbit: despite their limited size (lost screws, nuts, any kind of small parts lost by a satellite), they travel at very high speed (up to 10

[25] https://www.gsa.europa.eu/news/gnss-market-monitor

km per second) which gives them a very significant kinetic energy. They are thus likely to create severe damages to any satellites in case of a collision, potentially leading to a full destruction. The proposed SST actions would encompass funding of SST services provision, and networking and upgrades of existing national SST capabilities, with possible support for development of new SST assets. The objective would be to increase the performance and effectiveness of the EU SST and its complementarity with the US. This will allow the EU to better prevent collisions of satellites with debris and thus offer a better protection of EU assets.

The following impacts for Space Weather and Near Earth Objects are presented for information since the current budget does not allow for a financing of these actions.

Space Weather encompasses different types of events (storms of radiation, fluctuating magnetic fields, and swarms of energetic particles), each of them having a different effect on space based assets or ground assets. All EU assets constituting the basis for EU space actions can be potentially impacted by Space Weather and therefore the development of a framework for Space Weather is necessary to protect them and ensure efficient and reliable services provided by other space activities. The EU space actions are directly impacted by Space Weather events which may distort the navigation signals (GNSS) or the quality of data (Copernicus); ionosphere prediction services allowed by the Space Weather component are key to implement mitigation measures compensating the effects of these magnetic and ionospheric radiations Space Weather services are being developed and coordinated by ESA and some Member States. However, those are mostly focused on science and need to be tailored to meet the operational users' needs. Building on and in complementarity to the ESA and national activities, the EU proposes to support the continuous provision of operational space weather services according to the EU users' needs. This will help prevent damage to space and ground infrastructures.

Regarding Near Earth Objects (NEO), the aim is not to develop new operational services but to map and network the existing NEO assets in Europe and support coordination between EU public authorities concerned with civil protection. This will support federating activities at EU level and thereby strengthening its position towards key international partners.

Horizontal activities

- *Support to the space economy in particular start-ups and market uptake*

The space sector employs over 230,000 professionals in Europe. Aside the major big players (Airbus, Thales, OHB, etc.) are numerous SMEs and a growing number of start-ups, working in very different areas and covering the whole chain of expertise the space industry needs: electronic applications, ad hoc pieces, high technology wires or sensors etc. Every major contract signed within the framework of the European Space Programme provides positive economic outcomes to a huge number of sub-contractors in all European Countries. The role of the European public procurement is crucial to help SMEs maintain their technological advantage, in addition to the business opportunities it creates.

Reaching the objectives identified in the Space Strategy will require a stronger implication of the industrial sector. Because of their greater agility and their easier access to market information, companies can use EU space-based data and information to develop tailor-made applications, reach out to new users, communities and sectors and sell products in international markets. The downstream companies - and in particular entrepreneurs and start-ups - are thus a fundamental link between the EU space actions and their end users. Thus the Commission initiated a "start-up programme", to promote start-up creation and growth in the downstream sector of its space activities. The EU will continue to focus on actions aiming at maintaining the right ecosystem with soft measures like space hubs building on existing capacities (clusters, boosters, Galileo/Copernicus

masters, technology brokers) and the deployment of a common toolbox across such hubs. Additionally, space programmes shall be deployed in such a way so as to broaden participation providing opportunities to new comers. Actions shall be developed in full coherence and synergies with other related Union programmes, notably the research and innovation programme, InvestEU, the internal market programme and European Structural and Investment Funds.

- *Access to space*

The Space European industry is strongly boosted by the launcher manufacturing activity, which is the second largest in the sector just after the commercial satellites manufacturing. Currently, there are three operational launch vehicles guaranteeing access to space for Europe: Ariane 5, Vega and Soyuz. In the present industrial setup, ArianeGroup is the industrial prime contractor for the production of the Ariane 5 launch vehicle, ELV[26] is the industrial prime contractor for the manufacturing of the Vega launch vehicle and the Soyuz launch vehicle is manufactured by the Progress Rocket Space Centre in Samara, Russia.

In 2014 the launcher economy in Europe was estimated at around EUR 2.4 billion. More than 500 European industrial actors participate in the manufacturing chain of Ariane 5 and Vega. According to the OECD, they account for nearly 36,000 employees in the space manufacturing sector in Europe. The launcher manufacturing process includes the production of the core sub-systems (e.g. solid boosters, cryogenic engines, structures, electronics and avionics) and the integration of those sub-systems by the prime integrator.

In line with the crucial strategic objectives of leadership in the space sector, the issue of access to space is key to enable Europe to achieve its objectives.

Access to space consists of all components necessary to ensure transportation of assets from ground to space including space and ground segments in addition to manufacturing and exploitation aspects. As such it constitutes a critical and indispensable capacity for the space sector.

Having a guaranteed access to space means being able to launch satellites and their payloads into space without the risk that a foreign launch service provider places any restrictions on their use. Access to space is therefore strategic for security, defence or institutional needs, as well as commercial purposes.

Maintaining Europe’s capacity to accessing space should remain a strategic priority. This is important to maintain the competitiveness of the European space industry (in its entire value chain), but also to ensure the seamless implementation of the EU programmes for which flexible solutions are needed. The Union is a user of launch services for its space actions and underpins research and technology development for access to space.

In the endeavour to ensure an autonomous access to space and Europe's ability to use it freely and safely, the Space Strategy for Europe outlines the following actions: (i) aggregating the demand for launch services; (ii); supporting European launch infrastructures; and (iii) developing commercial markets.

Under the next MFF, the Commission will focus on the first action proposed in the Space Strategy (“aggregating the demand for launch services”). This will be attained through the establishment of a common set of requirements and procurement rules. According to studies performed by ESA in view of the preparation of the exploitation phase for the next generation of European launchers, the aggregation of Union demand will be a significant enabler of the economic model inducing

[26] European Launch Vehicle is a company established by Avio and ASI (Italian Space Agency)

economies of scale (e.g. 40% cost reduction of Ariane with respect to its predecessor (Ariane 5) or increased performance of VEGA from 1,400 kg to 2,300 kg at Sun Synchronous Orbit without additional charges)[27].

Both the Council[28] and the Parliament[29] have reacted positively to the strategic importance that independent access to space in Europe represents.

- *International dimension of Space*

The success of the EU Space Programme is an essential condition to strengthen the role of the EU in international organisations and ad hoc or specialised forums. The legitimacy of EU to be represented in the relevant multilateral framework (Group on Earth observation, Committee on Earth Observation Satellites for instance) can only derive from clear and continuous success in the different areas of space. The ability of Europe to maintain its autonomy in the space sector, the continuous innovations of its Programme are key factors needed to put Europe in the front scene of the global space community thus enabling Europe to become a key leader in the major decisions taken there (norms, constraints, international agreements etc.).

3.3. Priorities of the EU Space Programme

The priorities of the Space Programme for the coming years derive from the challenges and objectives described above. The priorities are listed below and detailed afterwards.

1/ Continuity of services for Galileo, EGNOS and Copernicus (93.4 % of the allocated budget)

2/ New missions for Copernicus (2.5% of the allocated budget) and evolutions for Galileo (1% of the allocated budget)

3/ New actions: SSA and GOVSATCOM (3.1% of the allocated budget)

Based on the budget allocated in the MFF proposal, most of the funds will be used for the continuity, leaving a minor part for the new mission/evolution and new actions.

The first priority is the continuity of the existing Galileo, EGNOS and Copernicus services. Copernicus, EGNOS and Galileo are all in operational phase. They provide critical data and services, which are used by a variety of public and private companies to provide end-users with new applications and services. To continue providing these data and services, it is essential that the existing infrastructure is operated, maintained (incl. obsolescence management) and secured. New satellites will need to be launched to replace satellites ending their lifespan and the ground infrastructure will need to be maintained and improved as well. The continuity of the services will be accompanied by a streamlining of the governance and the security management, as explained in section 4. This priority represents an increase compared to the current space budget, in 2021-2027 prices, as major investment notably in satellites and launches are mandatory to ensure the continuity of the services. There is no sub-priority within this first priority because GNSS and Copernicus are both key for the European economy and the Member States. By the same token, existing SST services need to continue to ensure a minimal level of protection of EU space assets.

[27] The expected economies of scale are taken into account in the estimated budget for launches for the next MFF
[28] http://data.consilium.europa.eu/doc/document/ST-9817-2017-INIT/en/pdf
[29] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2017-0323+0+DOC+PDF+V0//EN

The second priority, supported by the Space Strategy for Europe process encompassing the latest political imperatives focusing on additional enhancements of existing programmes, is to provide to the end-users new services for Copernicus, addressing the new EU priorities notably in the areas of climate and security. For Copernicus, these are totally new missions implying new investments for approximately 2.5% of the proposed budget. This will ensure a partial implementation of these new missions.

The third priority is linked to new activities:

- To develop Space Situational Awareness activities in order to give the European Union more autonomy and expertise in the field of space hazard prevention and mitigation. Into SSA, the first priority will be to continue and develop SST services at European level. In addition to SST, if additional funds are available, the programme could be completed by initial Space Weather services and, subsequently, by activities in support of Near Earth Object service.
- To provide guaranteed access to secure state-of-the-art satellite communication services for authorised governmental users at EU and national level;

These new activities represent approximately 3.1% of the proposed budget.

The risks linked to the continuity of Galileo, EGNOS and Copernicus services and their evolutions are limited on the basis of several years of experience in implementing these activities. This implementation has proven to be successful as per the conclusions of the related mid-term reviews, confirmed by the continuous delivery of services and data.

Regarding horizontal activities, there is no major risk associated to their implementation as they are cross-cutting activities not linked to specific infrastructure development.

The main risks are related to the development of SSA and GOVSATCOM as they are new activities. Yet, these risks are mitigated since:

- An important part of the SSA activities has already started with the support framework SST (5 years). Lessons learned from the first years of implementation are currently leading to changes in the structure and implementation of the programme (governance, decision-making process etc.). The new regulation will take into account these necessary changes in order to reduce the risks of non-achievement of the objectives.

- The GOVSATCOM initiative is planned to be gradually implemented in order to allow enough flexibility and adjustment to evolving demand and needs. In addition with the expertise of the EU in the field of space actions management, this will allow, together with the modularity of the initiative, to adjust its scope in order to avoid, for instance any oversized procurements.

3.4. Basis for EU intervention (legal basis, subsidiarity and proportionality check)

Article 189 TFEU is the main basis for the Union's competence in the area of space policy. It is a shared competence with the Member States.

Developing and operating a Space Programme exceeds the financial and technical capacity of individual Member States and can only be achieved at EU level. There is no viable business case for the commercial sector and no possibility for any individual Member State to build and operate the necessary infrastructures. No Member States could have achieved on its own the development of the GNSS and Copernicus infrastructures and services. It is the role of the European

Union to ensure the development of EU-wide space infrastructures and EU-wide space-based services to the benefit of all.

The current model for space navigation being a free access to the satellite signals, no private investor would invest in a global navigation system, in particular in view of the existence of two major competitors (US GPS and Russian Glonass) which offer completely free access to data for all users. This is illustrated by the inability of the originally designed Private Public Partnership to successfully develop the original GNSS European Project in the 1990s, resulting in the EU investing in this public critical infrastructure.

Furthermore, the global costs of such a constellation (satellites and ground infrastructure, including their renewal and improvement) are too high for a single Member State of the EU. The implementation at EU level of Galileo and EGNOS has brought a high added value compared to what could have been achieved by the Member States at national, regional or local level. The size and complexity of the programmes require implementation at EU level, as no viable alternative exists to ensure an appropriate return on investment. Stakeholders agree that the continuation of the programmes implementation at EU level is a condition for the achievement of the Galileo and EGNOS objectives, allowing a proper allocation of both budget and technological knowledge.

Galileo and EGNOS are critical European infrastructures that contribute to a safe and secure Europe. They also promote a stronger Europe on the global scene. Given the increasing competition with other satellite navigation systems (all State-owned), it is crucial that Europe develops and sustains its own systems to remain a world-class actor in space and a partner of choice on the international scene.

Copernicus is building a competitive European capacity to deliver actionable geo-intelligence for civil protection and civil security, as well as Earth observation-based services and applications, to support the protection of the environment. The customers for the delivered data were initially thought to be the public sector. Afterwards as the data exist, it was decided to provide them for free to the private sector to boost their use and the related added value for the EU economy. For this programme, as described above for satellite navigation systems, the private sector will not take the risk of investing in large infrastructure for a single customer (the EU) who will then provide data for free. Copernicus offers a public sector service which is not catered for by the market (e.g. systematic environmental monitoring) and for which industry will not deploy infrastructure because the initial investment is too high, too risky, or the user base is too fragmented (problem known in economics as a coordination problem): no company will, for instance, build a CO_2 constellation for reasons other than public sector demand. The availability of such data, should it be left to the private sector alone, would thus remain uncertain, with the additional consequence of not owning the relevant assets.

Another point is the time scale of such a programme: in addition to data from Copernicus programme being currently used, large amounts of data are being stored every day for a future use in the long-term (10, 20, 50 years; possibly longer) in the context of environmental and climate monitoring. These future uses will depend on the improvement of data analytics technologies and the knowledge in sustainable development that will have been built up by then. These types of investments are often of a public nature as they remain too risky for the private sector, and address areas where return on investment is too long-term (in particular, they are outside the satellite lifetime during which private operators need to redeem their investments).

Additionally, Copernicus, with its free, full and open data policy enables the development of new and unforeseen applications in a large number of sectors and policy areas. This includes, in particular, Europe's role as a global player in the international domain. In that regard, Copernicus is a public good, in the same way as transport or energy networks. The ownership of satellites is in the long-term the best way to implement and maintain the objective of a free, full and open data policy,

since the EU will not depend on the will of a private operator to invest in a constellation of satellites to provide data (risk of monopolistic situation of a private data provider).

Overall, the set-up of a Europe-wide space data ecosystem (i.e. further improvement of the efficiency of overall investment into space) requires to have "basic and steady" reference missions around which others (MSs, private companies, Private Public Partnerships) can build their missions as a complement without needing to invest in these mutualised resources. As previously stated, no Member States or private company has the financial capability to build projects of that size alone. Furthermore, the pooling of resources at EU-level is a clear source of cost efficiency compared to the cost of multiple national major space actions.

In short, regarding Copernicus and EGNSS, the timeframe for investment and the uncertainty of sufficient revenues imposes a public financing.

In a similar manner, SSA and GOVSATCOM are on their own unaffordable to be financed at national level. There is a further benefit of pooling resources and assets at EU level.

Furthermore, actions and programmes relating to space require active cooperation and coordination of national and/or international capacities (e.g. national in-situ contribution to Copernicus or pooling and sharing of national infrastructures such as MS-owned satellite communication capacities).

The envisaged EU Space Programme is considered to be proportionate as it is limited to those aspects that Member States cannot achieve satisfactorily on their own, and where the Union can do better. The strong support from Member States for the Space Strategy shows that Member States consider the elements of the Space Programme as essential.

4. DELIVERY MECHANISMS OF THE INTENDED FUNDING

4.1. Similarities and differences of the EU space actions

The EU space actions have similarities, but are also sufficiently different in key aspects to demand tailored delivery mechanisms – one size does not fit all.

The similarities are in particular the funding by EU budget, resulting at least in part in EU owned assets. The Commission, as executive arm of the EU is ultimately responsible for the implementation of the budget and is the overall programme manager. All EU programmes are user-driven: the objective is to provide space enabled services to citizens, businesses and public entities, creating added value to society and economy. Although different models have been tested and discussed, so far, all services based on the EU space infrastructure are free of charge. Free-of-charge services considerably simplify delivery of the services, have the highest positive scale effect, enable take-up by SMEs with limited investment capacity, by the scientific community and by individual users, and contribute to solidarity between MS, especially for services related to security and disaster management.

Currently, EU space programmes are delivered by a mix of actors: the Commission (including executive agencies and JRC), decentralised Commission agencies (e.g. GSA, FRONTEX, EMSA, EEA), Council agencies (e.g. SATCEN), Member States, non-EU states, and intergovernmental organisations such as ESA or EUMETSAT. Finally, the private sector plays an important role by building space and ground infrastructure and in some cases operating them and providing services.

The differences between the EU space actions are visible when analysing different dimensions. In terms of infrastructure investment, ownership and operations in the case of Galileo all infrastructure (space and ground) is owned by the EU; the space infrastructure of EGNOS (payload on

communication satellites) is managed by a long term service level agreement with a private operator; for Copernicus the supply is managed by a mix of EU owned satellites operated by ESA or EUMETSAT, commercially procured data, and data provided by Member States or other international partners; SST relies on information coming from MS owned and operated assets, in some cases by the military. GOVSATCOM will rely on existing, security-accredited national and commercial Satellite communication capacities, and provide the services to authorised users for free. In terms of services major difference exists between services which are unlimited (Galileo, Copernicus), and services based a resource that is by its nature limited, such as satellite communication bandwidth. Additionally, the types of services, targeted user communities and delivery mechanisms are different for Galileo (geo-location services requiring compatible devices) and Copernicus (user- and science-driven services generating large quantities of data). The service provider may be public (e.g. EU agencies in the case of Copernicus) or private, such as in the case of EGNOS. In terms of users, an important distinction needs to be made between open use (e.g. Copernicus, open Galileo Signals) and applications that are restricted to a specific group of governmental users (Galileo PRS, GOVSATCOM, Copernicus Security Service). Security aspects also vary widely: GOVSATCOM, SST and Galileo-PRS are security-driven, whereas parts of Copernicus have a limited link to security aspects.

In the last decade different governance models have been used for the delivery of Copernicus, Galileo, EGNOS and SST. Galileo started as a public-private partnership, with its dedicated implementing body, and only became an EU programme in 2007, when the implementing role was conferred partly to the Commission, and partly to GSA and ESA. JRC and ESA were at the origin of Copernicus and still play an important role in the provision of some of the Copernicus data and services. At a macro level an important difference exists between the Galileo model, where more and more functions are concentrated in the GSA, which then contracts implementing tasks to the private sector or to ESA, and the Copernicus model, where the Commission directs a distributed implementation, delegating space segment matters mainly to ESA and partially to EUMETSAT, and diverse service implementation tasks to a multitude of relevant EU agencies and qualified operators.

4.2. Delivery mechanisms strands

Taking into account the specifics of the different activities, the delivery mechanisms of the EU Space Programme will revolve around ensuring coherence and synergies, and allowing for simplification and flexibility.

Simplification and flexibility

As pointed out in some lessons learned and recommendations (see section 1.2, sub section GNSS p12), governance simplification, mostly on GNSS, will occur by streamlining the management of the implementation of the actions and the role of the main stakeholders (Commission, GSA, ESA and Member States), bringing coherence and synergies. It also responds to the stakeholders concerns (p15).

More concretely, the different actors in the governance will have the following responsibilities:

(i) The Commission will be responsible for:

- The implementation of the Union's Space policy, the management of the EU Space Programme and of the related actions (Galileo, EGNOS, Copernicus, SSA and

GOVSATCOM) - including the specific support activities linked to access to space, international cooperation and space economy;
- The definition of the broad lines of the Programme;
- The definition of the main requirements for the establishment and evolution of the services offered by the space actions;
- The supervision of its implementation in particular in terms of costs, schedule and performance, including for funds and tasks entrusted to other entities;
- the definition of high-level security and policy objectives of the actions and the supervision of their implementation.

The Commission will thus establish the appropriate instruments and structural measures necessary to identify, control, mitigate and monitor the risks associated with the Programme.

The Commission will be responsible for ensuring a clear distribution of tasks between the various entities involved in the EU Space Programme and the coordination between these different entities.

(ii) GSA will be responsible for:

- The exploitation of Galileo and EGNOS (as delegated tasks);
- The operation of the Galileo security monitoring centres;
- The tasks linked to the security accreditation for all the space actions (currently only for Galileo);
- The activities linked to the communication, promotion and marketing of data and information activities with regard to the services offered by all the components of the EU Space Programme ("market and user uptake") currently performed only for Galileo and EGNOS;
- The management of the intellectual property rights.

Furthermore the regulation will open for the GSA the possibility to implement other tasks in support of all space activities. For example, in case of crisis management missions and operations, the GSA could be responsible for the overarching coordination of user-related aspects of GOVSATCOM in close collaboration with relevant Union agencies and EEAS

Simplification and streamlining come from the following:

- All the security accreditation for all the space actions will be dealt by GSA based on the experience acquired with Galileo. This is an important governance aspect of the EU Space Programme considering the need to secure the infrastructure and provision of services.
- The user uptake activities will be centralised in the GSA for all the space actions while in the past these responsibilities were split between the GSA (for GNSS) and the Commission (for Copernicus).

In order to carry out all these activities, GSA would need more staff (+83 staff, mostly linked to security matters, to reach a total of 287 Full Time Equivalent, 216 Temporary agents and 71 contractual agents) and a higher subsidy from the Commission to cover these costs.

(iii) Subject to adaptations to its internal decision making process allowing for the protection of EU interests, ESA would be entrusted with the same tasks as today: notably Research & Development and evolution parts of the space infrastructure, the GNSS space and ground segments and the space segment for Copernicus. The relations with ESA will be streamlined under a single financial framework partnership agreement with the Union (as it will be defined in the Financial Regulation), defining a set of common principles and rules while today several delegation agreements and

working arrangements with different implementation rules have been signed with ESA by the Commission and the GSA.

(iv) Synergies with national space agencies and their existing programmes will be reinforced, notably through contribution agreements, Public-Public Partnerships, shared management and joint initiatives to promote the uptake of the space-based applications or to support competitiveness and entrepreneurship.

Coherence and synergies in dealing with the European Space Agency

The technical tasks of ESA will remain unchanged but the legal instruments used to allocate the tasks will be streamlined. This is linked to the lessons learnt on simplification of the governance (p12-13).

Since the beginning of the European investment in space infrastructures and related services, tasks have been delegated by the Commission to ESA and, subsequently for GNSS, working arrangements have been signed between GSA and ESA. This approach was effective with regard to the control means that were set-up by the Commission for each of its programmes Copernicus or GNSS. For the next period, the objective is to harmonise for the two programmes the working framework with ESA.

As already mentioned above, a common financial framework partnership agreement will be negotiated with ESA which will be applicable subsequently to all contribution agreements. This approach will allow a reduced time of negotiations for each specific agreement, provide a common set of rules for each programme in terms of internal governance, reporting, procurement schemes etc., clarifying the role and responsibilities, taking into account the lessons learnt and experience under the EU/ESA agreements concluded in the 2014-2020 MFF.

Coherence and synergies in relationships with Member States and National Agencies

The EU Space Programme will continue to be based on the subsidiarity and proportionality principles since it will deploy infrastructure and services of shared European interest, which cannot to be implemented at national level alone. The EU Space Programme will include operating space infrastructures, i.e. satellites and associated ground systems, in order to provide public services, such as Copernicus data and services; navigation signal and time stamps by GNSS; future secure satellite communication service by GOVSATCOM; as well as information needed to protect satellites from collisions with space debris in SST. Moreover, in the development of a digital society, the space data will be the main infrastructure on which other services will be built upon, with an increasing use of Big Data and artificial intelligence. In this sense the EU Space Programme invests in and maintains public infrastructures, with all related governance and delivery challenges inherent to the sound and efficient management of such infrastructures[30].

Appropriate interfaces with relevant national infrastructure are essential for an effective overall European ecosystem of space infrastructure and services. In particular, synergies with national space agencies and their existing programmes will be reinforced: Member States have adapted their own national programmes to complement the EU investments focussing on national needs and

[30] See also OECD Report to G20 Finance Ministers and Central Bank governors, September 2015, titled 'Towards a framework for the governance of public infrastructure'.
http://www.oecd.org/daf/ca/Corporate-Governance-Principles-ENG.pdf

national priorities. Vice versa, MS will continue to provide critical infrastructure, data and expertise to the EU Space Programme. Thus there is now a strong interdependence of Member States and European space activities and investments, the EU Space Programme is becoming the keystone of the overall architecture.

In order to enhance and streamline all potential cooperation, additional delivery mechanisms including Public-Public Partnerships, shared management and joint initiatives will be considered for developing activities in the space sector to support competitiveness and entrepreneurship.

Coherence and synergies in the field of Copernicus data treatment

Continuity is at the centre of the proposal which is strengthening (and not reinventing) the structure on the basis of the lessons learnt.

The revised structure of Copernicus stresses this continuity and integrates the lessons learnt from the mid-term review and evaluations (see section 1.2 sub section Copernicus p12 to 13) by reflecting the data value chain: 1) Space infrastructure and data acquisition; 2) Public services (existing Copernicus services); 3) Data distribution and access; 4) User uptake (maximising the socio-economic value of Copernicus by integrating it into different policy areas and economic sectors).

In particular, the updated structure responds to the identified challenges relating to making available huge data volumes available and facilitating their uptake by different user groups:

- Space infrastructure and data acquisition: this will not be changed and will be treated by ESA.
- Public (Copernicus) Services: this will not be changed and will be treated by the best available know-how expertise in Europe in the respective domains.
- Data dissemination and access to data (conform to relevant EU legislation[31]): will address the distribution of data to users and making it available in a cloud-based environment (i.e. without the need to download). This element is given more visibility and strengthened by moving it from the space infrastructure part of the programme – where it is currently – to a dedicated strand of actions since it is more an ICT than a space-related challenge. Implementation (strengthened in scope and ambition) is expected to be carried out by ESA and EUMETSAT as is currently the case and linked to the European Open Science Cloud.
- User uptake and communication: it is currently foreseen that this would be transferred from direct management by the Commission to the GSA which already deals with these activities for Galileo.

Coherence and synergies in the field of security accreditation

The security aspects of EU Space infrastructure are currently well taken into account but differences remain, in particular in the field of security accreditation and monitoring. In order to ensure coherence in the approach and based on a recommendation of the GNSS mid-term review (see section 1.2 sub section GNSS p12-13), it is proposed that the GSA manages the Security Accreditation Board which would support not only Galileo, as it is the case at present, but also EGNOS, Copernicus, SSA and GOVSATCOM infrastructures as appropriate. This would ensure a

[31] e.g the 2007/2/EC INSPIRE directive and implementing regulations.

common approach, consistency in the security procedures and norms for all the space activities, making the processes of accreditation smoother and quicker, subsequently allowing also a better follow-up of the security issues. It responds to the lessons learned and stakeholders concerns (p15).

The common principles of the security governance, based on the experience gained so far with Galileo and the lessons learnt and recommendations of the mid-term review, will be the following:

1. The EU space actions aim at reaching a high level of security which shall be appropriate to mitigate the threats resulting from the use of their infrastructure.
2. The main security objectives of the EU space actions are to:
   - Protect the space systems (including ground stations) deployed in the frame of the programmes;
   - Protect the services provided in the frame of the programmes;
   - Protect the know-how required for the functioning of the programmes and their international competitiveness.
3. The responsibility for the security should be integrated into, and be coherent with, the overall management of each space action.
4. Security accreditation for all space actions will be carried out via an independent Security Accreditation Board (SAB) with Member States' representatives. Appropriate mechanisms will ensure the independent operation of the Board.

Coherence and synergies in the field of access to space

Regarding access to space, a common approach is key for the European space actions. The definition of a coherent European launcher policy is necessary to strengthen the European industry, sustain its autonomy in this area of expertise and, by creating long-term committed demand and therefore economies of scale, allow the European space actions to benefit better financial conditions. The mechanism would be the aggregation of access to space demand (costs and cost evolution mechanism, launch manifest, information process etc.) and presenting options, to be activated when a specific launch is necessary according to the needs of each action. It is to be noted that this does not request any additional funds as the launchers are anyway budgeted within the GNSS and Copernicus activities to ensure the continuity of services. This replies to the common lesson learnt on Copernicus and Galileo (see section 1.2) to aggregate the request for launch.

Both the Council and the Parliament have reacted positively and specifically to the strategic importance that independent access to space in Europe represents.

The aggregation of demand will enable an improved financial planning (e.g. reducing the time and complexity of each launch service negotiation, enhancing launch manifest and back up options operations) of the EU Space actions; it will further provide the European launcher industry a better visibility of EU access to space needs with the intention to foster its competitiveness.

Summary of governance changes

The governance model proposed for the next financial period builds on the current framework, whilst taking advantage, where appropriate, of synergies, notably as regards security.

As regards the role of the GSA, it is proposed to build on its experience on security accreditation for GNSS to make it responsible for the security accreditation of all Space actions (Galileo, EGNOS, Copernicus, SSA, and GOVSATCOM).

As regards the cooperation with ESA, the objective is to streamline the current framework. Today several delegation agreements and working arrangements with different implementation rules have been concluded with ESA. It is proposed to establish with ESA a framework financial partnership agreement covering all actions, to allow for coherence in the implementation of activities by ESA. The tasks performed by ESA should remain the same.

5. HOW WILL PERFORMANCE BE MONITORED AND EVALUATED?

5.1. Monitoring based on indicators

The monitoring of the space actions will be done through a set of indicators adapted to each of them. The regulation should mention the need for indicators. These indicators will be developed as per the future negotiations for the contribution agreements and in defining the supervision of programme implementation. Several indicators are already identified, regularly monitored and have been evaluated during the mid-term evaluation for the established space actions (Copernicus, GNSS). It is expected that most of these indicators will be maintained and also used as a reference for the new programmes. Additional specific targets will be defined as appropriate at programme implementation level. High level indicators measuring the overall Space Programme performances could be defined as below.

OBJECTIVES	***POTENTIAL EXAMPLES OF INDICATORS***
Ensure the continuity of the existing space infrastructures and services, and the development of new or enhanced ones.	Number of satellites deployed (GNSS) Percentage of availability of the signal (GNSS) Accuracy of the signal (GNSS) Number of Airports equipped with EGNOS LPV[32] system Services availability (Copernicus, SST) Increase in volume of the data provided (Copernicus) Addition of new services (Copernicus) Number of users Users' satisfaction
Foster an innovative European space sector that can compete globally	Number of applications based on Galileo signal Number and volume of products downloaded (Copernicus) Number of companies providing earth observation related services (Copernicus) Data availability or integration into geo-information services (Copernicus) Use of data by non EU countries (Copernicus) Number of patents in EU Growth in the downstream sector related to the Space actions Number of space-related new applications in EU Number of research projects related to EU Space actions Number of international agreements and working arrangements World coverage of services and data

[32] Localizer performance with vertical guidance

Maintain the EU's capacity to have autonomous access to space and use it safely	Number of launches for EU Space actions Services availability Users' satisfaction Number of users

Detailed indicators taking into account the targeted applications will be further defined. In the field of aviation for instance, some indicators could be developed to compare the performance in terms of reduction of flight delays and cancellations of these airports with the ones of those airports not adopting the same technology etc. For Copernicus, indicators linked to new services or products answering emerging needs could be developed. New indicators are likely to be developed in the coming years, depending also on the level of integration reached between the space actions and other programmes of the Commission, for instance in the fields of intelligent farming, urban monitoring etc. In addition, where indicators cannot be easily defined or measured, ad hoc case studies or ex-post evaluations could allow measuring the economic, societal and environmental benefits for different types of users.

Information to establish the indicators are to be obtained from the various stakeholders involved in the implementation of the Space Programme, in particular (but not only) the different entrusted entities for which the contribution agreements will foresee data collection, monitoring and reporting.

The current delegation agreements with the ESA (Copernicus and GNSS) and GSA (GNSS) already foresee an important number of indicators to be collected; the future agreements will be similarly written and will detail the exact framework of the monitoring of the programmes:
- Precise definition of indicators;
- Frequency of submission.

The current submission of the different indicators is related to the submission by the different agencies of their quarterly reports, it is planned that the future submissions will follow the same time frame.

Member States as well will be called to contribute to this exercise, especially for areas under their direct or indirect responsibility, for instance, the in-situ data gathering or compliance with other relevant programmes, like INSPIRE.

5.2. Evaluation reports

The evaluation of the performance and efficient implementation of the Space Programme will be based on mid-term evaluations to be conducted separately for each action to measure their achievements, in line with the Better Regulation Guidelines i.e. in terms of effectiveness, efficiency, coherence, relevance and EU added value. Also in the coming years, a detailed plan for ad-hoc evaluations will be set-up in order to provide the programmes with focused studies.

These mid-term evaluations will likely to be conducted in the middle of the next MFF, probably in the course of 2023 or 2024. This period is in line with the timing of the evaluations conducted in the previous 2014-2020 MFF for GNSS and Copernicus. This timing will allow enough hindsight, which is necessary for programmes with such a long-term time scale.

The timing and process of these evaluations will be managed by the European Commission, potentially with the help of external consultants for the gathering of data, ad hoc studies and interviews, consolidation of information and creation of specific models.

Annex 1: Procedural information

1. Lead DG(s), D*E*cide Planning/CWP references

DG GROW

2. Organisation and timing

The first meeting related to the Impact Assessment for Space was held by the Inter Service Steering Group (ISSG) on February 7th, 2018.

This meeting was dedicated to the explanation of the context of the future MFF preparation, the expected outcomes of the IA and the current state of play of the preparation of the IA for Space together with the expectations of the other DGs towards the EU Space Programme.

The DGs involved in this meeting were:

SG (chair)

GROW (lead for Space Programme)

AGRI, BUDG, CNECT, EPSC, ENV, HOME, JRC, LS, MOVE, RTD, EEAS

The second meeting of the ISSG Space took place on March 19th, 2018 for a review of the draft Impact Assessment of the Space Programme.

The SG had provided a number of suggestions beforehand and summarised these points during the meeting, DG GROW confirmed that it would amend the document accordingly and explained in parallel the key messages of its Impact Assessment. Invited DGs then commented on the document.

The DGs involved in this meeting were:

SG (chair)

GROW (lead for Space Programme)

LS, BUDG, AGRI, CLIMA, ECFIN, ECHO, ENV, EPSC, HOME, JRC, RTD, EEAS

3. Consultation of the RSB

An informal upstream meeting was held on January 26th with RSB representatives and the participation of SG, DG BUDG and JRC. During this discussion Board members and representatives of the Commission horizontal services provided early feedback and advice on the basis of the Scoping Paper. Board members' feedback did not prejudge in any way the subsequent formal deliberations of the RSB.

A draft version of the impact assessment was presented to the Regulatory Scrutiny Board on 11 April 2018. The RSB issued a negative opinion on 13 April 2018. Subsequently, the draft report has been amended considerably in order to take into account the recommendations for improvement, as explained in more detail in the table below.

RSB recommendations – First opinion	How have the recommendations led to changes to the report?
(B) Main considerations	
The Board understands that the political intention is to consolidate into a single programme all space-related activities, to ensure the continuity of the existing space infrastructures and services, and to achieve improvements without substantially increasing the budget. The Board gives a negative opinion, because the report contains important shortcomings that need to be addressed, particularly with respect to the following key aspects: (1) The report does not prioritise across the challenges and actions to address them. It is unclear how much the new programme aims for continuity vs proposes significant changes. It is not clear what the support for the European launcher sector would imply in terms of new initiatives or spending. (2) The report leaves unclear how numerous governance challenges will be addressed, e.g. transformation of the Global Navigation Satellite Agency into an EU Space Programme Agency. It is also not clear how e.g. pooling of tasks would result in a more efficient governance structure.	(Introduction) - The document reflects that all space activities are consolidated into a single overarching programme, including sectorial and cross-cutting activities [as summarised in Chapter 1, under "Scope of the impact assessment"]. - Regarding the budget, the revised document includes the share of each action as a % of the overall budget covering all proposed actions [now under Chapter 3, *"Proposed scenario"* – describing the structure of the proposed programme]. (Point 1) - The major challenges are clarified; the text includes a differentiation between challenges coming from political and global developments and those based on lessons learned from existing programmes. [in Chapter 2, under "Challenges for the programmes of the next MFF"] - The links between the specific objectives and the challenges are better described [in Chapter 2, under " Objectives of the programmes of the next MFF"] - Priorities are better highlighted in case the budget allocated to the programme does not allow covering all actions [in Chapter 3, under "Priorities of the EU Space Programme"] - Continuity versus significant changes is emphasised in the description of the *"Proposed scenario"* [now under Chapter 3]. - The activities in support of the European launch sector are clarified; the main focus is on aggregating the demand for launch planned for Galileo and Copernicus. The associated budget is already included in the budget necessary for the Galileo and Copernicus infrastructures [Chapter 3]. (Point 2) - The evolution in the role of the GSA (Global Navigation Satellite Agency) and its transformation in an European Union Agency for the Space Programme (the exact name is under discussion) and improvement in governance are clarified in the presentation of the delivery mechanisms [Chapter 4].

(C) Further considerations and adjustment requirements	
(1) The report does not present a hierarchy or prioritisation among the numerous policy and governance problems. It should therefore discuss the key lessons from past experience and single out the most important, critical or urgent ones. In addition, it should identify the major challenges for the horizontal and for the specific Space actions.	[improved text of Chapter 2, under "Challenges for the programmes of the next MFF"] - The major challenges are clarified; the text includes a differentiation between challenges coming from political and global developments and those based on lessons learned from existing programmes. - Most major political challenges apply to the entire Space Programme, the main exception being the support to COP21 and climate change monitoring which is primarily related to Copernicus. - In the revised text, challenges linked to lessons learned are clearly related to the existing activities (Galileo, Copernicus, and SST).
(2) The revised objectives need to reflect the numerous lessons learned and the challenges identified in the evaluations, consultations and elsewhere.	[improved text of Chapter 2, under " Objectives of the programmes of the next MFF"] - The wording of the specific objectives has been modified to improve clarity. - The links between the specific objectives and the challenges are better described.
(3) The report should clarify whether this initiative essentially aims at ensuring continuity or whether it strives for an expansion of EU space activities. Against this background, it should clearly highlight the most important changes in terms of priority actions, magnitude, delivery mechanisms and governance. In addition, it should identify related risks.	[improved text of Chapter 3, "Programme structure and priorities"] - Continuity versus significant changes is emphasised in the description of the *"Proposed scenario"* and proposed activities are better described. - Priorities are further highlighted in case the allocated budget does not allow covering all actions. - Major risks are related to the development and implementation of new activities (see end chapter 3.3).
(4) In terms of improved governance of the EU space programme, it should clearly spell out which (new) tasks could be pooled horizontally. It should also clarify which would better remain with the specific programmes. It should demonstrate how this transformation of governance will lead to simplification rather than to more complexity.	[improved text of Chapter 4, "Delivery mechanisms of the intended funding"] - Clarification of changes made to the governance - Pooling of activities under the umbrella of the GSA is clarified (it concerns essentially security accreditation & actions linked to market development).

It should also show that the envisaged programme structure with one horizontal and five specific regulations creates sufficient flexibility in the implementation phase.	- It was finally decided to propose a single Space Programme regulation, taking into account common rules and the specificities of each action.
(5) The report should provide a stronger analysis of the support for the European launcher sector as well as of the intended transformation of the Global Satellite Navigation System Agency into a European Space Programme Agency. The Board notes that this impact assessment will eventually be complemented with specific budgetary arrangements and may be substantially amended in line with the final policy choices of the Commission's MFF proposal.	[improved text of Chapters 3 and 4] - The report includes clarification on activities in support to European launcher sectors (beside the aggregation of demands for launches). - The rationale for modifying the role of the GSA is better explained. - The report includes some indication of budget needed for the proposed actions.

A second draft version was sent to the Regulatory Scrutiny Board on 25 April 2018. The RSB issued a positive opinion on 3 May 2018 with a recommendation to further improve the report with two key aspects. Subsequently and in line with the instruction to take these comments into account prior to launching the Interservice Consultation, the draft report has been amended, as explained in the table below:

RSB recommendations – Second opinion	**How have the recommendations led to changes to the report?**
(B) Main considerations	
The Board gives a positive opinion, with a recommendation to further improve the report with respect to the following key aspects: (1) The report does not sufficiently explain the balance in the programme between ensuring continuity versus expanding activities. (2) The division of responsibilities between the new GSA and the Commission, as well as its budgetary implications are not sufficiently clear.	These two recommendations have been taken into account and the report has been revised accordingly. A more precise description of these recommendations and of the related changes in the report is provided below in this table. (1) [improved text of Chapter 3] The budgets have been clearly identified, providing in particular percentages of allocation for each action and specifically indicating the allocation between continuity and expanding activities. (2) [improved text of Chapter 4] The division of responsibilities was clarified by adding for both the Commission and the GSA more tasks, as currently planned by the regulation. These changes are visible in the chapter 4.2, part Simplification and Flexibility.
(C) Further considerations and recommendations for improvement	
(1) Notwithstanding useful clarifications made in section 3.1, the report is still unclear about the programme's balance between	[improved text of Chapter 3] The impact of the budgetary allocation proposed by the Commission has been taken

continuity and expansion. The impact assessment should provide more clarity on whether with the budgetary allocation proposed by the Commission, the new Space Programme will allow for new activities beyond ensuring continuity, and if so, which activities. It is also suggested to include the table with the information on the baseline scenario from the explanatory note into the main text.	into account in this revised version to explain, together with specific percentages for each action, the clear balance between continuity and expansion/new services. The suggested table has been added in the text as well as a table showing the allocated budget under the Commission proposal for the next MFF.
(2) The main/general objectives of the EU space policy have been introduced in the report. However, the specific objectives remain at a rather general level and two of the specific objectives (i.e. foster innovative space sector, autonomous access and security) seem to largely overlap with two of the general objectives. These overlaps should be addressed. It would also be useful to further explain the links between the specific objectives and challenges identified earlier in the report.	[improved text of Chapter 2] Additional information has been inserted in the two specific objectives mentioned in order to provide more clarity and better distinguish them from the general objectives.
(3) The report elaborates on the new tasks of the GSA and on the rationale for transforming the existing GSA into an EU agency for space. However, the report should explain in more detail the precise division of responsibilities between the Commission and the new GSA and the implications of this transformation. It should also clarify the budgetary implications of expanding the GSA's responsibilities.	[improved text of Chapter 4] The respective roles of the Commission and of the GSA and the related division of responsibilities have been more clearly described in the paragraph 4.2 “Delivery Mechanism Strands”, in the part “Simplification and Flexibility”.

4. Evidence, sources and quality

This Impact Assessment is based on the different consultations, studies and evaluations performed within the framework of the Space Programme. The stakeholder consultations are described in the Annex 2 whilst the evaluation results are described in the Annex 3.

Annex 2: Stakeholder consultation

There have been a number of consultation activities supporting the preparation of this impact assessment. The first round of consultations took place for the **preparation of the Space Strategy for Europe** which led to extensive consultations from various stakeholders that concluded to the importance of space for the European economy and the need to pursue the efforts at EU level. Additional specific consultations were launched and analysed to complement these findings. The major consultations are listed below:

- 2016: a major public consultation across all space aspects including the programmes proposed at present for the next MFF (i.e. thematic priorities such as GNSS, Copernicus, satellite communication, space situational awareness and horizontal ones such as launcher policy and space research) was undertaken by the Commission prior to the adoption of the Space Strategy for Europe. The public consultation closed on 12/07/2016[33] (see appendix A).
- 2015, 2016: two targeted consultations were undertaken for space research aspects including position papers by Member States, major industry trade associations and research organisations.
- 2015-2017: numerous dedicated workshops, meetings and reports at expert level have been held to consult stakeholders on: (i) the evolution of Copernicus and Galileo; (ii) specific needs of industry; (iii) specific needs on governmental satellite communications; (iv) specific needs on space situational awareness including Space Surveillance and Tracking, Space Weather and Near-Earth Objects.
- In 2016-2017, as part of the impact assessment for the future GOVSATCOM programme, targeted consultations were carried out with all relevant stakeholders – Member States in their quality of GOVSATCOM providers and users, EU Institutions and Agencies, and Industry including satellite manufacturers, operators and SMEs – trough bilateral contacts and plenary meetings. Most MS and industry clearly support the program and its objectives. Stakeholders' recommendations, in particular for strong security, aggregation of demand, reliance on national and commercial suppliers, civil-military synergies and a modular service-centred approach were integrated in the proposal.
- 2016-2017: targeted consultation of stakeholders through surveys and workshops organised in the context of the interim/mid-term evaluation studies of the existing programmes (Copernicus, Galileo/EGNOS, Horizon 2020 space).

Key messages

Copernicus

Copernicus is producing tangible results: the programme has already met some major expectations to support the European autonomy in the provision of high quality data and its exploitation for institutional and commercial purposes. The huge amount of data it

[33] https://ec.europa.eu/growth/content/public-consultation-space-strategy-europe-0_en

generates, coupled with advances in ICT and cloud computing, create business opportunities in many sectors of the economy and across EU Member States.

The Copernicus space component, including the ground segment is at a mature stage, but the data dissemination system has room for improvement. The Copernicus services are appreciated by the users regarding product relevance, timeliness of delivery and availability of products. The in-situ component has demonstrated good results with an increase number of users and the production of a wider catalogue of datasets.

The open data policy is a strong asset of the programme and the programme management is working efficiently. The Copernicus objectives are still appropriate and additional ones should be addressed (e.g. CO_2 emissions, polar zones, cultural heritage preservation etc.) There is a good level of coherence internally and with other EU actions and good complementarity of the different European and national entities in the management of the programme. EU action is providing considerable added value above what could be achieved at national level.

Recommendations: continuity and developments.

Access to Sentinel data and integration of various data sources could be improved (the data information access service – DIAS – now addresses this issue). In selecting suppliers for contributing missions, the European Commission should give preference to European actors, provided they match other suppliers in terms of relevance of data. Cohesion can be improved through awareness-raising and the development of networks. The user requirements gathering process could be made more robust with a stronger involvement of targeted communities. Communication and user uptake activities need to be expanded beyond specialist communities. This could be done through a greater coordination among entrusted entities to better communicate about Copernicus services and to foster user uptake. Stronger awareness of the development of the downstream, market and applications at national and regional level could also be beneficial.

GNSS

The importance of European satellite navigation services for the European economy and security is clearly recognised by all stakeholders[34].

Considering all the difficulties faced by the EGNSS as a "first of a kind" project for the EU, and thus as the first complex industrial programme implemented by the EU, the programme has shown a satisfactory level of effectiveness. There is globally a sufficient level of satisfaction from stakeholders with respect to the implementation of the EU intervention logic (i.e. identification of problems and needs, definition and establishment of objectives, identification and implementation of actions, achievement of expected impacts) and the achievements of the programmes during the evaluation period; stakeholders are also confident about the planned developments in the coming phases.

The effectiveness of the programme has been particularly evident in the achievements of Galileo's space segment. As for EGNOS, the programme has consolidated the stability and high performance of service provision with the declaration of the LPV-200 service and the provision of APV-I services over the 98,98% of the land mass of the EU Member

[34] Mid-term review of the Galileo and EGNOS programmes and the European GNSS Agency, PwC France study, June 2017, EU Bookshop: https://publications.europa.eu/en/publication-detail/-/publication/56b722ee-b9f8-11e7-a7f8-01aa75ed71a1

States plus Norway and Switzerland. Nevertheless, stakeholders consider that the effectiveness of the governance of the programmes could benefit from a reduction in their complexity often duplication of effort and delays.

Stakeholders have assessed efficiency as satisfactory, with security as the main area for improvement. In general, stakeholders recognise that the current governance arrangements represent a practical response to the intricate structure of the European space institutional scene. However, the majority of programme management stakeholders consider governance should be adapted in the future as Galileo moves into its exploitation phase.

Stakeholders recognise that both programmes show a high degree of coherence with other EU policies, within the programmes themselves, and with other GNSS programmes. There is a close alignment of the EGNSS action with the Space Strategy for Europe communication released in October 2016 and with the space industrial policy set out in 2013.

Compared to what could be achieved at national or regional level, the European dimension of the programme has brought additional value by enabling shared funding and risks, access to European expertise, technology cooperation, the creation of a single European market and guaranteed and equal access for all EU Member States to the signal and services provided by Galileo and EGNOS. Indeed, there was strong agreement among stakeholders concerning the necessity to ensure continuity of the EU action. As such, the EU added-value of the programmes can be assessed as satisfactory.

According to stakeholders, stopping or withdrawing the existing EU intervention would have such severe consequences for Galileo and EGNOS that the entire programme would be jeopardised. Ending EU intervention would entail a considerable waste of public funding and would impact the outcome of efforts supported by private investments. Stopping or withdrawing EU intervention would severely damage the image of the EU, as such a decision would reflect badly on the Union's reputation for leading programmes as complex and challenging as Galileo and EGNOS.

The GSA reached a good achievement rate during the evaluation period. It achieved important objectives for the progress of Galileo and EGNOS programmes and for the development of GNSS downstream markets in the period 2014-2016 through an effective implementation of both its core and delegated tasks. Hence, the Agency's results have been in line with expectations.

This is reflected in the satisfaction reported by stakeholders involved in the programmes (especially among representatives of the downstream industry, the majority of who emphasised the positive impact of the GSA on market development during the reporting period).

Through the achievement of all the milestones set for the period, as well as the feedback from stakeholders, it can be concluded that both programmes are on track to reach the long-term objectives set by the GNSS Regulation for 2020. The stakeholder reviews have concluded that in the mid-evaluation period the programme has shown a satisfactory level of compliance. The maturation of the governance of the programme, notably on security aspects will play a major role in confirming this statement for the next phase of the programme.

GOVSATCOM

Civilian and military users stressed the multiple operational benefits in terms of security and guarantee of access of the GOVSATCOM programme, in particular for the many civilian user communities which today have no access to secure satellite communication. Such an access, as primary or back-up system, is indispensable to carry out traditional security operations, to tackle new risks and threats, and to seize the opportunities provided by new applications (drones, internet of things) and geographic areas (Arctic). Industry, too, is largely supportive of the planned programme, and underlines in particular the multiple benefits of a) overcoming the current market fragmentation on the user side; b) having the EU as a stable and predictable anchor client, comparable with the processes and mechanisms in place in third countries like the US, and c) having a single set of EU-wide security and accreditation standards. This will also generate a positive impact on R&D, and enhance the competitiveness of European businesses in the global market.

Another round of public consultations took place in the context of the **preparation of the next Multiannual Financial Framework:**

An open public consultation was launched in the beginning of January 2018 within the framework of the preparation of the next MFF, which ran for 8 weeks. The consultation covered the broader policy area of strategic infrastructures, which among other policies also covered space. Of the 441 responses received, 33 were related to space. Respondents confirmed the long-term sustainability of Europe's space capability to be a very important challenge, as well as the importance of promoting economic growth and jobs. The respondents confirmed the EU added value of the current space activities and highlighted their strategic dimension and the need for adequate funding. Stakeholders supported simplification efforts and while many see the current programme design and governance as adequate, others see scope for better coordination between the various actors and potential for further synergies. Business stakeholders and public authorities share similar views regarding the challenges and EU added value. Both groups point out the importance of flexibility to react to unforeseen circumstances and to new user needs. Both also support most suggestions to simplify and reduce administrative burden. NGOs on the other hand have less clear positions except for the unanimous support to address environmental and climate issues.

It should be noted that this public consultation triggered a much smaller number of replies than the consultation for the preparation of the space strategy. (*More detailed results of this open public consultation can be found in appendix B.*)

The feedback received from the different consultation activities has been used as an important input into the design of the future space programme, especially regarding the setting of priorities and the simplification of the envisaged governance mechanisms.

Appendix A

SYNOPSIS REPORT ON THE CONSULTATION 'A SPACE STRATEGY FOR EUROPE'[35]

Space is an important, strategic sector for Europe. Space technology and the applications and services derived from space systems support the implementation of many public policies, from agriculture to transport, climate change or security. They enable research and innovation, growth and jobs creation, not limited to highly specialized sectors.

Space policy contributes to the growth and investment agenda of this Commission and space is recognized as a strategic sector in which Europe should maintain its global leadership.

The Commission has decided to present a Space Strategy for Europe as one of its key initiatives for 2016. The purpose of the Space Strategy is to set out the overall strategic vision for the Union's activities in space while ensuring proper coordination and complementarity with the activities pursued by the Member States and the European Space Agency (ESA). The preparation of the Strategy has included a comprehensive stakeholders' consultation process, the results of which are summarized below.

1 CONSULTATION PROCESS

The consultation was conducted in two steps: through an open public consultation and ad hoc targeted consultation activities. The open public consultation aimed at reaching out the largest possible base of citizens and stakeholders. Targeted consultation activities towards main European space actors were conducted in order to ensure a balanced approach to sectorial interests.

1.1 Open public consultation

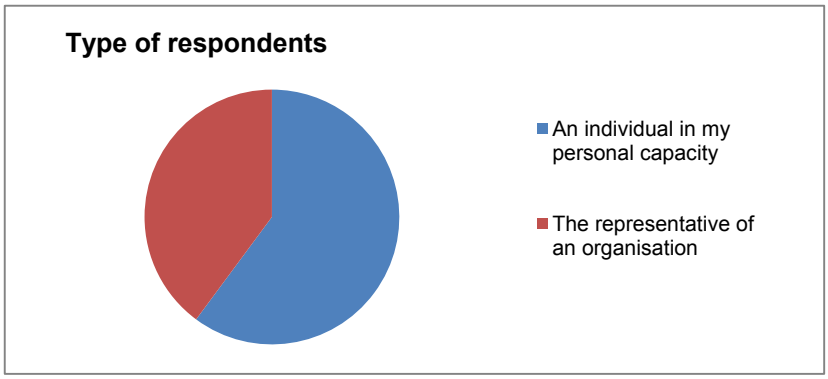
An open public consultation was conducted from 18 April until 12 July 2016 and was available on the public website of the Commission https://ec.europa.eu/eusurvey/runner/SpaceStrategy. The consultation was addressed to all interested stakeholders in the public and private sectors, in industry, including small and medium-sized enterprises (SMEs), research and academia in Europe, as well as to all interested citizens who wanted to share their views on the future Space Strategy. It contained 36 questions calling for open replies, multiple-choice replies or ranking replies, built around the main domains expected to be covered by the Space Strategy:

- General objectives of a Space Strategy for Europe
- Space economy and Competitiveness
- Access to space
- Security
- Future developments
- International cooperation
- Uptake and evolution of EU flagship space actions
    - Copernicus
    - Galileo/EGNOS

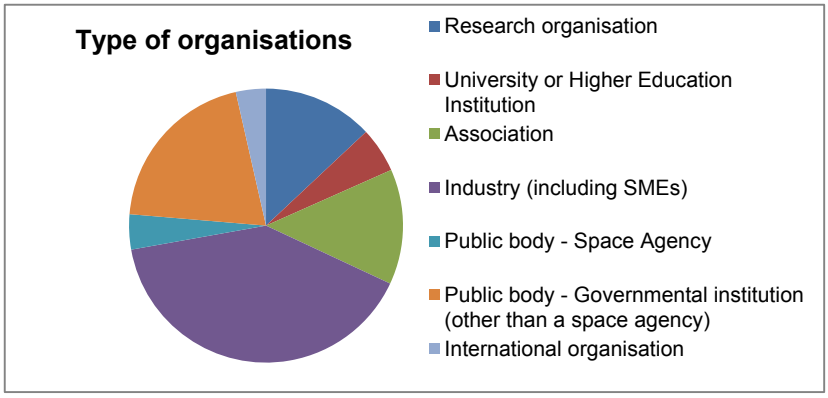
[35] http://ec.europa.eu/DocsRoom/documents/19483/

A relative high number of replies were received (424) representing a wide coverage of respondents across different categories and geographic origin. The data regarding the characteristics of the respondents is however incomplete due to the fact that many respondents (almost 40%) have not replied to the questions concerning the type/size of organisation, geographic origin, domain of activity, etc.

From the partial data collected, the results appear to be rather balanced between individuals (60% of the replies) and organisations (40%)



Replies from organisations represent mainly associations and industry (53% of the replies to the question on the type or organisation) and the public sector (28% of the replies). The majority of these organisations are involved in space-related activities.



From all the replies which indicated the geographic origin (including replies from individuals and from organisations), most originated from the European Union (from 21 EU Member States), with a strong participation to be noted from Spain, France, the UK, the Netherlands and Germany, followed by Belgium, Italy and Finland. 24 replies (out of 255 indicating geographic origin) were received from 15 non-EU countries (e.g. USA, Turkey, Tunisia, Thailand, South Africa, Korea, Japan, Mexico, Australia, Brazil, Chile, etc.)

1.2 Other consultation activities

The European Commission also conducted a number of targeted consultation activities. Other EU institutions and agencies were consulted and some of them provided written input. Written contributions were received from the European External Action Service (EEAS), the European Defence Agency (EDA), the European Global Navigation Satellite Systems Agency (GSA) and the European Union Satellite Centre (SatCen). The Commission cooperated closely with the Council, and followed the work of the European

Parliament on "Space capabilities for security and defence"[36] and on "Space Market Uptake"[37].

Regular meetings were held at the level of Director General with the European Space Agency (ESA) during the period concerned, addressing notably the Space Strategy, and an EU-ESA Informal Space Ministerial meeting took place in The Hague on 30 May 2016. Other intergovernmental organisations, such as EUMETSAT and EUROCONTROL also provided their views on the Strategy.

The Member States have been extensively consulted on elements of the Space Strategy, in particular through:

- the Space Policy Expert Group (meetings of 3 March 2016, 11 May);
- the Council Space Working Party (meetings of 4 March, 8 April, 13 May, 10 June);
- the Competitiveness Council of 26 May 2016;
- three ad hoc meetings with all EU Member States dedicated to the Space Strategy (17 May, 8 July and 9 September in Brussels) in which the Commission presented the initial concept of the Space Strategy for Europe and gathered the feedback of the national representatives;
- informal bilateral meetings and written contributions received at the initiative of some Member States (e.g. Denmark, France, Germany, Ireland, Italy, Sweden, the Netherlands, Poland, United Kingdom). A group of 10 Member States sent a joint letter reflecting their views (Bulgaria, Croatia, Cyprus, Czech Republic, Latvia, Lithuania, Malta, Portugal, Romania and Slovenia).

The 'Space Solutions Conference' organised on 30 and 31 May by the Dutch Presidency of the Council of the EU was also an opportunity to collect the views of the stakeholders.

In addition, the private sector, notably the industry and its business associations, were consulted through the industry dialogue process (meetings of 18 April and 17 June), through Workshops on Access to Finance and Market Conditions for the space industry (on 25 January, 3 May and 5-6 July), and through several informal bilateral meetings at the initiative of some industry actors. Around 25 written contributions were received in addition.

Some inputs were also received from universities and research centres and associations.

Finally, in view of the global nature of space, an outreach on the public consultation on the Space Strategy for Europe was initiated through the European External Action Service and the EU delegations in order to target international partners in third States. The outreach suggested that the national authorities dispatch the link to the online consultation among local administration bodies and non-public actors. Around 20 formal contacts/meetings have been held with the national authorities of third States. These contacts resulted in verbal exchanges reported by the EU delegations or in contributions (written or online through the questionnaire).

[36] European Parliament Resolution of 8 June 2016, P8 TA (2016) 0267

[37] European Parliament Resolution of 8 June 2016, P8 TA PROV (2016) 0268

2. RESULTS OF THE CONSULTATION

Overall, the results of the online questionnaire and the outcome of the ad hoc consultation activities have provided material that the Commission has carefully analysed with a view to feed its reflection on the Strategy.

There is little divergence between the positions of the various stakeholders (Member States, manufacturers, operators, users, science and research centres, etc.) on the different topics: the results of the online questionnaire (60% of the replies to which come from individuals) are very often confirmed by the positions of the Member States and of other stakeholders and vice-versa. There is thus a general consensus on the topics to be addressed in the Strategy, on the current shortcomings and on the future challenges. When some differences appear, they are mostly in the order of priorities for each category of stakeholder.

2.1 General objectives of a Space Strategy for Europe

The large scope of this subject (4 questions) triggered the largest number of replies and contributions. The results of the online questionnaire, mainly answered by individuals/citizens, differ slightly from those of the targeted consultations, with citizens emphasising societal goals, while industry tended to emphasise economic goals.

The Commission has reflected this input in defining the principal objectives around which the Space Strategy is constructed, emphasising the need to maximize the integration of space into European society and economy among the key goals. The Commission has focused on the socio-economic aspects of space as a driver for competitiveness and jobs creation rather than on the "inspirational" aspects, linked to activities such as space exploration or human spaceflight, which it considers an area of primary responsibility for the European Space Agency and national space agencies.

▪ *Results of the online questionnaire*

When invited to provide free comments on the Space Strategy for Europe, some respondents to the online questionnaire refer to four main high-level goals:

- provide an inspirational and ambitious vision for a new societal horizon;
- bring security and prosperity to our society,
- ensure the non-dependence and the influence of Europe, as a major space power, at global level;
- prepare the future of the next generations and of the humankind, the future 'civilisation challenge', for instance through manned flights and exploration.

Among the possible objectives of the Space Strategy a vast majority of the online respondents equally mentioned, contributing to the competitiveness of European industry, supporting the uptake and evolution of the EU space actions, investing in research and innovation and enhancing international cooperation.

In the free text comments, some respondents also mentioned some transversal/horizontal aspects, such as an improved governance at European level, an increased effort on education and promotion of space, streamlined and enhanced public funding at European level, optimised through more agile and flexible instruments (H2020 being perceived as

too slow and complex and the 'juste retour' of ESA as discouraging true competition and access to market by SMEs).

On the question on how the respondents see the role of the EU under article 189 of the TFEU, 28 % of the respondents chose scientific discoveries and innovation, 19% the creation of jobs and growth and the protection of critical infrastructures, 14% the security and safety of European citizens.

Concerning the areas in which space technologies and space services play an important role now and in the future, no one area seemed to be highlighted over the others as the replies to the online questionnaire are evenly distributed across the thematic areas proposed[38].

▪ *Results of other consultation activities*

The feedback from the Member States which took position on this aspect largely confirmed the results of the online consultation, except that they tend to see the priorities in a different order from a more economic perspective, putting the emphasis for instance on sustaining and using the existing infrastructures (Galileo, Copernicus, European launchers and Europe's spaceport) and encouraging the development of new space applications.

The feed-back received from the majority of stakeholders representing the industry puts the focus on the need to exploit to the full potential and extend the existing EU programmes and to increase European industry's competitiveness through support to R&D. Users, such as European regions, recall the necessity to take into account user-relevant policies, in particular at regional and local level.

2.2 Space economy and Competitiveness

The input received through the consultations largely confirm the Commission's analysis of the main trends shaping the global space environment and affecting the competitiveness of the European space sector (e.g. with technological shifts and new business models emerging globally).

In the Space Strategy, the Commission has addressed the main issues raised in the consultations. In particular it has considered measures to support the competitiveness of the sector by fostering research, innovation and developments of skills, by opening up new sources of finance and investments for the sector and by promoting an entrepreneurial eco-system. The detailed results of the consultation are as follows:

▪ *Results of the online questionnaire*

Concerning the **main challenges** facing the European space sector, respondents identify a number of issues but not one stands out as being particularly important: the industrial competition from existing or emerging space powers (12%), the lack of appropriate financing mechanisms supporting space activities, such as venture capital and risk financing (11%), the fragmented European market and lack of critical mass (11%), as

[38] 16 areas proposed: Environment, climate change mitigation and adaptation, energy, transport, telecommunication, security & defence, border control, civil protection, migration, marine and maritime activities, agriculture, education, development, health, employment, leisure activities, others

well as the security and sustainability of space activities linked to e.g. space debris, cybersecurity or other threats (11%).

Concerning the **most important opportunities** in the next 10-15 years no one issue seems to emerge as respondents equally identify the following opportunities: The trends towards lower cost and more frequent access to space (18%), the commercialisation of space activities (18%) and the use of small satellites (18%).

Regarding **possible actions to be undertaken at EU level** to foster the competitiveness of the European space sector, the respondents rank the following as most important:

- Support state-of-the-art space research (14%);
- Support skills development, from space–specific engineering skills to entrepreneurial skills (12%);
- Facilitate access to space data and technologies generated in the EU (12%);
- Facilitate access to finance to support the space industrial base and foster space entrepreneurship in Europe (11%).

Regarding the question on the actions that could be taken at European level to facilitate access to global markets, 40% of the respondents to this question consider that it is necessary to reinforce cooperation between the European Commission, Member States and business to identify market access barriers and define joint barrier removal strategies. 34% would like the EU to design economic diplomacy initiatives specific to the space sector in coordination with Member States.

For what concerns the most important action for the EU to encourage private sector collaboration/investment in space, the highest number of responses (36% of the respondents to this question) refers to the promotion of partnerships between the public and private sectors.

Dependency on a few third country suppliers, in particular for 'critical technologies' (i.e. those components or subsystems essential to the development of EU space infrastructures), is a concern for the European Space actions/activities for 50% of the respondents to this question, while 30% of them considers that it is not a concern. . For those who consider that this is a threat and who made proposals to mitigate this risks, the most effective way of reducing such dependency according to the survey results is by ensuring support for research in order for the critical technologies to be developed in Europe.

▪ *Results of other consultation activities*

For the large majority of Member States access to and use of space data delivered by the EU's Earth observation and satellite navigation platforms is a major strategic strand to be supported by the EU. In particular, research and innovation actions should foster the market uptake and development of downstream applications using space-based solutions.

The feed-back received from the majority of stakeholders representing the industry also recognises reaping the benefits of past investments in Copernicus and Galileo infrastructures as a strategic priority. However, industry stakeholders stressed more the importance of reinforcing the competitiveness of the European space sector by investing in the development of critical space technologies, leading to European non-dependence, attaining a sustainable and reliable supply chain of European component and systems providers, and by ensuring public private partnership schemes with industry.

Both the Member States and the stakeholders representing the industry which provided contributions on this subject recognise the importance of providing adequate support for a booming ecosystem of European-based "Newspace" actors, similar to the North American Silicon-Valley-minded community of space entrepreneurs. The conclusions of the three consultative Workshops on "Access to finance" organized by the Commission early 2016 called for means facilitating access to financial instruments leveraging opportunities through Horizon 2020 and the Union Investment Plan.

2.3 Access to space

The contributions received on this topic generally support further actions in support of European independent access and use of space, as a strategic asset, subject to ensuring a competitive level playing field for the European industry and anticipating future evolutions in particular towards cost reduction of access to space.

In line with the input received, the Commission has made proposals in the Space Strategy for maintaining an autonomous, reliable and cost-efficient access to space for Europe, such as aggregating the launch service needs of EU programmes, contributing to long-term research and innovation needs, and considering ways to support launch infrastructure facilities where this is needed to meet EU Policy objectives or needs. The detailed results of the various consultation activities on this topic are as follows:

▪ *Results of the online questionnaire*

When asked whether access to space is an area where the EU should become more involved in the future, 74% of the online questionnaire respondents to this question replied positively. When requested to provide suggestions on how this involvement should materialize, some of these respondents call for:

- The consolidation of the European institutional demand for launchers, with a European preference;
- The development of low-cost access to space and re-usable launchers;
- The need to foster private initiatives in line with the 'New Space', facilitating the emergence of a competitive market for SMEs, Public-Private Partnerships with industry and disruptive approaches;
- Access to space for small satellites.

Other suggestions call for European autonomy, investment in R&D and innovation, and for the development of manned space flights (for space tourism or exploration).

The need for a close synergy with ESA is underlined by several respondents.

▪ *Results of other consultation activities*

The majority of Member States which took position on the issue of access to space sees the EU primarily as a customer of launch services, but acknowledge the need to look ahead and anticipate new technological developments and new evolutions, especially in low-cost launchers and microlaunchers. They also mention that research should address not only technological innovation but also industrial processes.

Some Member States underline the need for a micro/mini launcher capacity for Europe to be able to catch the small satellite launch market and would support EU action in support of low-cost access to space technologies, including for new spaceports. Some of them also stress the strategic priority of keeping European autonomy in access to space, and of sustaining and using the European launch systems. They call for the aggregation of institutional demands for launch services to provide better visibility to the industry. Some Member States consider that EU involvement is needed in the financing of launch infrastructures in order to enable European industry to compete on a level playing field globally.

European industries involved in access to space that participated to the consultation underline the need for a level-playing field with main international competitors. They would welcome in particular better visibility on long term institutional demand, investments on launch infrastructures and support to Research and Innovation in order to prepare the next generation of launch systems.

2.4 Security

*The contributions received on this topic are quite consensual and generally support the development of civil-military synergies in space. The evolution of the existing Space Surveillance and Tracking support framework (SST) seems to be supported. Stakeholders also call for actions going beyond SST to prevent the proliferation of debris. On governmental satellite communication (*GOVSATCOM*), stakeholders seem to support an initiative by the EU subject to establishing clear user needs and building on existing capacities.*

In line with the input received, the Commission has considered in the Space Strategy an evolution of SST to other types of threats. However, at this stage, an action to remove debris proliferation has not been considered due to the lack of international consensus on this issue. On GOVSATCOM*, the Commission and EDA have already taken action to establish user requirements and the Commission will prepare an impact assessment to assess the feasibility of action in this area. The detailed results of the various consultation activities on this topic are as follows:*

▪ *Results of the online questionnaire*

Around 50 % of the respondents to the online consultation have replied to the question regarding the way dual-use space systems and technologies could be optimized. 93% of these respondents support the promotion of civil-military synergies at European level, particularly in Earth observation, navigation and satellite communications.

When requested to indicate whether the EU action on SST should evolve, 80% of the respondents to this question replied positively, giving priority to the protection of European satellites against cyberthreats and space weather hazards, followed by intentional (manmade threats) and other natural threats.

73% of the online respondents to the question on governmental satellite communications considered very important or somewhat important for the governmental and security users to have the possibility to benefit from better access to secure satellite communications with guaranteed availability and improved resilience. Several replies to the online questionnaire supported a dual-use approach and hybrid (space/terrestrial) solutions.

▪ *Results of other consultation activities*

The results of the online questionnaire are confirmed by the direct contributions received from various categories of stakeholders (Member States, manufacturers, operators, users, science and research centres).

- Member States and industry acknowledge the link between space and security and the need to consider potential dual-use synergies when launching new space activities or programmes.
- On space debris, all categories of stakeholders express concerns on the need to ensure security in space and protect European space assets. The industry in particular calls for a 'Clean Space' in which space weather, Near Earth Objects (NEO) and man-made threats would be identified and mitigated. Member States support the SST and in particular its governance model. They are in favour of the SST evolution, for instance towards space weather activities, but stress the importance of taking action in parallel to mitigate the proliferation of debris. They would like to see the EU playing a regulatory/policy role, at EU or international level, in preventing debris proliferation, e.g. through a regulation on de-orbiting or through the development of space traffic management activities.
- On GOVSATCOM, the Member States, the industry (including manufacturers and operators), and the users support a better access to secure satellite communications with guaranteed availability and improved resilience, as well as the principle of de-fragmenting the demand for governmental satellite communications. But some of them consider that EU action in this regard should be subject to confirmation of the exact users' needs (or rather security needs) and should take due consideration of already existing satellite communication services. Some of these stakeholders, notably the satellite operators, point to the importance of having a global approach to communications needs (e.g. interoperability with future 5G).
- Other comments (from all categories of stakeholders, including the European External Action Service) make reference to the need to use the full potential of Copernicus and of the European Global Navigation Satellite Systems (EGNSS) for security purposes (see § 2.7).

The European Parliament, in its report on "Space capabilities for security and defence" calls for a reinforced use of European space capabilities to support the European Common Security and Defence Policy (CSDP). The European Defence Agency underlines that the next generation of European space systems should take into account their potential for dual-use and support initiatives such as the SST, GOVSATCOM, the use of Galileo for security purposes, and Earth Observation and imagery analysis.

2.5 Future developments

This subject is the one that triggered the least contributions in the online public consultation. Due to the wide scope of the question and the longer timeframe considered (2030), the results are not precise enough to allow any precise proposals, particularly since most of these future developments might be dependent on the evolution of the international legal framework.

▪ *Results of the online questionnaire*

Regarding which development could most impact space activities and business in the long-term future (beyond 2030), 59% of the respondents to this question refer to sustainable space activities (such as space debris reduction and in-orbit satellites servicing) while 50% favour also space exploration, closely followed by developments leading to sub-orbital flights (enabling, for instance, point-to-point transportation, space tourism and access to space).

▪ *Results of other consultation activities*

The topic is not clearly addressed in the feedback from Member States and industry. In the timeframe beyond 2030 space exploration is however mentioned as an important topic deserving a strategic definition often in a context of international cooperation. This message is particularly underlined by industry and to a lesser extent by Member States.

2.6 International cooperation

Reinforced international cooperation is supported by most space stakeholders, in particular by European actors and for all space sectors. The Commission has taken the responses into consideration in the Strategy, in particular the suggestions to support European companies access external markets and on a reinforced European position in the global fora.

▪ *Results of the online questionnaire*

72% of the respondents to the online questionnaire replied to the question on the areas in which the EU should reinforce its cooperation with international partners in space. The answers are equally distributed among the proposed sectors (around 17% for each category): satellite navigation, earth observation, space situational awareness, space science, space exploration and use of space data. Among the other areas suggested by respondents, the cooperation in the development and promotion of downstream applications is often indicated.

▪ *Results of other consultation activities*

For Member States and industry who provided direct contributions, it appears paramount that Europe maintains and strengthens its position as a major space power and a key international partner in all space matters. For them, the Space strategy should consider how to allow for a more robust European position in the international cooperation context, with the aim to promote common development and partnerships at the international level. Most Members States also highlight that the EU should improve coordination with national authorities to facilitate market access and motivate enterprises to enter international markets. For some of them, the EU should consider supporting measures to initiate new international cooperation initiatives.

Several third countries have stressed interest and readiness to cooperate with the EU, as a key partner in space, notably with regard to EGNOS, Copernicus data, joint research activities and downstream market.

2.7 Uptake and evolution of EU space actions

2.7.1 Copernicus

Contributions converged around three main aspects, namely the importance of Copernicus to evolve and have a long term perspective as a primarily publicly funded and user driven programme, the need to improve access to the data generated by Copernicus and the need to increase activities concerning uptake by public and private users to promote market creation and development.

The Commission has partly reflected these inputs in the priority actions detailed in the Strategy, specifically as regards user uptake, market development and data access. The detailed results of the consultation activities are as follows:

▪ *Results of the online questionnaire*

Data access and long term availability of Copernicus products (service and satellite data) are considered as the most important aspects for Copernicus (more than 70% of the respondents to the question on the key elements to be included in the data infrastructure component). Storage, processing of Copernicus data and the combination with other data are considered key issues. Commission activities to foster uptake of Copernicus should focus on facilitating access to data and information; about 72% of the respondents consider this very important. Awareness, both within the earth observation sector as in other sectors is considered very important (51% and 61% respectively). Access to hosted processing capabilities, interoperability, support start-ups and dedicated education programmes are considered slightly less important.

More than 85% of the respondents consider that solutions for data availability should include public funding, with about 39% of the respondents promoting a mixed public-private funding model. Only 9% is convinced that solutions should be developed entirely by the private sector.

Access to all Copernicus data is deemed most relevant by 68% of the respondents. Access to tools is considered the second most important element (33%), while access to a market place seems least relevant (17%). Only 15% of the respondents consider the purchase of data from private sources by Copernicus relevant.

88% of the respondents would support an extension of the Copernicus service portfolio, with only 12% wishing to limit the service portfolio to the current scope. Future products considered most important include natural hazard monitoring (60%), land use and soil monitoring (58%), agricultural monitoring (54%), land and Sea borders (47%), Greenhouse gas emissions (47%) and polar monitoring (44%).

▪ *Results of other consultation activities*

For the Member States who provided input on Copernicus and industry stakeholders, the continuation of the Copernicus programme should be ensured, and multiple stakeholders stress the necessity to formulate an ambitious long term strategy for Copernicus, including elements on the evolution of the Copernicus infrastructure and services, long-term data access and the development of the downstream sector. Member States expressed the view that Copernicus should remain a publicly funded programme.

According to some Member States user uptake activities, including the recently started Copernicus Masters programme and Copernicus for start-ups, should continue to increase

the use of Copernicus data by public, scientific and private users. Furthermore, Copernicus should address the Big Data challenge and promote market development. Copernicus should foster the establishment of a globally competitive downstream sector.

Several stakeholders and Member States indicated that International cooperation in the context of

Copernicus should be pursued and take into consideration the existing agreements between ESA, EUMETSAT and other satellite agencies worldwide. Coordination with the Group of Earth Observation should be reinforced. Satellite systems developed and operated by ESA and EUMETSAT are an asset for Europe and synergies with Copernicus should be actively established, along with tailored EU-funded research activities for the development of downstream environmental applications and forecasts. Copernicus needs to build upon infrastructures available in Europe, in particular in the Member States, ESA and EUMETSAT.

As one of its priorities, Copernicus should guarantee long-term observations in the framework of climate change mitigation and adaptation activities, according to some Member States and external stakeholders. In particular, space-borne observations of greenhouse gases in conjunction with in-situ measurements should be included as part of its portfolio. A seamless integration between Copernicus Data and Services and Basic National Services is desirable. Furthermore, with regards to the evolution of the space Component, the development and operation of a constellation of small / medium Sentinels should be considered an option.

2.7.2 Galileo/EGNOS

The contributions received converge around three main aspects namely, the achievement of the current deployment of Galileo, the need to increase activities concerning uptake by users and the preparation of the evolution of the European Global Navigation Satellite Systems. Overall stakeholders call for a long term stability of the programmes with a strong R&D support.

The Commission proposed related responses in the Strategy. Regarding user uptake and market development, proposed actions could for instance address standardization, R&D support, use of Galileo for emergency calls (E112), critical infrastructures and extension of regional coverage to EU neighbourhood countries and Africa. As regards the evolution, the strategy underlines the need to make it more robust, performant and cost-effective with a strong R&D support. Provision for new services in the evolution is also considered.

▪ *Results of the online questionnaire*

The market uptake of Galileo faces obstacles, which are, according to respondents, evenly distributed between insufficient R&D funding (16%), existence of other GNSS (15%), absence of standards (14%), insufficient awareness raising (14%) and regulatory barriers (third countries: 12%; national level: 11%, EU: 10%). Only 7% of respondents identify the cost of enabling Galileo as an obstacle.

As to the areas and actions that the EU should promote the use of Galileo/ EGNOS there is an even distribution between the different markets (road, rail, aviation, maritime, agriculture, surveying, location based services, and timing and synchronization). A majority consider standardisation as the most important tool to promote the use of

Galileo/EGNOS, followed by R&D and regulatory measures. Public private partnerships are the favoured form of support in almost all markets except surveying, in which calls for tenders are preferred.

The use of Galileo for emergency calls (E112) is perceived as very useful; most stakeholders believe that the caller location would be more accurate if GNSS location data was used, including Galileo/EGNOS. Moreover, 52% of the respondents to the question see a need to take action to increase the resilience and reliability of the synchronisation of several network infrastructures, by using the exact timing provided by Galileo/EGNOS.

A majority of respondents consider that the existing IPR regime fulfils the objective of encouraging the adoption of new technologies using the EU GNSS.

At international level, stakeholders believe that more should be done to support the export of European satellite navigation technology, notably by signing cooperation agreements with third countries, by extending EGNOS coverage to third countries and by organizing space dialogues. Trade promotion fairs, on the other hand, are seen as less important.

The majority of the respondents are of the opinion that, in modernising the two systems EGNOS and Galileo, they should not be developed separately in the long term. The most important priorities for the evolution of Galileo in the long-term are: to improve navigation performance (40%), to reduce lifecycle costs (38%) and to improve the robustness of the system (22%). In addition, stakeholders support the need to consider new services to meet emerging user needs.

▪ *Results of other consultation activities*

In the consultation meetings organized by the Commission, Member States expressed the view that it is vital to complete Galileo, to exploit the benefits of Galileo and EGNOS and to make sure that services are reliable, precise and continuously available. Moreover, the long-term viability of Galileo/EGNOS is considered as crucial, in order to establish a good investment climate and to reassure potential investors and users.

The Member States highlighted as well that Galileo/EGNOS should serve three purposes: to bring benefit to the European citizen, to bring economic benefits and to support societal challenges and political priorities such as energy, the digital economy, migration and border control. According to some Members States governance stability is needed for Galileo in the near future.

There is a consensus among Member States and industry to consider the gradual preparation of the next generation of Galileo satellites as important.

For the industry, the main objective is to finalise the deployment of the first generation of Galileo, to enhance European Galileo/EGNOS downstream industry competitiveness, to foster European Galileo/EGNOS uptake and to support coordination between national and European initiatives. Key support actions should include standardization, procurement policy (taking into account the specificities of the space sector), new and innovative sources of funding, R&D, development of an "EU space diplomatic policy" and availability and protection of frequencies.

Appendix B

Summary of the Open Public Consultation in 2018 in the context of the preparation of the next Multiannual Financial Framework

An open public consultation has been carried out for the broader policy area of strategic infrastructures, which among other policies also covered space. The consultation was published on the European Commission's central consultation webpage. It ran from 10 January 2018 to 9 March 2018 and was available in all official EU languages. The consultation period was eight weeks (instead of the standard 12 weeks), which was the same for the other policy areas for which consultations were held in order to prepare for the next Multi-annual Financial Framework.

A total of 441 responses have been received. Respondents had the possibility to indicate whether they had experience with a number of funds and programmes, which included as possible answer "Galileo, EGNOS, Copernicus or Space Surveillance and Tracking". Respondents could also indicate a topic to which the responses relate and "space" was one of the four possible answers.

In order to analyse the replies, we focus on those respondents that have either indicated that they have experience with the current Space actions (30 replies[39]) or that had not indicated experience with the current Space actions but who have indicated that their response relates to the topic "space" (3 additional replies).

Challenges

Two questions relating to space were answered by all 441 respondents. These relate to the **importance of the long-term sustainability of Europe's space capability** and to the **extent to which current programmes address this challenge**. For those two questions, we will present the views of all respondents, while for the other questions, we will only present the views of the 33 responses relating specifically to space.

Of all 441 respondents, 45% considered the **long-term sustainability of Europe's space capability** either very important (16%) or rather important (29%) while 36% had no opinion on this, 13% were indifferent and 7% considered it either rather not important (5%) or not important at all (2%).

The results for those interested particularly in space are much more pronounced: Of the 33 respondents with particular interest in space, 82% answered either very important (64%) or rather important (18%) while 3 respondents were ambivalent and 3 respondents had no opinion.

On the question regarding the **extent to which the current Space actions address the long-term sustainability**, all 441 respondents provided the following answers: the majority (58%) had no opinion, 23% considered it addressed to some extent only, 12% fairly well addressed, 5% fully addressed and 2% not addressed at all.

For those particularly interested in space, the responses were considerably more positive: 6% saw them fully addressed, 40% fairly well addressed, 36% saw them addressed to some extent only and 18% had no opinion.

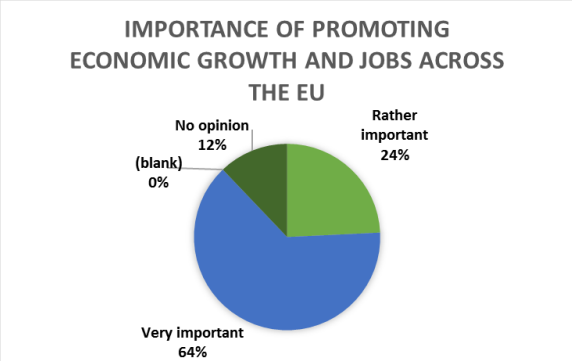
The 33 replies with particular interest in space are mostly made on behalf of an organisation (73%), while 27% are made in a private capacity. The replies come from 18 different Member States and one non-EU Member State. 8 replies are made on behalf of

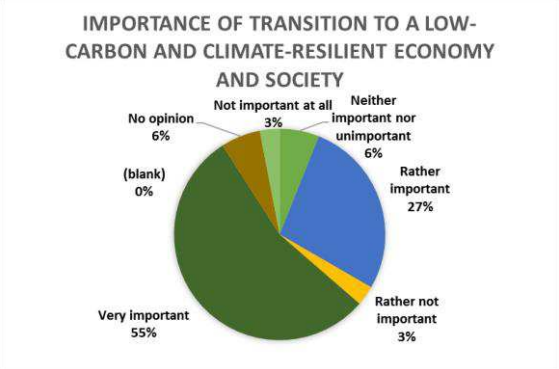
[39] Excluding one reply that was submitted twice by the same person.

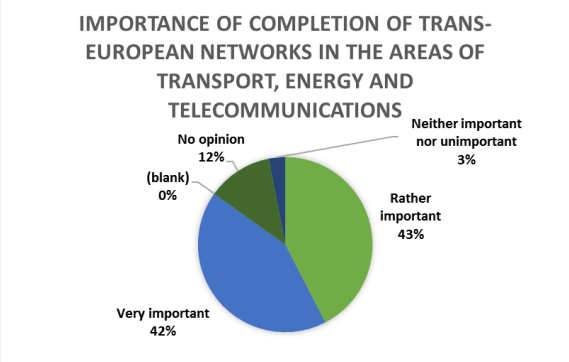
private enterprises, 8 replies come from NGOs, 4 from a public authority, 3 from a trade organisation and one from the category "other".

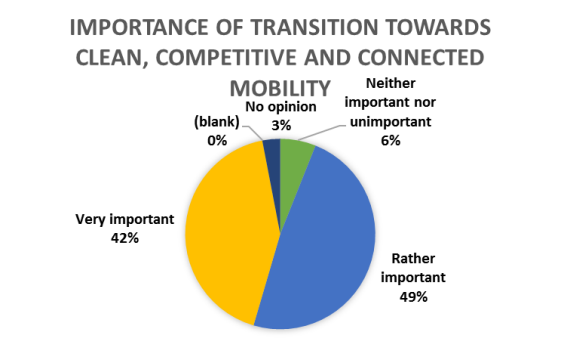
Five **position papers** have been attached, of which three are nearly identical and do not contain any space-related points but rather argue in favour of more consideration for environmental sustainability aspects under the Multi-annual Financial Framework. The fourth position paper relates to funding for space research under FP9 (Horizon Europe) and argues that it should include funding for lunar exploration. The fifth position paper is not specifically related to space but to social economy and the MFF.

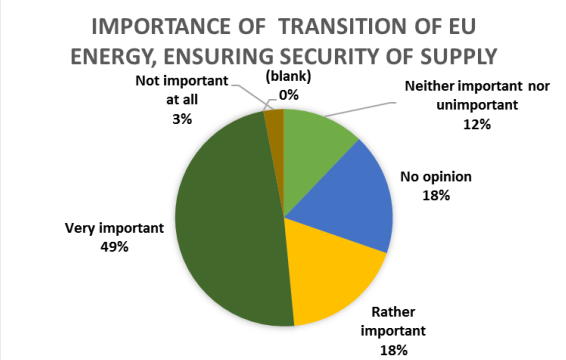
The respondents were asked to assess the **importance** of several **policy challenges** for the infrastructure policy area more generally, which yielded the following results from respondents interested particularly in space:

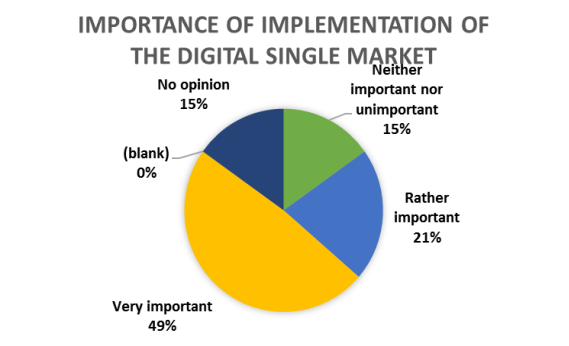


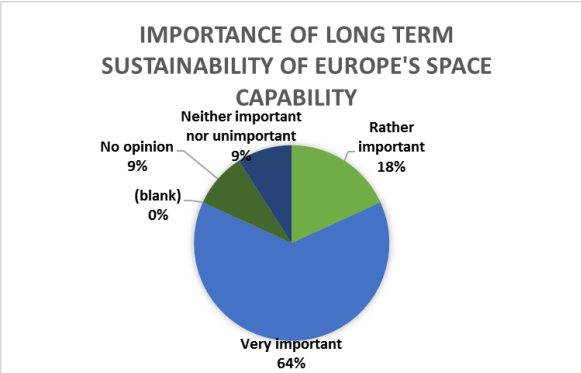


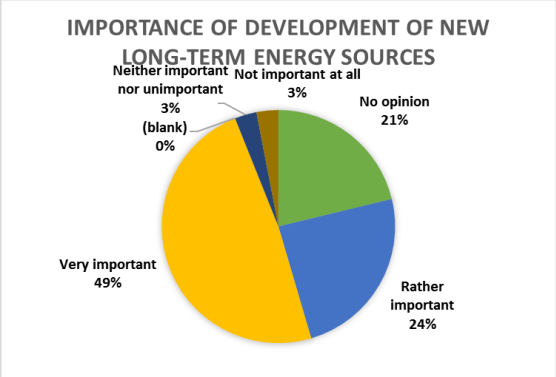










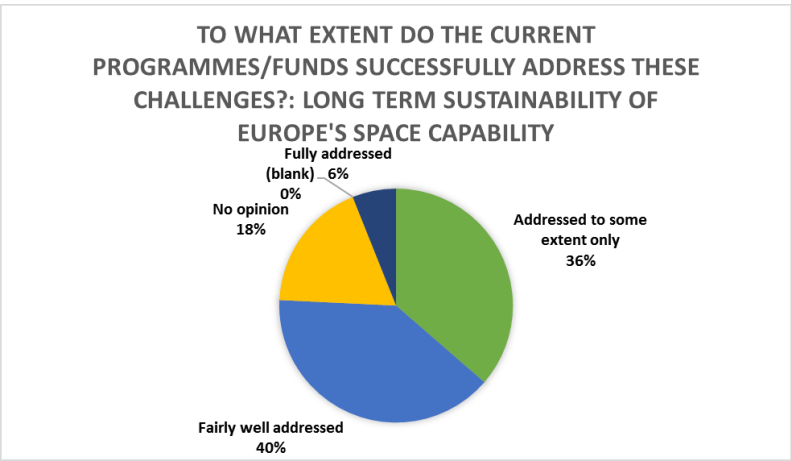


The results show that those stakeholders with a specific interest in space consider **promoting economic growth and jobs** as the most important challenge, followed by the **sustainability of Europe's space capability**.

When asked about **additional challenges**, the following were mentioned with respect to space:

- Good privacy regulations for the whole EU
- Sustainability of European industry/capability in general
- Ensure full implementation of EU space programs. Using data from space systems where appropriate. Ensuring adequate funding for EU space programs.
- Development of infrastructures that combine sustainability and accessibility and design for all people
- Development in leadership of space exploration, with a focus on the Moon
- Human Digitalization, teach people how to work with all this new technology
- The implementation of a pan-European defence, security, humanitarian and emergency response that includes the deployment / the use of innovative European telecommunication satellite infrastructure.
- EU Data Infrastructure
- Independent access to space for Europe

On the question regarding the **extent to which the current Space actions address the challenge of long-term sustainability of Europe's space capability**, many stakeholders indicated that this was addressed to a fairly large extent while a bit more than one third of the respondents saw it addressed to some extent only:

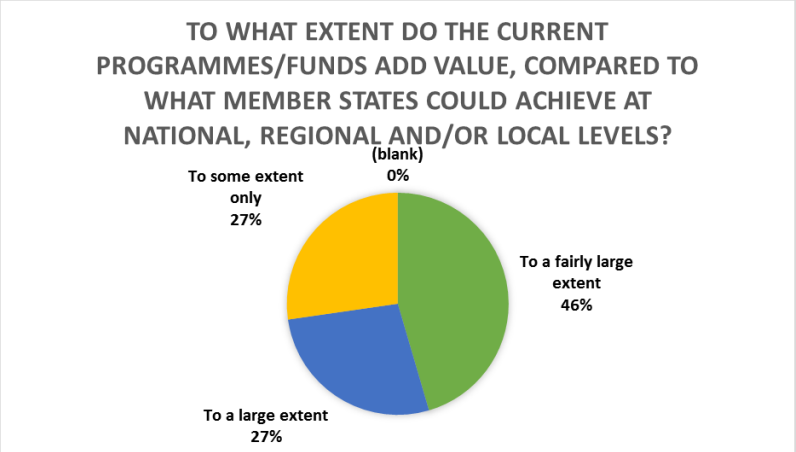


Asked about other policy challenges, the following was mentioned with respect to space:

- Competitiveness of the European space industry

EU added value

When asked to qualify the extent to which the current programmes provide **EU added value**, a clear majority considered this to be the case, while about a bit more than one quarter of the respondents considered this to be the case to some extent only:



Asked to specify how the current programmes/funds add value compared to what Member States could achieve at national, regional and/or local levels, the comments received from those interested in space touched upon the following points:

- Availability of resources and economies of scale: a single country cannot achieve significant results alone or afford a large space programme. The Galileo/EGNOS and Copernicus programmes have created world-class strategic infrastructures that no Member State would have been able to create on their own. Space matters are requiring a high level of investment to achieve results and bring the necessary independence of Europe.
- Ensuring space capacity for Europe means fostering collaboration between Member States in the industrial sector. Bringing together several nations, competences, skills add value to any of these endeavours for the benefit of European society. Transboundary infrastructures clearly provide EU value added. Promotion of common European interests.
- Return on investments at societal level in terms of growth, profits, jobs created and high-value added companies on the market. The EU has a key role to play in supporting the sector and allows it to continue to innovate and develop new services for citizens, supporting also the competitiveness of the space industry at large including satellite operators
- Downstream, the data, signals and services create far more valuable information and knowledge.
- Considering that the European Space port located in French Guiana is a strategic asset enabling independent access to Space, a reflexion should be pursued to define in which way the European Commission could participate to its long term sustainability.
- The EU programmes allow Member States to specialise in specific upstream technology.
- Infrastructures are of strategic importance, require multiannual financial security (because of the high investment and maintenance cost) and continuity.
- Pooling and sharing of national space capabilities would allow also Member States without own capabilities to develop their services based on satellite systems at a national level, with a positive industrial fallout that otherwise they

would not have. Moreover, the development and use of common and shared spatial systems favours the achievement of other EU objectives, common to all Member States; a significant example could be border control and maritime surveillance with satellite systems, or the development of trans-European transport networks.

Objectives

Stakeholders were asked if they saw a need to **modify or add to the objectives** of the programmes/funds in this policy area and if so, which changes would be necessary or desirable.

Those stakeholders interested in space raised the following points:

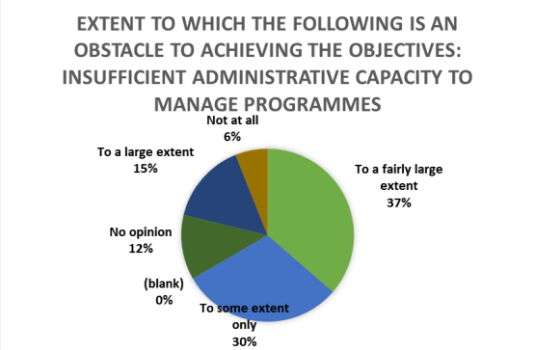
- Simplification of rules, contract standards, flexibility in contract conditions needed.
- It is fundamental to guarantee the continuation of the two current space actions of the EU, namely Copernicus and Galileo, but other activities such as SST, GOVSATCOM and also launchers related activities, as foreseen in the European Space Strategy
- Continuity of the European space actions, continued user-driven modernisation and the open data policy should remain a primary focus.
- A dedicated line for space in FP9 (Horizon Europe) must be considered with a possible higher budget.
- The objectives of the programs need to be reviewed regularly to meet the needs of users and current technological advancements. It is important to ensure that programs are more flexible and implementable faster than at present.
- It is of great importance that Space remains a priority for the European institutions. To ensure the continuity of the previous European space successes and of a strategic autonomous access to space, a dedicated and clearly identified budget would be of outmost importance. Some stakeholders argued that an increase of the financial budget is needed.
- Cost should be capped and brought down by using more and different contractors.
- Deployment of high-capacity networks integrated in 5G with a financial instrument managed at central EU level is advocated.
- Consider the needs of citizens with disabilities.
- In the next MFF, the EU should focus on increasing the use of the European space capacities, also by non-traditional space policy areas such as the digital economy, innovation in transport, agriculture and water management, environmental policy and security and defence.
- It is important to keep the traditional grant agreements and avoid the intended /unintended distortion by the overwhelming new organisation model. Alternatively, the proven federative business model has to be treated on equal footing.
- Strengthening and maintaining long-term European spatial capacity is also of major strategic importance for other key areas of European policy (such as industrial development, environment, transport systems including Intelligent Transport Systems, defence and citizens' security).
- Need for adequate allocation of funds for the continuation and strengthening of ongoing programs (Galileo, EGNOS and Copernicus), and for the launch of new

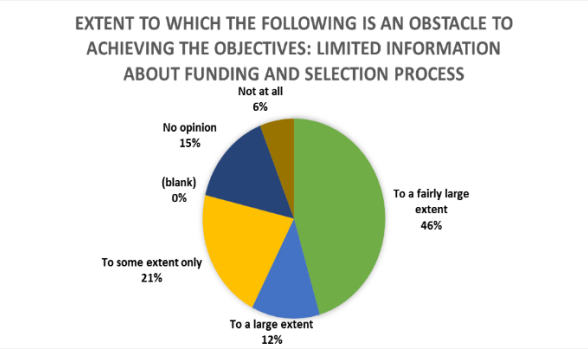
programs (such as GOVSATCOM, or the development of constellations of small satellites), also in research and innovation in the FP9 (Horizon Europe).

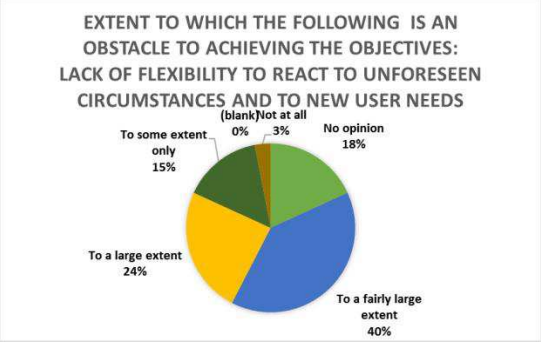
- Fundamental objectives for European space programs are:
  - ensure business continuity and counteract obsolescence for already active programs;
  - create an autonomous, independent and competitive European industrial chain, from the production of the space / terrestrial segments, up to the supply to the users of the services;
  - develop synergies between civil and military activities for the defence and security of citizens (priority to dual-use systems);
  - strengthen and promote autonomous access to space with European launchers (above all Vega);
  - protection of critical infrastructures;
  - ensure appropriate levels of cybersecurity;
  - implement systems for processing Big Data (also for the integration of spatial and non-spatial data).
- Establishing green infrastructure and applying nature based solutions.
- It is crucial to continue offering financial support for projects in the area of air traffic management.

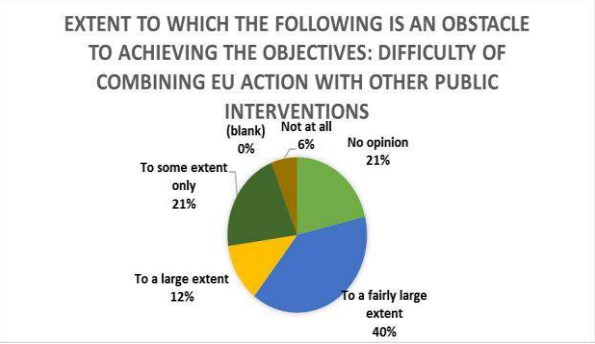
Obstacles

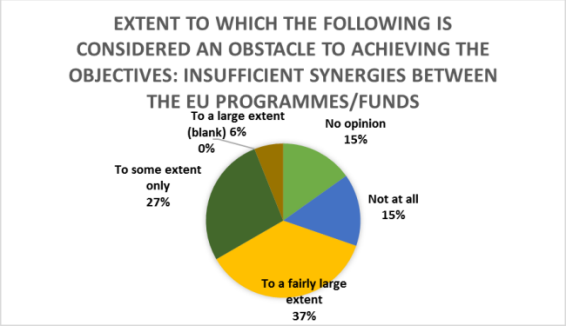
Respondents were asked to qualify to what extent particular factors were considered an **obstacle to achieve the programmes' objectives**. Those interested in space provided the following replies:

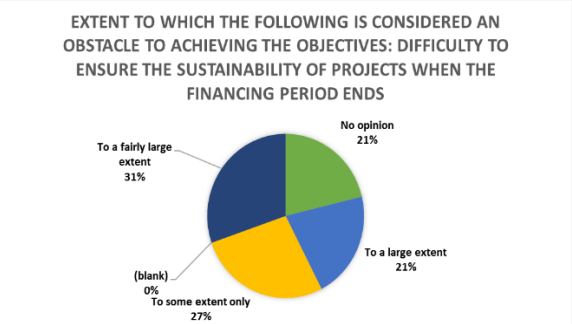


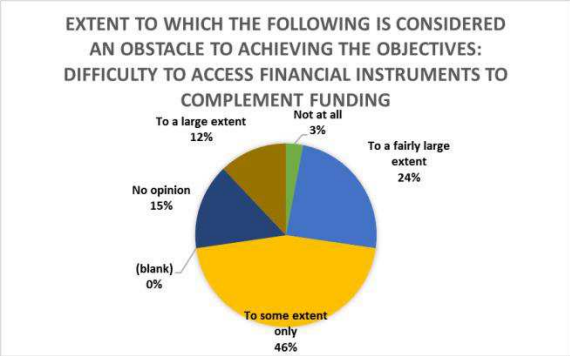


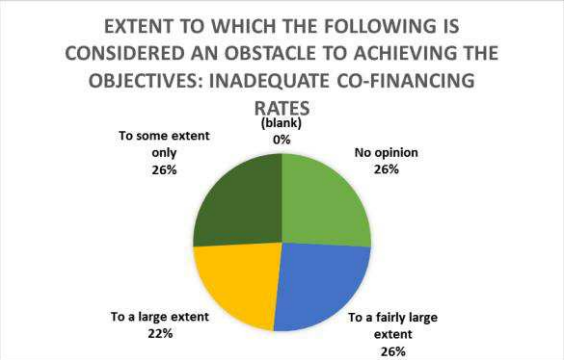












Those stakeholders with particular interest in space appear to consider all of the potential obstacles as relevant.

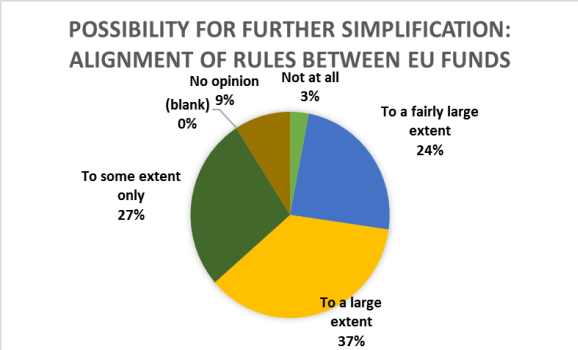
When asked to **identify other obstacles**, the following were mentioned:

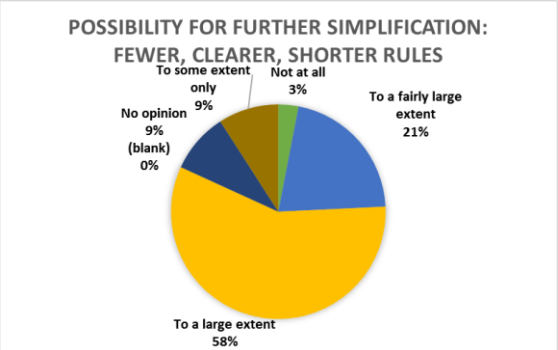
- Over-billing of EU projects vs. Comparable National, inadequate supervision. Must have minimum and higher average co-financing rates to deter.
- Competition is restricted to only few companies, no one exists the field despite performance failures.
- Distribution of funds is not fair between Western and Eastern European countries (see e.g. ERC grants). Even though there are some attempts to level off the playground, these are very far from adequate. If equal rights and equal access means anything to Europe, it should do much more the remedy this glaring inequality.
- Internal Limited access to programs by Public Administrations.
- Mismatch between EU and ESA funding and internal cost methodology. These are currently addressed on an ad hoc basis, a more structural solution is preferable.
- Understanding how to use the systems which are sometimes overly complex MS burden, lack of cooperative culture.
- Limited access to programs by Public Administrations.
- Difficulty to contact the persons in charge of the programmes/funds, and if contacted, difficulty to obtain an answer.
- Coherency between policies of the various departments of the Commission has been improving but need to continue to be reinforced
- In addition to the development of the programs themselves, the Commission should pay the utmost attention to the use phase of users, also and above all not directly related to the space sector. In fact, from a "user driven" perspective, it is necessary to promote, support and sensitize users to the diffusion of satellite systems. Unfortunately, however, the use of data and services based on satellite systems is often limited and not widespread due to the lack of common standards and certifications, which make it difficult, and sometimes impossible, to use.

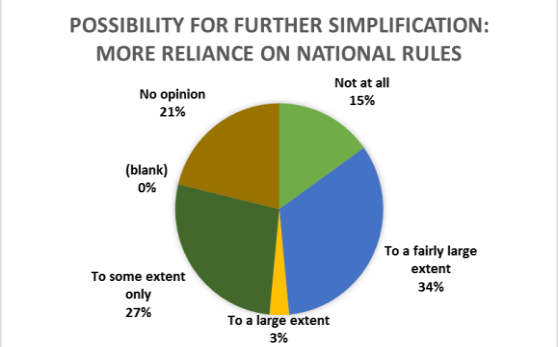
- Another obstacle identified for the development of programs is the length and slowness of administrative processes, for example in the negotiations of the Working Arrangements between the EC, GSA and ESA. This often causes delays in the implementation of programs, whose developments, on the contrary, should be in step with those of other global competitors.
- As the High-Level Expert Group on the Sustainable Finance identified, the key bottleneck in developing sustainable infrastructure is project development capacity. See their final report: [https://ec.europa.eu/info/sites/info/files/180131-sustainable-finance-final-report_en.pdf.](https://ec.europa.eu/info/sites/info/files/180131-sustainable-finance-final-report_en.pdf)

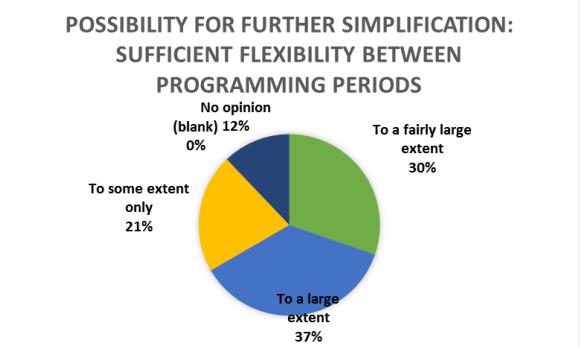
Administrative burdens

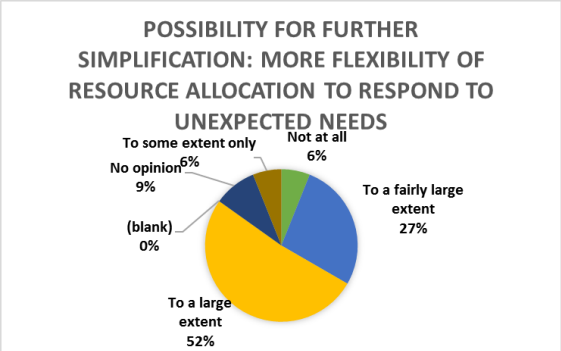
Stakeholders were asked to identify how possible measures could lead to **more simplification and reduction of administrative burdens**, to which they provided the following responses:

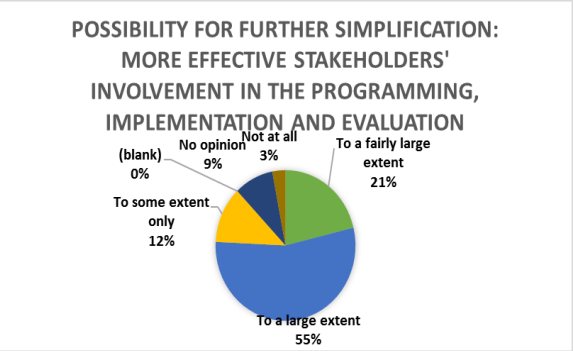












While all suggested possibilities received a positive reaction, the suggestion of more reliance on national rules showed the least support.

Stakeholders interested in space also identified the following **other ways to simplify and reduce burdens**:

- Mandatory data-sharing between branches of government and between national government - whatever answers, documents were provided in one kiosk already within a certain timeframe should be visible for all other institutions/agencies barring justified cases of data protection
- Cancellation is an efficient way to solve problems.
- Simplify and Minimum of administrative process of rules and Standards, closing of all over regulations. Harmonised EU-Regulation only for human safety aspects. Rest not needed to regulate / over regulate.
- As to the DSM, it is necessary to introduce more flexibility on the eligibility of different types of infrastructure to expenses. Eligibility of technological solutions to expenses needs instead to be based on their ability to achieve the social and economic objectives pursued by the EU. Monotechnological solutions can hardly reach the targets as they are not neutral and flexible.
- Rules that do not change during programming.
- A more comprehensive evaluation of the entire value chain would be advised. The roadmap and evaluation by the roadmap, whilst keeping in mind European added value, is important.
- Alignment of rules between EU funds and national funds
- Structured dialogue with the industry on key priorities
- The Commission should take all appropriate measures, including regulatory measures, to introduce common standards and certification of satellite systems; for example, the certification of the GNSS Galileo system would be highly strategic for its diffusion in transport systems, from aviation to Intelligent Transportation Systems (ITS). For the simplification of procedures related to the development of space systems, it could be useful to strengthen the role of the GSA, entrusting it with greater direct responsibilities and greater financial flexibility.
- As the HLEG on Sustainable Finance recommends, the EU should establish "Sustainable Infrastructure Europe, which would be an entity built on existing institutions and designed to accelerate the development of high-quality infrastructure projects that meet investor demands and deliver the EU's sustainable objectives, including its obligations under the Paris Agreement. Sustainable Infrastructure Europe would focus on providing project development expertise on the ground across different parts of Europe.
- To some extent, eligibility of cost reported is subject to the personal interpretation of Auditors. EU should publish more detailed rules based on actual cases and lessons learned in previous programs /calls in order to minimize misinterpretation risk and therefore leading to an efficient administrative work.

Synergies

Finally, the stakeholders were asked to identify how **synergies among programmes/funds** in this area could be further strengthened to avoid possible overlaps or duplication. Stakeholders interested in space provided the following suggestions:

- More harmonisation of programmes, conditions, procedures
- Each individual space program fulfils its purpose and does not duplicate it. Maintain the current distribution of EU space programs (Galileo, EGNOS and Copernicus) with an emphasis on better use of their synergies. However, for better use of synergies, it is appropriate to discuss the governance structure of these programs.

- Create a Institute that can manage all this project, and have the right view over them
- The synergies would be greater if there was public-private collaboration for the management and implementation of the programs.
- It's important to build on the available space capacities in Europe, notably the European Space Agency (ESA) and EUMETSAT: avoid duplication of efforts and/or fragmentation of capabilities and cooperate building on each other's expertise.
- The current governance and cooperation with ESA has been positively evaluated. We believe the many positive elements of the current governance should be preserved. Consider grouping the Space actions when there is a convincing case this would increase efficiency, synergies, and would stimulate and increase cooperation with other space organisations in Europe but sensitive given programme complexity.
- Space actions are well identified and have their own legislation and budget lines. This should be continued.
- With regard to space programs, priority should be given to the development of dual-use systems, to strengthen synergies between civil and military activities (defence and security). The often limited availability of financial resources imposes, in fact, the implementation of systems dedicated to a dual user chain, in order to simultaneously meet different types of needs. For example, possible future missions could be dedicated to:
    - strengthen the earth observation capacity at high spatial and / or temporal resolution;
    - develop secure telecommunications systems.

  In general, precisely because of the strategic importance of the space programs and their multi-disciplinary nature, we also hope for greater synergy between the various DGs of the European Commission (e.g. DG GROW and DG MOVE).

- Space is a policy where several European actors are involved: EU, ESA and their respective MS, for this reason a high level of coordination between all the involved entities is strongly recommended. At the moment this coordination is in place, thanks to a Framework Agreement between ESA and EC signed in 2004. Anyway a better coordination could be envisaged in the future also considering that maybe the common programs will be even more than the original two. This is fundamental to avoid duplications and overlaps, and guarantee that all the available resources for space at national, ESA and EU level are optimized.
- The current approach of having several special programmes (Galileo, Copernicus, etc.) devoted to crucial subjects is kind of adequate.
- In case funding for 1 topic is available by two different funding sources, it should be ensured, double funding for 1 project is not possible, but it is supported that projects can be mapped to different funding programmes.

Views of different stakeholder groups

An attempt has been made to break the responses down to different categories of stakeholders. It should be noted that the very limited number of replies regarding space (33) raises concerns with respect to representativeness. Breaking responses down further aggravates this concern.

In order to attribute responses to stakeholder groups, we only retain those replies made on behalf of an organisation. We further group responses from private companies and trade associations together as representatives of businesses. This group has 11 responses. The group of NGOs has 8 responses and public authorities provided 4 responses (2 are from different authorities from the same Member State).

Businesses:

Businesses consider the creation of growth and jobs as the most important challenge, followed by the sustainability of Europe's space capability. Roughly half of them (55%) consider the latter challenge to be addressed fully or fairly well by the current Space actions, while a bit over a third (36%) consider this to be the case to some extent only. A large majority do see considerable added value of EU Space actions (82%) while 18% see that only to some extent. While most obstacles were considered relevant to varying degrees, the most important one appears to be the lack of flexibility to react to unforeseen circumstances and to new user needs. Most suggestions to simplify and reduce administrative burdens are supported while more reliance on national rules receives the lowest support.

NGOs:

NGOs unanimously consider the transition to a low-carbon and climate-resilient economy and society as the most important challenge, while many of them have no opinion on the importance of the long-term sustainability of Europe's space capability or are indifferent on this question. On the question how well the current Space actions address the latter challenge, many respondents have no opinion or consider it fairly well addressed. On the issue of EU added value responses vary with half of them indicating that the current programmes provide added value only to some extent. Most obstacles were considered relevant to varying degrees, with about one third of the replies having no opinion on this. The same applies to the different suggestions how simplification and burden reduction could be achieved.

Public authorities:

Public authorities unanimously consider the long-term sustainability of Europe's space capability as the most important challenge. They mostly also consider that the current programmes address that challenge fairly well. As regards the programmes' EU added value, most authorities consider this to be case with only one respondent seeing only a limited EU added value. The lack of flexibility to react to unforeseen circumstances and to new user needs was seen as the most important obstacle. All suggestions for simplification and burden reduction received support with fewer, clearer, shorter rules and more flexibility of resource allocation being the most supported.

Annex 3: Evaluation results

The GNSS and Copernicus programmes were reviewed in the middle of the current MFF. The references and dates of these evaluations are as follows:

Programme	Evaluation	Additional info
Copernicus	Mid-Term Evaluation of Copernicus COM(2017)617	Adopted on October 23rd 2017 by the Commission[40]. Council conclusions adopted on December 1st 2017[41].
GNSS	Mid-term Evaluation of the Galileo and EGNOS programmes and of the performance of the European GNSS Agency COM(2017)616	Adopted on October 23rd 2017 by the Commission[42]. Council conclusions adopted on December 5st 2017[43].

Outcomes of the Mid-term evaluations:

Copernicus

The European Council conclusions on the mid-term evaluation of Copernicus welcomed the Report from the Commission and recognised "*the significant progress achieved in the implementation of the programme since 2014*." It reiterated its call for ensuring the continuity of Copernicus and for sustaining the emerging EO data ecosystem in Europe. It urged "*the Commission, Member States and other actors involved to explore new partnership models and innovative ways of financing*" and called on the Commission to support further private sector involvement.

The mid-term evaluation of Copernicus states that, just three years after the launch of the first Sentinel satellite, Copernicus is producing tangible results which clearly demonstrate the added value of the EU action. The programme is well on track and its original objectives have largely been achieved. Today Copernicus is one of the biggest data

[40] https://publications.europa.eu/en/publication-detail/-/publication/86fe47d6-c501-11e7-9b01-01aa75ed71a1/language-en/format-PDF/source-47687480
[41] http://data.consilium.europa.eu/doc/document/ST-15299-2017-INIT/en/pdf
[42] https://publications.europa.eu/en/publication-detail/-/publication/56b722ee-b9f8-11e7-a7f8-01aa75ed71a1/language-en/format-PDF/source-67017671
[43] http://data.consilium.europa.eu/doc/document/ST-15435-2017-INIT/en/pdf

providers in the world. It delivers data and services to support the implementation and monitoring of EU and national policies. It also creates unprecedented business opportunities in many sectors of the economy and across the EU Member States. Enabling a vibrant ecosystem capable of transforming Copernicus data and information into innovative products and services must remain a priority of the programme. In particular, further efforts should be devoted to user uptake and communication activities, to bring the benefits of Copernicus to new user communities and policy areas.

The mid-term evaluation also emphasised that the long-term stability of the programme and its free, full and open data policy must be ensured in order to provide predictability and planning certainty for businesses and users. Its future evolution must keep up with the evolving requirements of the users and the paradigm shifts in the Earth observation sector globally. Priority areas for expansion are the monitoring of CO2 and other greenhouse gas emissions, land use and forestry, or changes in the Arctic. Enhancing the security dimension of Copernicus is also called for to improve the EU's capacity to respond to the evolving challenges of border controls and maritime surveillance. Strong link should be built with research and science, to make sure that the Copernicus products remain first-class and attractive for users.

Regarding the governance and architecture, the mid-term evaluation recalls that the principle of partnerships under the coordination of the European Commission should continue to drive the future development of the programme since its distributed governance has proven to be successful. However, the Commission should explore further opportunities for streamlining and optimisation, and assess the need for involving new actors. In particular, further private sector involvement (through data-buy or public-private partnerships) could support a robust European Earth observation capacity, which in turn is expected to stimulate further investments. Copernicus should also engage with key international partners in building positive synergies and pooling capacities for tackling global challenges (e.g. anthropogenic CO2 emissions monitoring).

The mid-term evaluation concludes that "*Copernicus is a great opportunity for Europe. It offers a huge potential for innovation, growth and jobs. With Copernicus the European industry has a unique opportunity to become a leader in a global fast growing market. The next years will therefore be crucial to consolidate the achievements and prepare the future adapting to the changing reality of the programme*."

The public report related to this mid-term evaluation is presented in appendix C.

GNSS

The evidence presented in the Commission Report on the interim evaluation of the EGNSS programmes demonstrated that overall the implementation of the GNSS Regulation and of the GSA Regulation has shown good results in the light of the general evaluation criteria and specific requirements for the European GNSS programmes. The Galileo and EGNOS programmes have achieved all the milestones that were set for the period concerned and progress is being made towards delivering on all the programme implementation objectives set for 2020: "*Programmes proved to be effective in the achievement of all milestones sets for the evaluation period and were, therefore, on track to achieve the programme objectives set for 2020*".

The deployment of the Galileo infrastructure was considered effective for both ground and space segments, stressing in particular the fact that the initial delay due to the launch

schedule had been recovered. It also emphasised on the declaration of the initial global provision of the Open service, SAR services and pilot PRS services.

The efficiency and services provision of EGNOS were also highlighted, in particular regarding the "*stability and high performance of the service provision covering over the 98.98% of the land mass of the EU-MS, Norway and Switzerland*".

Regarding both programmes Galileo and EGNOS, the mid-term review specifically mentioned the sound financial management of these programmes, indicating that "*from a financial point of view no cost overruns have been registered during the evaluation period, nevertheless unallocated budget has decreased considerably and shall be properly managed in the next phase of the programme*".

The mid-term evaluation also stressed the importance of the GNSS programmes towards the other EU policies, stating in particular that "*both programmes show a high level of coherence with other EU Policies, within the programmes themselves, and with other GNSS programmes. Stakeholders knowledgeable about EU policy (e.g. Members of the EU parliament, GNSS Committee, and Programme Management), see a strong alignment of the EGNSS action with the five lines of the Space Strategy for Europe communication released in October 2016 and with the space industrial policy strongly outlined in 2013. R&D activities implemented under the Horizon2020 and Fundamental Elements present no overlaps and very limited inconsistencies*".

The Council, when adopting this report, supported all these conclusions, recognising the role of key-technologies enabler of Galileo and EGNOS thus "*forming a firm basis for the development of a strong and innovative downstream application market within the EU and making an important contribution to the socio-economic growth while addressing global political challenges*".
It also highlighted the role and expertise of the GSA and the need to "*find a sustainable solution to ensure that GSA's human resources are adequate to its responsibilities*".
Eventually, the Council concluded by highlighting "*the importance of Galileo and EGNOS for ensuring Europe's strategic autonomy in the field of satellite navigation while fostering a globally competitive European space sector and opening up business opportunities for European downstream industry; CALLS ON the Commission to promote non-dependence regarding key technologies for the Galileo space and ground infrastructure*".

The public report related to this mid-term evaluation is presented in appendix D.

Appendix C – Public report on Copernicus [44] (Mid-term evaluation of the Copernicus programme (2014-2020) - COM(2017)617)

INTRODUCTION

This report highlights the key findings of the mid-term evaluation of the European Earth monitoring programme, Copernicus, three years into its implementation. The report is based on an external study carried out on behalf of the Commission to respond to the obligation imposed by Article 32 of the Copernicus Regulation. The evaluation provides valuable insight for the second half of the programme implementation and for defining the approach to future Copernicus initiatives.

The Commission has launched this exercise not only to assess the benefits and achievements of the Copernicus programme, but also to verify how adequate its original objectives still are, and how the programme may better respond to new challenges and ambitions, considering that in the past few years the overall political, societal, scientific and economic environment has dramatically changed. The Space Strategy for Europe approved in 2016, of which Copernicus is one of the pillars, has already outlined the main priorities for the future of EU space activities and will inspire future developments.

The emergence of a new space economy has undoubtedly been a driver of change, but it is mostly the advent of a hyper-connected information society and digital economy that calls for a re-alignment of priorities and perspectives: data are changing our lives in many domains. The combination of big space data with digital technologies and cloud computing are opening up exciting new business opportunities for companies using these data to develop innovative products, services and applications. We look at a system of actionable geo-referenced data and information, feeding and sustaining endless applications. Copernicus geospatial-intelligence is, in fact already a driver of the 4.0 society. The objectives of the programme will, therefore, need to reflect these societal updates and, while ensuring the existing achievements, provide ground for development in areas like security while promoting economic growth.

That is why this evaluation report adopts a new approach, following the data value chain of Copernicus: from the data gathering and processing to the data and information distribution, to user and market uptake dynamics. This new approach reflects the changing reality of Copernicus which in just a couple of years has become one of the biggest providers of Earth Observation data in the world and engine for Europe's digital economy. From a simple, although unique, Earth observation tool, Copernicus is becoming a dynamic geospatial-intelligence system.

From the success of its data provision infrastructure, to the accuracy of the data distributed according to a free, full and open data policy, to the huge potential for commercial applications, Copernicus has already shown its value and earned recognition for the EU on the international scene. It supports policies and applications in climate change and environment, maritime safety and security, agriculture, disaster management, urban planning and infrastructure. It helps civil authorities to save lives in emergency circumstances, such as earthquakes, forest fires or floods. The programme fosters international cooperation and contributes to global initiatives like the Global Earth Observation System of Systems (GEOSS) and the Committee on Earth Observation Satellites (CEOS).

[44] https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-617-F1-EN-MAIN-PART-1.PDF

This report is accompanied by a staff working document providing more details and references to the study on which it is based. The study itself included a series of consultations with stakeholders, the results of which are reflected in the final analysis of the various components of the programme.

The evaluation covers, as expected, only the first 3 years of operation of Copernicus. Even in this short period of time all objectives established in the Regulation have been met, to a various degree of achievement. The infrastructure and the services are set up as planned in a satisfactory way. Some implementation aspects related to the creation of market applications or even user uptake are still too early to be properly assessed as they depend on the provision of raw data that first arrived, as by default operation, months after the launches of the Sentinels. An excellent execution of the allocated budget and a satisfactory progress in user uptake complete the picture of a healthy and dynamic programme. The complexity of the interaction among the programme's clusters (space infrastructures, services supply and users' access) has, however, highlighted the need for a simplification of procedures and governance models, to deliver the best results in terms of industrial policy implementation.

BACKGROUND

Copernicus is the Union programme for Earth observation and monitoring, established in 2014 as a successor to the previous space programme GMES. Its general objectives support the protection of the environment, civil protection and civil security. The programme aims at maximising the socio-economic benefits, ensuring the European independent access to environmental knowledge and fostering the development of a competitive European space and services industry. Copernicus has three key components: a space infrastructure (including satellites and ground equipment for data reception and processing), services for the generation of thematic data and information products and their distribution, and the coordinated access to in-situ data. Most of the operational, project-management, coordination and implementation tasks for the space component have been delegated to the European Space Agency (ESA) and partially to the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), while Services rely on the support of DG JRC and different Service Operators with whom delegation agreements have been concluded. These include the European Environment Agency (EEA), the European Centre for Medium-Range Weather Forecasting (ECMWF), Mercator Océan, the European Border and Coast Guard Agency (FRONTEX), the European Maritime Safety Agency (EMSA) and the EU Satellite Centre. Copernicus has inherited from GMES a great synergy with the INSPIRE programme with which it interacts for the operational context of the core services and data distribution platforms. Copernicus conformity with INSPIRE online services and interoperability is mandatory to ensure effective and efficient integration with all other geospatial data resources.

MAIN FINDINGS OF THE EVALUATION

Following the rules for evaluation, the results of the programme implementation have been assessed against the five criteria of effectiveness, efficiency, relevance, coherence (and associated complementarity and cooperation), and EU added value. The assessment has been based on the key performance indicators defined in the Regulation and the various delegation agreements.

Data acquisition

Copernicus acquires its data from various sources: satellites, in-situ sensors and other missions. The space-borne data transmitted by the Sentinels (Copernicus satellites) to the ground segment are complemented by non-space-borne data with a geographic dimension, including observation data from ground-, sea- or air-borne sensors, as well as reference and ancillary data licensed or provided for use in Copernicus from different sources (mainly Member States data sources, or European and international bodies, such as EUMETNET), the so-called "in-situ". The evaluation has confirmed that the space component, delegated to ESA and EUMETSAT, is the most advanced element of the programme, in terms of deployment of the satellites, the volume and quality of data transmitted and processed for further distribution. All the data acquired by the satellites are controlled, calibrated based on in-situ data, and validated before being published, ensuring a homogeneous quality level. Many users perceive this aspect as being the key asset of the Copernicus programme.

At the end of the first quarter of 2017, the Sentinels constellation counts five satellites in orbit performing very well. Only limited delays for two of them have been registered, due to the availability of the launchers: both satellites (Sentinel -3A and Sentinel -2B) were planned to be launched with a Russian Rockot, identified as the most economical option at the time the launchers were procured. The deterioration of the political context and the impact on the supply chain affected the launch schedule. In order to mitigate the launch delays for at least one of the two satellites (Sentinel 2B), a swap with another launcher (Vega) was decided, allowing its successful launch on 7 March 2017. The delays, however, can be considered negligible for a space programme of this scale and the deployment schedule has generally been respected.

The data volume, accuracy, reliability and quality are one of the most successful elements of Copernicus implementation. By the end of the first quarter of 2017 the Sentinels have reached and exceeded the expected daily volume of data production .The original core ground infrastructure, dedicated to data reception and processing for further dissemination through data distribution hubs, was integrated with additional local stations for receiving data from the satellites, data processing, mirror sites and archives promoted by Member States (called "collaborative segment"). To prevent fragmentation and duplication of structures and investments, an ad-hoc task force to coordinate the initiatives in the data distribution and reinforce synergies was set up by the Commission in 2015.

To complement the Sentinels data with additional data relevant to final users and necessary to generate the Services products Copernicus makes also use of the so-called Contributing Missions, i.e. National or International space missions, vital to the programme. For instance, access to some Very High Resolution data is guaranteed by the contributing missions as Sentinels alone are not able to provide it. From a historic perspective Contributing Missions data have allowed to kick-off Copernicus Services before the launch of the first Sentinel in April 2014. As of today, 10 licences have been signed with Contributing Missions data providers. All the contributing missions' datasets are included in the Data Warehouse (DWH). Latest statistics from 2017 show that the demand for Contributing Missions data is rapidly growing as the services become increasingly operational.

Copernicus is a "user driven" programme, based on the requirements of the user communities demanding specific data, information and products. This is reflected in the governance structure of the programme, including a "User Forum", where all user communities are represented and can support and steer the implementation of the programme. After one and a half year since the last update, the Commission is currently reviewing the DWH operation for data requirements gathering procedure, user satisfaction and DWH monitoring tools. Several milestones have also been achieved before 2017 on the coordination of activities: Copernicus in-situ data requirements have been revised and updated for all six Copernicus services; critical in-situ data gaps have been listed, including proposals for gap closing activities; data access agreements have been signed with selected European networks; Copernicus Reference Data Access (CORDA) node became operational; a plan for the involvement of selected global level networks has been agreed with the services; a cross-service register of stakeholders, partnerships and data access arrangements was constituted. The agreement with international networks of partners such as EUMETNET has established a single interface providing access to several dozens of partners and is recognised as a best practice of efficiency.

Findings on the budgetary aspects are also positive: according to the feedback from industrial partners Copernicus space operations show no cost overruns and a very efficient procurement process. Spending on the space component (the biggest part of the budget allocated to the programme) is in line with the forecasted budget for the 2014–2016 period. Considering the complexity of the programme and the related costs, difficult to be borne by a single Member State, the EU added value of the programme is very high: with its capabilities, data production and coordination system, Copernicus is more than the sum of each Member State's contribution to the programme; it is a truly European capacity at the service of citizens, industry and society at large.

- The data gathering activity is efficient: high quality satellites have been successfully deployed on time and on budget, supplying high quality imaging. The performance is clear proof of a competitive European Space industry capable to deliver.

Data and information processing

The six Copernicus Services, at the heart of what can be defined as Copernicus geo spatial-intelligence system, provide timely and reliable information to a growing community of users in Europe and world-wide. For this knowledge generation activity, the data acquired are processed and transformed into appropriate products available for the end-users and distributed through the services. Based on both space-borne and in-situ observations and data the Copernicus services generate timely and reliable geo-information products along defined and agreed processes, in some cases involving significant data assimilation and modelling efforts. Each of the six services responds to specific environmental or security-related themes identified as key for the European society. The services are delegated to competent service operators (or Entrusted Entities) that manage the services on behalf of the Commission.

At the onset of the Copernicus Programme, two of the six Core Services, Land monitoring (CLMS) and Emergency management (EMS) were operational, thanks to the contributing missions data provided under the GMES GIO programme. Atmosphere monitoring (CAMS) and Marine environment monitoring (CMEMS) services were in pre-operational phase while Climate Change (C3S) and Security services were still being designed or developed. Three years later, all services are in operation, except specific

product groups of the Security service and the Climate Change, still in pre-operational phase. All delegation agreements with the entrusted entities, however, have been signed according to the planned schedule.

Some of the products supplied by the Services are particularly important for the public sector and local authorities: the land monitoring service registers urban planners, city administrators and transport authorities among its user clients. An increasing number of private operators in the field of urban monitoring and development, such as energy and utilities companies, real estate companies, chain stores, and building material suppliers buy Earth observation products. The typology of users varies according to the Service, of course: Emergency service's users are, for example, only entities and organisations at regional, National, European and International level, active in the field of crisis management.

The list of EU and Commission political priorities supported by Copernicus services and products is long and includes Climate change, Migration, Environmental policy, Agriculture and food safety, Maritime surveillance, Security, Transports and Energy, Smart urban development, Disaster management and reduction.

The performance of the services is generally considered good by users, based on their good availability, timeliness and the variety of the products portfolio. Even the Climate Change service, although still in a pre-operational phase is already on good track as the number of users doubled between 2015 and 2016, clearly attracted by the highly innovative first results. One example of excellent Service output is the first Ocean State Report, based on Copernicus marine environment monitoring service products, which is a precious tool for environmental directorates, agencies, conventions and international organisations' activity.

The Security Service, in particular, has acquired an increasing relevance for the information it can offer in response to Europe's security challenges, especially for the border surveillance and maritime surveillance. Its data and products are fully integrated and supporting the agencies' mandated tasks in the areas of border protection, maritime safety, and support the EU CFSP/CSDP.

A balanced definition of new products within the Copernicus product portfolio has been identified as a challenge, but has been dealt with by the Commission through the establishment of a specific procedure for the definition of new products and the user needs gathering process, in agreement with the stakeholders. This process allows Copernicus to respond dynamically to a rapidly changing environment.

- Copernicus is not only the world's largest single Earth Observation programme, but by incorporating Copernicus Services knowledge generation into its architecture it became a pole of Earth Observation-related scientific and operational expertise which has become a true European success story.
- By responding to evolving user needs with its timely and reliable geo-information products, Copernicus has been able to dynamically adapt to rapidly evolving challenges and to the European political landscape, for example tackling with its Climate Change Service the foremost environmental challenge facing Europe and the world as a whole.

Data access and distribution

Space-borne and in-situ data, as well as Service information and products have to be made available to users in an efficient manner. One of the weaknesses identified during

the stakeholders' consultation, as regards the data distribution component of the programme, is the fragmentation of product offer and data dissemination mechanism (via the Entrusted Entities, via EU web portals, via ESA), and this might have created confusion for some users and been perceived as a duplication of effort. Further work is therefore suggested to facilitate access to data with specific attention on collaborative ground segments and data distribution at national level. Data transfers between the Copernicus pick-up points and the users are relatively slow, thus affecting the ability to make use of them on large scales. Readability of metadata is also identified as an issue for users, typically if supercomputers are needed to store the data. Users would also expect to have online processing facilities close to the data in order to avoid downloading large volumes of data. The Commission has taken action to respond to these user requests. The traditional distribution routes for accessing Copernicus data and information are being strengthened and innovative Data and Information Access Services (DIAS) are being launched, within the agreements with ESA and EUMETSAT, to bring users closer to the data. The first DIAS are expected to start operations in early 2018. Today, beside the access to Copernicus Services platforms run by the different delegated bodies, the main satellite data access channel consists in the 4 ESA hubs:

1. Copernicus Open Access Hub (COAHub), previously Scientific Hub

2. Copernicus Services Data Hub (ServHub), previously CopHub, only open to Copernicus Services and European institutions.

3. Collaborative Data Hub (ColHub), open to the GMES Space Component (GSC) and Copernicus participating States following a signature of a Collaborative Ground Segment agreement with ESA.

4. International Access Hub (IntHub), open to international partners which have signed an arrangement.

The large volume of data downloaded creates challenges regarding the management of the network traffic on the ICT infrastructure. A dedicated link to the network "GÉANT" was set up in May 2016 to answer this challenge: it currently routes around 66% of the network traffic. The current infrastructure has been upgraded in March 2017 to double the bandwidth capacity.

As for the security aspects, the full, open and free data policy has been implemented in accordance with the Article 23 of the Regulation, including the limitations therein defined. No particular cyber threats have been identified, considering the current images resolution and each entrusted entity's internal measures to face those threats.

- Copernicus new thresholds of data and information production and processing provoked a paradigm shift in Earth Observation big data domain. The associated challenges have been addressed by engaging with state-of-the-art solutions in building a digital economy.
- The original concept of Copernicus foresaw a provision of data serving primarily the needs of the Copernicus services and this objective has been achieved with great success. However, new user needs have emerged, calling also for large-scale access to and exploitation of direct Sentinel data, at various timeliness and processing levels. In response to this user need the Commission is planning a programme evolution to add a robust big data provision system,

Data uptake

To maximise the socio-economic benefits of the programme by supporting the development of smart applications as requested by the Copernicus Regulation has been a challenging task, given that Copernicus data were planned but not yet available (due to the progressive deployment of the constellation).

The free, full and open data policy adopted by Copernicus has led to unforeseen interest: by the end of March 2017, the number of registered users in the main dissemination hub (the Open Access Hub) well exceeded the target set at the beginning of the programme, as well as the number of products downloaded. The availability of Copernicus data and services was met with strong growth in the European Earth Observation downstream sector (over 10% per annum in 2014 and 2015, compared with 1.8% on average in the European economy).

The European Commission has supported this trend by launching many user uptake initiatives. To boost the promotion at regional and local levels, two European networks have been set up, the Copernicus Relays and Copernicus Academy, charged with the organisation of awareness activities and acting as local helpdesks. A Copernicus support office was set up to provide support to all users. Furthermore, to stimulate innovative uses of Copernicus data, the Commission joined forces with ESA in the organisation of the Copernicus Masters, an annual competition aimed at stimulating innovation, increasing awareness and providing visibility for start-ups. The Copernicus start-up programme also includes the Copernicus Accelerator, a one-year coaching programme launched in 2016, soon to be complemented by the Copernicus Hackathons and the Copernicus Incubation programme. A large number of information and training sessions and thematic workshops have also been organised targeting public and private users. Communication on the web and on social media has been significantly strengthened. In parallel, the Commission has created a Copernicus skills programme, featuring a partnership on skills for the geo spatial-sector (through the ERASMUS+ programme) and cooperation with two Knowledge Innovation Communities, KIC climate change and KIC raw materials. These activities are complemented by communication and user uptake activities undertaken by the Copernicus Entrusted Entities.

Though the efforts of the Commission to launch user uptake actions have been substantial, there is still a need to expand activities among users who are not earth observation specialists. Some communities should be targeted in particular, such as the IT community or some promising sectors (smart cities, insurance and others). This would widen the user base of Copernicus, thus multiplying its societal impact. To further increase the number of user uptake actions, the Commission could also evaluate delegating some tasks to an operational agency. Finally, a greater involvement of Member States and closer coordination with EU level actions could further accelerate Copernicus user uptake. The Commission has started to address this issue and will soon launch a framework partnership agreement with Member States in order to jointly finance user uptake activities.

- The Copernicus programme has attracted considerable interest from users, with more than 80,000 registered users on the main Sentinel hub (well beyond the original target)
- Since 2015, the Commission has launched ambitious user uptake activities, including awareness events, training courses, start-up support programmes, and regional initiatives.

- Expanding activities to non-specialist communities should be considered. Greater involvement of Member States could also considerably accelerate the uptake of Copernicus.

CONCLUSIONS AND WAY FORWARD

Just three years after the launch of the first Sentinel satellite, Copernicus is producing tangible results which clearly demonstrate the added value of the EU action. The programme is well on track and its original objectives have largely been achieved. Today Copernicus is one of the biggest data providers in the world. The huge amount of data it generates, coupled with advances in ICT and cloud computing, creates unprecedented business opportunities in many sectors of the economy and across the EU Member States. Unlocking this economic potential is one of the main challenges Copernicus faces today. Enabling a vibrant ecosystem capable of transforming Copernicus data and information into innovative products and services will remain a clear priority during the next phase of the programme until 2020.

Looking to the future on the basis of the present evaluation, continuity and sustainability of services and observation data will be absolutely critical for the lasting success of Copernicus. The long-term stability of the programme and its free, full and open data policy must be ensured in order to provide predictability and planning certainty for businesses and users. Copernicus is and should remain a user-driven programme. Its future evolution must keep up with the evolving requirements of the users and the paradigm shifts in the Earth Observation sector globally. In line with the Space strategy adopted in 2016, the Commission should plan a long-term vision for the programme, in order to give visibility and predictability to all partners in Copernicus, allowing them to invest, benefit and support, especially considering the shifting priorities of the programme.

The Copernicus services constitute a major part of the added value of the programme. They should continue to develop, improve and evolve, addressing new challenges and new policy priorities. The Space strategy for Europe identifies a number of priority areas for expansion and evolution to address the challenges of climate change and sustainable development, to monitor CO2 and other greenhouse gas emissions, land use and forestry, or changes in the Arctic. Enhancing the security dimension of Copernicus is also called for to improve the EU's capacity to respond to the evolving challenges of border controls and maritime surveillance and to explore how Copernicus could cover further security needs, including defence. In preparing the post-2020 phase of the programme, all options should be thoroughly analysed and prioritised together with the Member States.

Copernicus has been built as a partnership between the EU, the Member States, ESA and EUMETSAT. The principle of partnerships under the coordination of the European Commission should continue to drive the future development of the programme since its distributed governance has proven to be successful. For the period after 2020, the Commission might, however, explore further opportunities for streamlining and optimisation, and assess the need for involving new actors where this could bring clear value and increased efficiency to the programme.

New business models based on public-public partnerships, public-private partnerships or service-buy schemes, to leverage the capacity of the Member States and the European industrial competences, could support a robust and sustainable European Earth observation capacity, which in turn is expected to stimulate further investments.

International cooperation is essential in Copernicus. It provides a vital tool underpinning Europe's commitments and leadership role in tackling global challenges such as climate change and global opportunities for marketable products. Future developments must strengthen this aspect even further to enhance the scope and quality of Copernicus data and services, based on mutually beneficial data exchange arrangements, and to engage with key international partners in building positive synergies and pooling capacities for tackling global challenges in a coordinated manner (e.g. CO2 emissions monitoring). Efforts should therefore be directed towards the consolidation of Copernicus as global standard in the geo-location data domain.

Copernicus is a great opportunity for Europe. It offers a huge potential for innovation, growth and jobs. With Copernicus the European industry has a unique opportunity to become a leader in a global fast growing market. The next years will therefore be crucial to consolidate the achievements and prepare the future adapting to the changing reality of the programme.

Appendix D – Public report on GNSS[45] (Report on the implementation of the Galileo and EGNOS programmes and on the performance of the GNSS Agency – COM(2017)616)

1. INTRODUCTION

On the occasion of the 60th Anniversary of the Treaty of Rome, EU leaders, the European Parliament and the European Commission committed to the Rome Agenda, and pledged to work towards a safe and secure Europe, a prosperous and sustainable Europe, a social Europe and a stronger Europe on the global scene. The European satellite navigation programmes EGNOS and Galileo contribute to this Agenda.

In line with the Union's Space Strategy and the objectives of the GNSS Regulation, Galileo and EGNOS focus on:

- maximizing the integration of space into the European society and economy, by increasing the use of satellite navigation technologies and applications to support public policies;
- fostering a globally competitive European space sector, by supporting research, innovation, entrepreneurship for growth and jobs across all Member States;
- strengthening synergies between civilian and security activities in the field of navigation, and ensuring European autonomy;
- promoting the role of the Union in the world and opening up new business opportunities for the European satellite navigation industry.

This report presents the interim evaluation of the European satellite navigation programmes, Galileo and EGNOS, and the evaluation of the European GNSS Agency (GSA) as required by Article 34 of Regulation (EU) No 1285/2013 on the implementation and exploitation of the European satellite navigation systems ("the GNSS Regulation") and Article 26 of Regulation (EU) No 912/2010 setting up the European GNSS Agency ("the GSA Regulation") . The report is accompanied by a Staff Working Document detailing the evidence based assessment.

The interim evaluation focuses on the period from 1 January 2014 to 31 December 2016. It covers the progress made in the European GNSS programmes Galileo and EGNOS against the evaluation criteria set up in the Better Regulation Guidelines : effectiveness, efficiency, relevance, coherence and EU added value, specific requirements enshrined in the GNSS Regulation, and the overall political objectives of the Union. As the GNSS Regulation entrusts the GSA with a key role in the implementation of the European satellite navigation programmes, the Commission considered it is appropriate to evaluate the GSA jointly with the evaluation of the programmes.

2. MAIN FINDINGS CONCERNING THE IMPLEMENTATION OF THE EUROPEAN GNSS PROGRAMMES

2.1. RELEVANCE OF THE GALILEO AND EGNOS PROGRAMMES

The European satellite navigation systems, Galileo and EGNOS, owned by the European Union, are fundamental for both the European economy and security. Positioning and timing signals provided by satellite navigation systems are used in many critical areas of

[45] http://eur-lex.europa.eu/legal-content/EN/TXT/DOC/?uri=CELEX:52017DC0616&from=EN

the European economy, such as mobile phone networks, in-car navigation, traffic management, power grid synchronisation or electronic trading. It is estimated that almost 11% of the EU economy is impacted by satellite navigation services . Therefore, the EU clearly needs to maintain and operate independent satellite navigation programmes to secure the availability of those applications and services ensuring global coverage, including the circumpolar area. In addition, space capacities are strategically important to civil, commercial, security and defence-related policy objectives. For this reason, Europe needs to ensure an autonomous, safe and cost-effective access to space.

2.2. ACHIEVING KEY OBJECTIVES

2.2.1. Market uptake

Over the evaluation period, the market uptake of Galileo and EGNOS has progressed well. The European GNSS industry has grown and accounted for 25% of the global GNSS market in 2015. European manufacturers represented the majority of manufacturers for the road and maritime market segments. European system integrators represented the majority of integrators for the maritime, agriculture and surveying market segments.

Driven by a few large companies and a plethora of innovative SMEs and start-ups, Europe performs strongly in the development of added-value applications.

The development of Galileo has already generated major benefits in Europe, like the development of services. Thus, following the declaration of Galileo Initial Services, chipset and receiver manufacturers have had the possibility to start leveraging on more performant GNSS signals, especially for smartphones and in-vehicle navigation systems. The vast majority of new navigation chipsets include the processing of Galileo signals and are gradually integrated in user receivers in various market segments. All new products of the two largest smartphone manufacturers do include Galileo-compatible chipsets, which is a true measure of its success. The regulatory measures taken by the EU in the automotive sector (eCall and Digital Tachograph) are pushing for the adoption of solutions integrating GNSS based technologies, whilst at the same time ensuring compatibility with Galileo and EGNOS. It is worth pointing out that Galileo competes with other GNSS that are supported by regulatory measures to impose or stimulate the use of these systems.

As for EGNOS, major socio-economic benefits have already been produced especially in three industrial domains with the largest market penetration: aviation, agriculture and surveying. In other sectors, such as maritime and rail, the GSA has been implementing market penetration roadmaps. However, due to the slower adoption of new technologies and existence of alternative ground based technologies the market uptake in these sectors is slower.

2.2.2. System deployment and services

The Galileo programme has achieved its key objective set out for the evaluation period - the system was declared operational and is providing Initial Services since December 2016, namely an initial open service (OS), search and rescue support service (SAR) and public regulated service (PRS).

The space segment of Galileo was enhanced with 14 additional satellites launched in the evaluation period, one of the enablers for declaring the Galileo Initial Services operational. In November 2016, for the first time ever, four Galileo satellites were launched together on an Ariane-5 rocket. The implementation of complex technology intensive programmes however entails risks. Galileo is no exception. Such risks

materialised in 2014 with a Soyuz launch incident, which resulted in two satellites being injected into an incorrect orbit. It materialised also with an anomaly affecting some atomic clocks on board of Galileo satellites. In both cases, the root cause has been identified and the necessary mitigation actions have been implemented. The delay in the deployment schedule induced by the launch anomaly was recovered with an accelerated ramp-up of the Galileo space segment and the two satellites are already being used for the SAR service. As regards the clocks, a refurbishment programme for the next satellites to be launched has been implemented and operational procedures for the satellites in orbit established. The quality of the services provided by the system has not been affected by the difficulties encountered and the performance of the system is above expectations.

The EGNOS services were continuously provided and improved during the period 2014-2016. Thus, EGNOS now provides the highest quality guided approach services available today to airline and aerodrome operators, with an increase in flight and landing safety, and benefits related to the optimisation of fuel consumption. In addition, EGNOS is used by a larger number of users: more than 230 airports in 20 countries are using EGNOS landing approach procedures at the end of 2016.

However, the priority for EGNOS remains to cover the entire EU-28 territory with the EGNOS service and to extend the EGNOS service coverage to the remaining 1.02% of the EU-28 territory (eastern part of Cyprus, the Azores, and the northern parts of Norway and Finland).

2.2.3. International cooperation

In the field of international cooperation, several actions were undertaken to strengthen Europe's role as an international player in the field of GNSS. In particular, negotiations were concluded in 2016 with the Agency for Aerial Navigation Safety in Africa and Madagascar (ASECNA), laying down the terms and conditions for the provision of space based augmentation systems in Africa based on EGNOS. In addition, the GNSS agreement with Korea was concluded in June 2016 for increased cooperation.

2.3. EFFICIENT DELIVERY - MANAGEMENT

2.3.1. Budget

For the period 2014-2020, the European Union allocated a total budget of EUR 7.072 billion for the Galileo and EGNOS programmes. This envelope covers programme management activities, Galileo deployment and exploitation activities, EGNOS exploitation activities and risks associated with these activities. As of end 2016, the Galileo and EGNOS programmes are on track to respect the budget boundaries set by the GNSS Regulation for the period 2014-2020. The Commission monitors the budget closely to ensure its stays within the limit.

2.3.2. Delivery mechanisms

Over the period 2014-2016, the governance scheme that was decided in 2013 has been progressively implemented: Delegation Agreements were concluded between the Commission and the European Space Agency (ESA) on the Galileo deployment phase, as well as between the Commission and the European GNSS Agency (GSA) on the Galileo and EGNOS exploitation phases. Working Arrangements between the GSA and ESA for both Galileo and EGNOS programmes were equally concluded. The role of the GSA in the operational management of the programmes has gradually increased.

The new governance scheme has brought more robust management processes. These have contributed to maintain the programmes within budget boundaries and to mitigate risks and the impact of unforeseen events on the programmes.

The new governance set-up required the key actors (European Commission, ESA and GSA) to adapt to their new role, a role which is not necessarily fully in line with their corporate culture, competencies and/or structure. That adaptation however led to some inefficiency. For example, the organisation of responsibilities and control processes has often required lengthy discussions among the governance actors, thus affecting the reactivity of the decision-making process. Furthermore, the fact that the deployment phase and the exploitation phase run in parallel with different governance set-up required both agencies to perform additional activities to ensure consensus with the Commission on the way tasks have to be executed.

A learning curve of the involved entities and of the programmes themselves is expected to further improve the situation in the next few years. An efficient decision-making process is particularly important for operational programmes driven by services and users' needs as Galileo and EGNOS. In that context, the interaction between the entity in charge of deployment (ESA) and the entity in charge of operations (GSA) will have to be looked at closely.

In terms of security, the declaration of Galileo Initial Services and the overlap of the deployment and exploitation phases have led to some challenges. In particular, the independence in operation of different entities responsible for the implementation and verification of security requirements (European Commission, GSA, ESA) should be maintained.

However, it is still worthwhile to further optimise the current governance scheme for the Galileo and EGNOS programmes, in order to reflect the entry into operational phase of such service-driven programmes. This may involve reducing the administrative burden for the key actors, as well as the complexity and length of the decision making process. Finally, it should evolve to take into account new security challenges such as cybersecurity and to clearly define the roles and responsibilities of the actors in charge of the implementation and verification of security requirements.

2.4. EU ADDED VALUE

With the Declaration of Initial Services, Galileo officially moved from a testing phase to the provision of live services. Users around the world are now guided using the positioning, navigation and timing information provided by Galileo .

A few months after the Declaration of Initial Services, a number of Galileo-ready devices already hit the mass market. All main chipsets (sold by 17 major suppliers worldwide, representing 95% of the market) that are used in smartphones, tablets, cars, professional survey equipment, etc. use Galileo.

These chipsets are embedded in consumer and professional products that we can buy today. Based on the main products on sale, the GSA estimates that more than 100 million user devices enabled for EGNOS and/or Galileo services are today in the hands of European citizens. From 2018, all new car models sold in the European Union will rely on EGNOS and Galileo to calculate the position of emergency calls in case of accidents.

In addition, the potential number of users is expected to become bigger: shipments of GNSS devices in the European Union are expected to grow from 210 million units in 2015 to almost 290 million in 2020 , representing a much larger base of users for EGNOS and Galileo.

Thus, the implementation at EU level of the Galileo and EGNOS programmes has brought a high added value compared to what could have been achieved by the Member States at national, regional or local level. The size and complexity of the programmes require implementation at EU level, as no viable alternative exists to ensure an appropriate return on investment. As a result of this, all stakeholders agree that the continuation of the programmes' implementation at EU level is a condition for the achievement of the Galileo and EGNOS objectives.

The Galileo and EGNOS programmes contribute to a safe and secure Europe by ensuring European autonomy in accessing and using space in a safe and secure environment, and in particular consolidate and protect its infrastructures, including against cyber threats, as well as by strengthening synergies between civilian and security activities in the fields of navigation, communication and observation, including through monitoring borders, land and maritime security conditions.

The Galileo and EGNOS programmes also promote a stronger Europe on the global scene. Given the increasing competition with other GNSS and SBAS systems, it is crucial that Europe develops its own systems, to take part in the race to the technology, to remain a world-class actor in space and a partner of choice on the international scene.

3. MAIN FINDINGS CONCERNING THE GSA

3.1. IMPACT AND EFFECTIVENESS OF THE GSA

Over the period 2014-2016, the GSA has successfully achieved important objectives for the progress of Galileo and EGNOS programmes and for the development of European downstream markets. This has been accomplished through an effective implementation of both core tasks entrusted to the GSA directly on the basis of the GSA Regulation, and tasks delegated to it by the Commission through Delegation Agreements.

Key achievements of the Agency include the implementation in particular of testing activities that were a prerequisite for the declaration of Galileo Initial Services; the transition towards the Galileo exploitation phase, in particular the award of the contract to the Galileo Service operator (GSOp); the smooth implementation of FP7, Horizon 2020 and Fundamental Elements R&D projects; as well as downstream market development through monitoring, communication and promotion activities. These results have been delivered within budget.

3.2. EFFICIENCY IN TERMS OF SMOOTH RUNNING, WORKING METHODS AND USE OF RESOURCES

Over the period 2014-2016, the Agency has been efficient overall in terms of smooth running, working methods and use of resources.

As regards the smooth running of the Agency, the processes implemented by the GSA are primarily defined in the legal framework governing the Agency, which the Agency has complied with. This has contributed to the effective implementation of the programmes.

Regarding working methods, the GSA has been proactive in improving the effectiveness and efficiency of its delivery process, to be able to handle properly the increasing responsibilities with which it is entrusted. Thus, the Agency has been awarded in the period the ISO-9001 certification, showing a quality management system.

Concerning the use of resources, the GSA has faced a challenge in terms of attracting the relevant resources and skills. Between 2014 and 2016 with the increasing responsibilities entrusted to the GSA, the total budget managed by the Agency has grown by 85,9%, and the GSA staff has increased by 22,1%.

3.3. ROLE OF THE SECURITY ACCREDITATION BOARD (SAB) AND SECURITY GOVERNANCE

The GSA Regulation established the SAB, which is responsible for security accreditation related tasks for the European GNSS systems. It works independently with no reporting to the GSA Executive Director. The SAB has performed well, and constant monitoring is required to ensure its complete independence.

The evaluation has demonstrated that all relevant bodies (e.g. security organisation in EC, ESA and GSA; SAB) and processes (e.g. security requirement identification, security accreditation, security risk identification and management, security of the operations, system security monitoring) are today up and running. This has allowed the relevant actors to fulfil their tasks ensuring the accreditation of all the deployed elements of the European GNSS systems, the accreditation of the Ariane 5 as a launcher for the Galileo satellites, and the declaration of the Galileo Initial Services in December 2016.

The efforts to optimise security will have to continue, in particular, with regard to the appropriate management of cyber threats and the need to improve the independence of security accreditation activities from other programme activities. The GSA will have to monitor its ability to maintain the security processes through the exploitation phase.

4. WAY FORWARD

4.1. MARKET UPTAKE OF GALILEO AND EGNOS

Continuing to reinforce the market uptake of Galileo and EGNOS services is essential to ensure the return on the Union's investment in the programmes and to maximise the socio-economic benefits that these services can generate. There is a need to continue working on ensuring an appropriate regulatory framework for the uptake of GNSS services. This will also require reinforcing available legal mechanisms.

At EU level, EU policies have to take into account the benefits of Galileo and EGNOS positioning, navigation and timing services through concrete measures, including regulatory measures, development of standards and future sectoral strategies. The emphasis needs to be on key sectors with the highest added value such as mobile phones, Internet of Things, autonomous and connected cars, aviation and unmanned aerial vehicles (drones) and critical infrastructure using timing synchronisation. The Commission will release a European radio navigation plan to facilitate the introduction of global navigation satellite system applications in sectoral policies. At national level, these efforts should also be supported by encouraging the use of Galileo and EGNOS services in national policies and government applications.

Devices and applications using Galileo and EGNOS are developed by SMEs and start-ups. European companies are facing fierce competition from US and Chinese companies and they are dependent on non-European critical components and technologies. There is a need to step up the support for increasing the competitiveness of European downstream industry aimed at improving their global market share, and creating jobs. Support for research and development activities, SMEs and start-ups in the area of satellite navigation through EU funding programmes are to be monitored.

Galileo and EGNOS services must continue to develop based on the needs of users to deliver state-of-the-art satellite navigation services with higher robustness and new innovative features. This is especially important in an ever more competitive international environment where other constellation providers have ambitious modernisation plans. The Commission is already working on the next generation of Galileo and EGNOS infrastructure that will allow for modernised services. To ensure that developments are driven by user needs, including security-related requirements, the Commission will strengthen the user consultation process and set up dedicated user platforms.

4.2. GALILEO AND EGNOS SERVICES

After the Initial Services phase, the Commission will ensure that Galileo services are gradually improved with the aim of reaching full operational capability by the end of 2020. To reach this objective, the space and ground infrastructure of Galileo will continue to be deployed. The Commission will procure necessary launch services to ensure the launch of all procured satellites.

The Galileo Commercial Service will also be introduced before 2020 consisting of innovative high accuracy and authentication features, both expected to be differentiators for the adoption of Galileo by users. In addition, the Commission has launched the work on the evolution of the system, in full consultation with Member States and end users' communities to ensure that future services continue to be fully in line with their needs.

Emphasis should also be put on cyber security to ensure that protection mechanisms are in place, and are commensurate with the evolving cyber threats.

The EGNOS services are provided to end users in Europe with a high degree of stability and performance. The key user community of EGNOS is the aviation sector. To guarantee the continuity of the EGNOS services, recurrent activities will continue to be implemented and system updates prepared. The Commission will ensure that full coverage of the targeted area is achieved in line with the EGNOS Service Evolution plan.

In parallel, the development of the next generation of EGNOS is well under way. This new version will augment both GPS and Galileo signals on dual frequencies, which will bring major improvements to the EGNOS services and increase user uptake.

Finally, the safeguard the resilience of the services, the Commission will assess measures to secure the provision of critical components for both satellite navigation systems, in particular through diversification of the supply chain.

4.3. INTERNATIONAL COOPERATION

The promotion and use of Galileo and EGNOS services worldwide is important to increase the use of European technologies worldwide and to open up new market opportunities for European companies. The adoption of EGNOS technology and services in the Western Balkans, in the European Neighbourhood Policy (ENP) countries and on the African continent is expected. As regards Galileo, promising markets which would greatly benefit from its services and applications will be targeted, such as for example Asia and South America.

Galileo and EGNOS programmes are also means for reinforcing the role of the EU as a global actor. The representation of the programmes' interests in international organisations and fora needs to be reinforced, in particular on subjects related to compatibility and interoperability with other global satellite navigation systems and proper use of frequency bands.

4.4. GOVERNANCE OF THE PROGRAMMES

The public governance of the programmes put into place for the period 2014-2020 ensured a smooth transition from the deployment to the exploitation phase of the Galileo programme. The GSA is progressively settling into its new role in the operational management of Galileo.

The experience with the operational management of EGNOS shows that an approach where design, construction, operations and service provision are most efficiently delivered in fully integrated management.

In the governance of security related issues, adequate mechanisms are in place to ensure smooth management of requirements during the overlapping deployment and exploitation phases up to 2020. The independence of operation of the organisations (the Commission, GSA and ESA) responsible for security requirement implementation and verification should be maintained and the independence of the security accreditation activities from other programme activities could be further improved.

The Commission will monitor and, if necessary, adjust the interactions with the GSA, ESA and other stakeholders of the Galileo programme in particular in order to ensure that the needs of the exploitation phase of Galileo are met.

Ahead of the proposals for the next multi-annual financial framework, the Commission will initiate a review of the overall governance to address the shortcomings identified during this evaluation process.

5. CONCLUSIONS

The evidence presented in the interim evaluation demonstrated that overall the implementation of the GNSS Regulation and of the GSA Regulation has shown good results in the light of the general evaluation criteria and specific requirements for the European GNSS programmes. The Galileo and EGNOS programmes have achieved all the milestones that were set for the period concerned and progress is being made towards delivering on all the programme implementation objectives set for 2020.

Looking to the future, the Commission aims to provide a long-term vision for the programmes, allowing businesses and users to reap the benefits of the European satellite navigation systems. In this context, the Commission will strive for greater synergies between space and defence programmes, in line with the recently adopted Space Strategy for Europe and Defence Action Plan.

The growing demand for precise location information, in combination with the ongoing evolution of satellite navigation technology, means that the European market for users of Galileo and EGNOS will expand. Also, the traditional GNSS market will be complemented with the field of Internet of Things, smart cities and Big Data.

Therefore, the next years will be crucial for consolidating the achievements and preparing the evolution of the programmes.

Annex 4: Description of the European space actions

The space actions of the European Union consist of:

- EGNOS and Galileo – EU Global Navigation Satellite System
- Copernicus – EU Earth observation
- SSA - Space Situational Awareness
- GOVSATCOM - Governmental Satellite Communication

Copernicus, Galileo and EGNOS are already operational whilst the Space Situational Awareness and Governmental Satellite Communication are new initiatives. The specific activities covered by these programmes and the specific related context are explained below:

EU Global Navigation Satellite System: EGNOS and Galileo

EGNOS (European Geostationary Navigation Overlay Service) is Europe's regional satellite navigation system, monitoring and correcting open signals emitted by the US GPS and soon Galileo.

The overall aim of EGNOS is to monitor and correct open signals emitted by existing global satellite navigation systems like GPS or Galileo. The specific objectives of EGNOS are to ensure that the signals emitted by the EGNOS system can be used to fulfil the following functions:

- to offer an Open Service (OS), which is free of charge to the user, and provides positioning and synchronisation information intended mainly for high-volume satellite navigation applications in the area covered by the EGNOS system;

- to offer a service for the dissemination of commercial data, namely the EGNOS Data Access Service (EDAS), to promote the development of applications for professional or commercial use by means of improved performance and data with greater added value than those obtained through its open service;

- to offer a Safety-of-Life (SoL) service aimed at users for whom safety is essential; this service, which is provided free of direct user charges, fulfils the requirements of certain sectors for continuity, availability and accuracy and includes an integrity message alerting the user to any failure in, or out-of-tolerance signals from, systems augmented by the EGNOS system over the coverage area.

EGNOS makes information received from global satellite navigation systems more accurate, by correcting errors such as those linked to ionospheric disturbances, and checking the integrity of the information received, providing an alarm in case the position information is unreliable. This is fundamental for the safety of critical applications such as aircraft in flight. Precision agriculture is another representative example, where EGNOS plays an important role.

Galileo is Europe’s global satellite navigation and positioning system which provides a highly accurate, guaranteed, global positioning service that is interoperable at system level with GPS (USA) and Glonass (Russia). It ensures Europe’s strategic autonomy in satellite navigation, which is key for Europe’s economy and security.

The aim of Galileo is to develop, deploy and operate the first global satellite navigation system under civil control, for use by public and private entities in Europe and worldwide. The specific objectives of Galileo are to ensure that the signals emitted by the system can be used to fulfil the following functions:

- to offer an Open Service (OS), which is free of charge to the user and provides positioning and synchronisation information intended mainly for high-volume satellite navigation applications

- to contribute to integrity-monitoring services aimed at users of safety-of-life applications in compliance with international standards

- to offer a Commercial Service (CS) for the development of applications for professional or commercial use by means of improved performance and data with greater added value than those obtained through the open service;

- to offer a Public Regulated Service (PRS) restricted to government-authorised users, for sensitive applications which require a high level of service continuity, free of charge for the Member States, the Council, the Commission, the European External Action Service (EEAS) and, where appropriate, duly authorised Union agencies[46];

- to contribute to the Search And Rescue (SAR) support service of the COSPAS-SARSAT system by detecting distress signals transmitted by beacons and relaying messages to them.

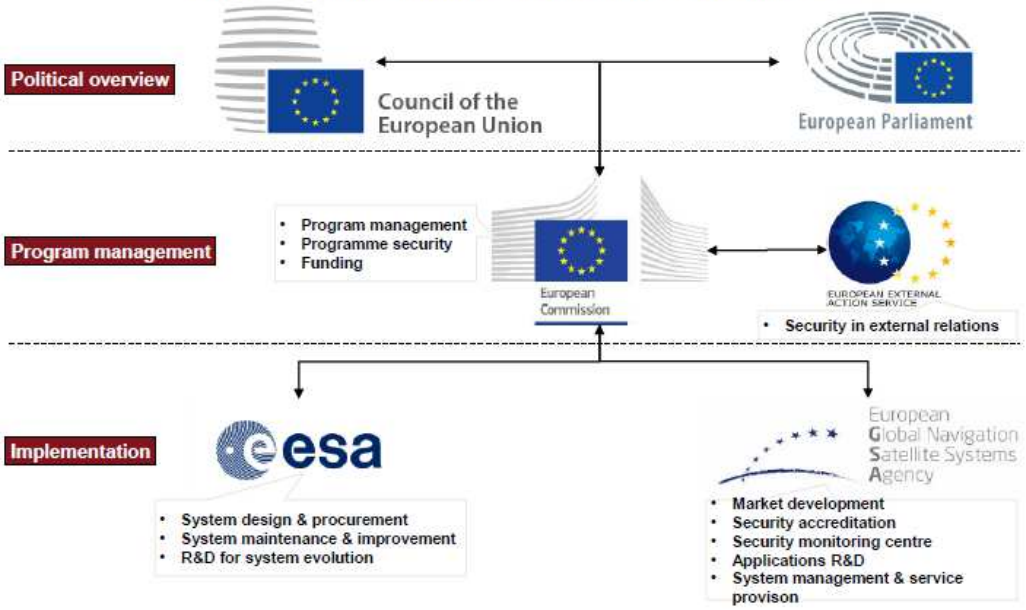
Galileo has been operational since December 2016, providing initial positioning, navigation and timing services. The Galileo system consists of satellites in orbit, ground stations located worldwide necessary to control these satellites and operation of positioning, navigation and timing services. Gradually, Galileo will be used in many critical areas where uninterrupted navigation and timing services are needed such as mobile phone networks, power grid synchronisation, electronic trading, and traffic management.

Satellite navigation based applications and solutions are more and more sophisticated, driven by the evolution of receivers, improved signals and increased possibility to integrate the signals with other source of data or services (e.g. meteorological data, air/ground/rail/maritime traffic management data, delocalisation data) to generate integrated applications. It determines the interest of industries and developers, including a large number of SMEs, toward the development of user segment elements and application for a specific GNSS system.

The organisation of the GNSS actions is summarised as follows:

[46] At present, the EU Member States military are fully dependent on the US military GPS. GALILEO-PRS will establish EU autonomy in this domain, but this could not be achieved without a close cooperation with the US.

Figure 3: Galileo and EGNOS programmes governance[17]



Regarding the system security, the current governance for Galileo is as follows:

- The European Commission, as programme manager, is responsible for the security of the system and its operations (definition of security policy and requirements, coordination and supervision of the implementation of the security policy, endorsement of the security risk analysis etc.)

- The GNSS Security Board (expert group) advices the Commission

- The GSA manages the implementation of security requirements and consolidates the overall statement of compliance with the security requirements

- The Security Accreditation Board (SAB) is responsible in particular to authorise the provision of services and the deployment of the infrastructure

- Member States take local accreditation decisions for Galileo infrastructure located in their territory and determine the competent PRS authority in their capacity as PRS participants

- Other bodies (Council, EEAS) have specific tasks related to security (crypto approval authority, High Representative decisions in case of emergency etc.).

EU Earth Observation - Copernicus

Copernicus is the EU's Earth observation component, successor of GMES (Global Monitoring for Environment and Security), building a competitive European capacity to deliver actionable geo-intelligence for civil protection and civil security as well as Earth observation-based services and applications, to support the protection of the environment and monitoring of climate change.

With its dedicated Space segment (the Sentinel satellites) and its Services , the programme aims at providing Earth observation data and geo-information products of general interest, to the benefits of public authorities, researchers, businesses and citizens. It also ensures that Europe has an independent and reliable access to sensitive

observation capacities in the environment and security areas, in particular for the implementation and monitoring of EU and national policies. Finally, it targets the development of a strong European Earth observation value chain, including the upstream, midstream and downstream segments. Copernicus has four components:

- Data acquisition, including the EU-owned Sentinel satellites, but also in-situ measurements and data procured from national or commercial missions.

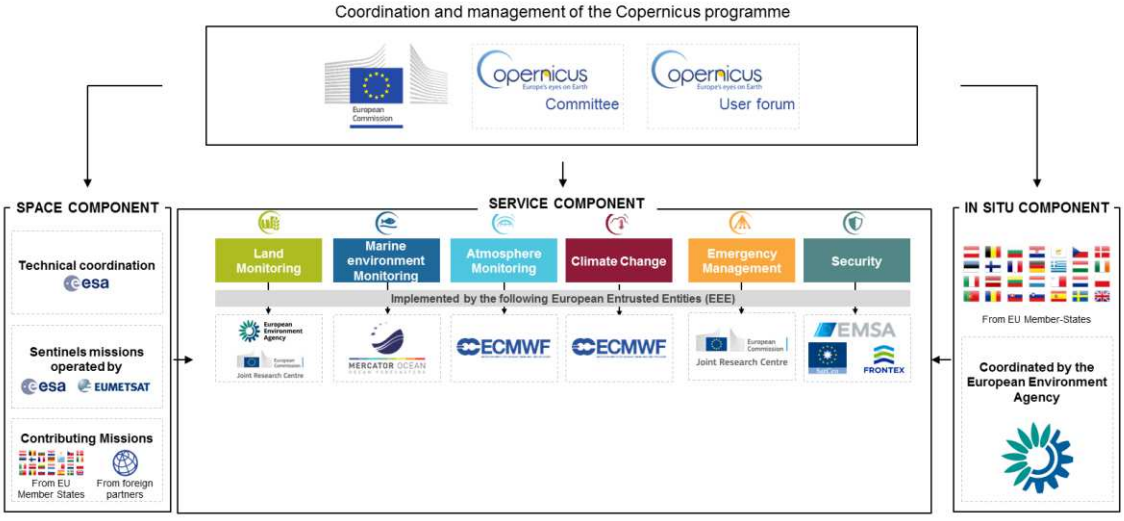
- Data and information processing, including the Copernicus services, which currently provides information products in 6 thematic areas (Land, Marine, Atmosphere, Climate Change, Security and Emergency).

- Data and information distribution, including the Data and Information Access Services (DIAS) which is a cloud-based infrastructure currently being implemented by five industry consortia.

- User uptake and market development activities, including awareness events, training, support to start-ups, regional initiatives, exchange of best practices, R&D or demonstration programmes.

In support of the implementation of Copernicus, to date some 1100 contracts have been signed, of a volume exceeding € 2.1 billion, directly benefitting participants in 22 MSs. Copernicus services are based on information from the Sentinels (a dedicated constellation of satellites), as well as tens of third party satellites complemented by on-site measurements. Copernicus services are in operation since 2014, supporting several policies, such as agriculture and forestry, migration, border security, maritime safety, disaster management, urban planning, development, energy and fight against climate change.

The organisation of the Copernicus Programme is summarised as follows:



New European Space initiatives:

Space Situational Awareness encompasses Space Surveillance and Tracking (SST), Space Weather (SWE) and Near Earth Objects (NEO). The three components cover the main space hazards: collisions between satellites and space debris (SST), space weather phenomena (SWE) and detecting, tracking natural objects (e.g. asteroids or comets) that can theoretically impact Earth and cause damage (NEO). Following the decision adopted in 2014, the programme SST has been financed since 2015 and led to the delivery of initial services in July 1, 2016, free of charge and operational 24/7. The SSA programmes aim at ensuring the continuity of these services, expand them and provide additional features through the other components SWE and NEO.

Space Surveillance and Tracking (SST)

SST consists of monitoring, surveillance and tracking of active and inactive satellites, discarded launchers stages and debris fragments that orbit around the Earth.

Following the steep increase of launches, there has been an exponential proliferation of space debris. According to the data provided by the United States more than 500,000 pieces of debris,[47] or "space junk," are orbiting the Earth. They all travel at speed up to 28000 km/h, fast enough for a relatively small piece of orbital debris to damage a spacecraft. In addition to tracked debris, debris smaller than 1 cm can currently not be observed but can still create damage to satellites and human flights[48].

The US has developed a catalogue of debris. Part of this catalogue is shared with 13 nations (Norway, United Kingdom, the Republic of Korea, France, Canada, Italy, Japan, Israel, Spain, Germany, Australia, the United Arab Emirates and Belgium), two intergovernmental organisations (the European Space Agency and the European Organisation for the Exploitation of Meteorological Satellites) and more than 60 commercial satellite owner/operator/launchers already participating in data-sharing agreements with the US Strategic Command (USSTRATCOM)[49]. The US is currently re-assessing the access policy to their catalogue, they have launched an overall reflexion with the Federal Aviation Authority (FAA).[50]

In order to have a more precise and detailed catalogue, the US is planning to deploy the US space fence[51], a new asset which is under construction in the Marshall Islands. It will give the United States the possibility to detect much smaller satellites and debris than current systems. In the LEO (Low Earth Orbit), the new system should be operational by 2018. Regarding GEO (Geo-stationary Earth Orbit), the ground-based (e.g. GEODSS) optical systems have been recently reinforced with the deployment of new systems (e.g. Linear DARPA),[52] which are assumed to remain in service up to 2025, providing survey and tracking capability especially in the GEO region. The ground-based optical systems

[47] https://www.nasa.gov/mission_pages/station/news/orbital_debris.html
[48] Evaluation of options for a space programme in 2014-2020, Prepared for The European Commission Enterprises and Industry Directorate-General May 2011 Final Report Booz & Company, Table 40.
[49] http://www.stratcom.mil/
[50] Results of the Workshop organised by the Consortium and the European Commission with the United States, Paris, October 2017.
[51] http://www.af.mil/News/Article-Display/Article/485271/space-fence-contract-awarded/
[52] http://www.afspc.af.mil/About-Us/Fact-Sheets/Article/249016/ground-based-electro-optical-deep-space-surveillance/

will be further strengthened by a new space-based optical system which will replace the current system in-orbit and this is planned for launch in 2021.[53]

To tackle the issue of space debris, the European Union adopted in 2014 a Decision[54] (Decision 541/2014/EU) which aimed at establishing a Framework for Space Surveillance and Tracking Support (the SST Decision). The target was to establish the first steps of a European approach regarding this growing concern.

The first SST services were delivered to users (Member States, the Council, the Commission, the EEAS, public and private spacecraft owners and operators and public authorities concerned with civil protection) in July 2016. The current framework is based on pooling Member States' SST capabilities, which are used to provide SST services to users (free of charge). The SST support framework aimed at supporting the networking and upgrading of national SST assets to provide EU SST services.

Governance of the SST support framework:

- EU SST services are provided by five Member States (France, Germany, Italy, Spain and the United Kingdom) and soon to be eight (plus Poland, Portugal and Romania). Those MS pooled to the EU SST their existing SST assets (sensors e.g. radars and telescopes and data processing capabilities) fully controlled and operated by SST national operational centres (NOC). SST is nationally sensitive because its assets can be of civil and military use, and SST data are subject to security restrictions (e.g. orbital parameters of space objects in low Earth orbit).
- EU SATCEN acts as a front desk and manages the EU SST portal.
- The Commission is in charge of monitoring the implementation of the SST Decision and finances EU SST services provision, networking of national SST assets and their upgrades.
- Based on bilateral agreements at MS level with the US, EU SST services greatly rely on data from the US (especially for low Earth orbit), those reliability vary and require further processing by the EU SST to deliver quality services.

Space Weather (SWE)

SWE concerns the monitoring of conditions at the Sun and in the solar wind, and in Earth's magnetosphere, ionosphere and thermosphere that can affect space borne and ground-based infrastructure.

Space weather refers to changes in the physical state of the natural space environment. It is concerned with environmental conditions in near-Earth space and deals with phenomena involving ambient plasma, particulate radiation (electrons, protons and ions), electromagnetic radiation (including radio frequencies, visible light, ultraviolet and X-ray radiation) and magnetic and electric fields in space. Changes in the space environment are resulting mainly from changes on the Sun. A well-known example is the aurora effects that occur close to the earth's poles. Strong changes due to increased solar activity are referred to as 'Solar storms'. They can be classified in Geomagnetic Storms, Solar Radiation Storms and Ionospheric disturbance, according to their physical characteristics and impacts on systems and infrastructures.

[53] http://spacenews.com/u-s-air-forces-next-space-surveillance-system-on-target-for-2021

[54] Decision No 541/2014/EU of the European Parliament and of the Council of 16 April 2014 establishing a Framework for Space Surveillance and Tracking Support, OJ L 158, 27.5.2014, p. 227–234.

Space weather can influence the performance and reliability of space-borne and ground-based infrastructures (aviation, power grids, pipeline operators, civil and military communications …) and can induce threats to human life or health.

With increased reliance of different sectors on modern technology, the society has become more susceptible to impacts of solar activities and those impacts started to be more noticeable. The largest solar storm ever recorded is the Carrington event dating back to 1859. An extreme space weather event of this type is rare, but its immediate and cascading effects can cause significant, long-term disruptions of critical infrastructures with potentially catastrophic economic consequences. Lower-intensity solar storms occur more often although with less severe impacts.

Space weather services focus on generating past casts, now casts and eventually forecasts (such as warnings and alerts) of the upcoming storms. Currently, users of SWE services rely on the services provided from multiple sources, national and international, for storms forecasts and warnings, since space weather monitoring systems are complex and too-capital intensive for the operators to own and operate. The awareness of the space weather risks is still limited and users potentially impacted by extreme events are not managing the risks.

Currently, there is no EU programme or actions developed at the EU level to tackle this risk, only research activities have been funded through Horizon 2020. The SWE function would aim at supporting industries and activities on Earth and satellites that may be affected by space weather effects.

Near Earth Object (NEO)

NEO actions aim at detecting, tracking natural objects and potentially launch deflection mission, (e.g. asteroids or comets) that can theoretically impact Earth and cause damage.

A Near Earth Object (NEO) is a natural solar system object, whose orbit brings it into close proximity with the Earth. This includes a few thousand near Earth asteroids (NEAs), near Earth comets, and meteoroids large enough to be tracked in space before striking the Earth.

The NEO problematic is a matter of probability. ESA has established a model making links between the size of the objects, the probability of occurrence and the potential impacts on earth.[55]

Governmental Satellite Communication is a project that aims at ensuring secured and stable communications through satellites, indispensable namely when ground infrastructure is inexistent (maritime, air, remote areas), unreliable, disrupted or destroyed (natural disasters, crisis situations, conflicts). In addition, the transmission of security critical information requires guaranteed access and protection against interference, interception, intrusion, and cyber-security risks. The impact assessment report for GOVSATCOM was already presented to the Regulatory Scrutiny Board on September 27th 2017 and received a positive opinion.

[55] http://neo.ssa.esa.int/;jsessionid=5A860B1290F947EAA6CE3538F1CE2D3A

Annex 5: Space in support of EU policies

The Space actions directly support many EU policies as further described below.

Climate

The global nature and dimension of climate change necessitates large amounts of a variety of high quality measurements from space borne instruments. Monitoring climate change requires long term commitments through the Space actions to sustain the global observation system. The essence of the critical information contained in these space data needs to be extracted using advanced re-analyses and modelling tools integrated into a dedicated service. This is already established in the current Copernicus programme.

The policy framework to which these services respond is represented by the United Nations Framework Convention on Climate Change and its European implementation. The impetus for synoptic observations of climate have only been enhanced following the 2015 Paris Agreement where multiple areas of this agreement can take advantage of these space data and Copernicus services, e.g. adaptation, loss and damage, mitigation, as well as climate change projections.

The EU has been at the forefront of international efforts towards fighting climate change with a major milestone its role in the process leading to the Paris Agreement. The Paris Agreement itself designs a transparency framework that is to be implemented by individual countries through national reports.

A global CO2 Monitoring and Verification Support (MVS) capacity is currently considered in the frame of the evolution of the Copernicus programme. This capacity will provide Europe with the necessary and unique information to assess, for instance, the effectiveness of the impact of climate change policies. Such a capacity will largely rely on a constellation of greenhouse gas monitoring satellites to extract the anthropogenic emissions.

Geospatial data acquired from space borne instruments provide an opportunity to support and improve the implementation of climate policies such as REDD+ (Reducing Emissions from Deforestation and forest Degradation) in tropical regions and the LULUCF (Land Use, land Use Change and Forestry) Regulation adopted in May 2018.

Environment

In its 2018 Environmental Compliance Assurance action plan[56], Copernicus is mentioned as a major asset to promote, monitor and enforce environmental legislation including tackling the growing problem of environmental crime. It refers to Copernicus for building up a European geo-intelligence capacity in which the global positioning capacities of Galileo and other sources of geospatial information will be combined. In addition, the 2017 Commission report "Actions to Streamline Environmental Reporting" [57] refers to Copernicus to improve the efficiency and effectiveness of environmental monitoring and statutory reporting.

[56] Environmental compliance: European Commission launches Action Plan to help Member States improve environmental protection, http://ec.europa.eu/environment/pdf/19_01_2018_news_en.pdf
[57] COM(2017) 312 final

From an environmental policy perspective, Copernicus and Galileo can contribute significantly to closing the environmental implementation gap by delivering the geospatial intelligence needed for sound decision-making. Copernicus core Services (Land, Marine, Atmosphere, Emergency and Climate Change) are recognised as an international reference in monitoring global environmental dynamics. In addition, Copernicus data and information has the potential to significantly contribute to the Sustainable Development Goals agenda.

Finally, Galileo, EGNOS and Copernicus enable solutions to weather-related challenges in particular, by providing the maps for finding the best locations for renewable energy infrastructure, outlining the most fuel-efficient flight paths, enabling precision farming, optimising road transportation routes and monitoring CO_2 emissions.

Agriculture

In line with the objectives of better implementing the Common Agricultural Policy (CAP), there is an increased requirement to use Earth observation information, offering wider possibilities in terms of policy monitoring and smart farming.

Copernicus paves the way for the monitoring of agricultural activities serving the CAP objectives, providing free and open Earth observation data at high revisit time. These data combined with the capacity of the Land Parcel Identification System and complemented by other satellite imagery provided by private industry offer real added value.

Copernicus supports also the Common Organisation of Market regulation by providing information for crop and production forecasting at European and global scale, including for food insecure and food production areas.

Indirectly managed by the Commission through grants and funding to Member States, many applications are also being developed in the field of Digital Farming. EU and MS farming communities expressed a significant interest for these applications which contribute significantly, by combining different data (aerial / satellite remote sensing and in-situ observation) to a more resources efficient farming (crop production, input optimisation, planning optimisation etc.) in order to save time, money, preserve biodiversity and reduce impact on the environment and climate (“greening of the cap”).

Precision Agriculture is a representative example where EGNOS plays an important role. Precision agriculture is the application of different technologies and solutions to make farming more efficient, improve crop yield and reduce the environmental impact. The main application of this technology is tractor guidance. Positioning applications can be used to guide a tractor around a field and minimise the effort exerted by a farmer, thus increasing efficiency and reducing labour costs. EGNOS can also be used to help farmers enhance crop management and improve position-based tasks like spraying insecticides and pesticides and harvesting crops. In turn, this increases yields and helps provide much-needed food supply around the world.

Sustainable Transport

GNSS has become an enabling technology without which many high tech capabilities would be impossible. This is specially the case in the automotive sector where Galileo services will become essential for supporting emerging applications, especially automated cars. Galileo is much more innovative than its predecessor, GPS, is. In

particular, Galileo will provide a service that is more resistant to signal interference in urban canyons, along with an authenticated signal capable of detecting spoofing attacks – both vital features for the safe operation of autonomous cars.

Aviation is one of the most GNSS dependent sectors. Over the period 2016-2035, we can expect the number of flights to rise about 3 to 4% in Europe. As a result, the traditional ground-based air traffic management (ATM) technologies will not be able to accommodate this growing demand. The only viable solution to this problem is satellite technology. Programmes like EGNOS have changed the way we travel. EGNOS since September 2015 is providing the highest quality guided approach services available today to airline and aerodrome operators. With regular use in already 230 aerodromes, EGNOS contributes to increasing flight and landing safety, management of airspace and optimisation of fuel consumption.

European GNSS serves the rail sector in many ways. From asset management to High and Low Density Command & Control Systems, the increasing amount of initiatives all over the world shows the importance of GNSS in rail development. GNSS-enabled signalling applications provide increased safety and reduce costs of infrastructure management and operations compared to traditional signalling solutions.

European GNSS, and specifically EGNOS, contributes substantially to the maritime sector. All passenger ships and cargo ships larger than 500 gross tonnages are regulated and rely heavily on GNSS for navigation. Furthermore, GNSS systems for maritime navigation are widespread across commercial and recreational vessels, both overseas and in high traffic areas. GNSS is also used to ensure safe navigation in inland waterways (rivers, canals, lakes and estuaries). Although GNSS has become the primary means of obtaining Position, Navigation and Timing (PNT) information at sea, augmentation (EGNOS) is required to achieve the necessary level of integrity and accuracies, improved over the use of GNSS alone. While such ground-based augmentation systems such as marine radio beacons have been in use for some time, recent developments enable EGNOS to be considered also for maritime use.

Civil Protection

The effort to ensure citizens safety has been the first drive for the setting-up of the Copernicus Emergency Management Service (EMS), providing timely and accurate geo-spatial information for the management of natural disasters, man-made situations and humanitarian crises. The service was extensively used for the forest fires of summer 2017 in Europe and lately praised by the US State department for the precious help provided by EMS maps in the early warning and rescuing operations for the 2017 hurricanes hitting the United States and the Caribbean region.

Improvements are regularly made from users' feedback for the existing EMS service portfolio that consists of: **rapid mapping** module, available hours after an emergency event to assist decision-makers and response teams on the ground, and **risk and recovery mapping** module to support prevention, preparedness and recovery activities. In addition, EMS has an **early warning** component providing regular information to assist floods, forest fires and drought events in Europe and globally.

Digital Society

The digitalisation of society is changing many aspects of life, be it at work or at home. The space and satellite communication sectors are certainly contributing to this, and this is reflected in the major transformation from a more broadcast-oriented past to new growth areas in broadband, mobility and big data type of applications, be it urban, rural or remote areas.

The Mid-Term Review of Digital Single Market (DSM) emphasised the importance of the measures proposed in the European Electronic Communications Code to encourage the deployment of very high capacity networks, while maintaining effective competition and adequate returns relative to risks, including in rural areas. In 2016, the EU adopted a new connectivity strategy which foresees that all European households should be covered with digital networks capable of delivering a connectivity of 100 Mbps (upgradable to gigabit speed) by 2025 as well as full 5G coverage in cities and along major transport paths. Therefore the initiatives towards 5G and the 5G Action Plan are important, in the context of 5G the next generation of satellites (and possible new constellations) will increase the performance and capacity significantly – and therefore play a positive role in connecting households and as feeder links in 5G to offer connectivity for all Europeans regarding the new broadband targets, 30 Mbps (download) by 2020 and by 2025 to reach 100 Mbps for all, even then in very remote areas.

In Earth observation there is the need to analyse and process the huge amount of data being collected and stored for long term preservation, as well as the requirement to expand the data services offered. Therefore the convergence with information and communication technologies (ICT) should be encouraged, and in particular with the Commission's ICT programmes, to maximise the use and re-use of data collections of significant commercial value – this is also relevant for Galileo as modern ICT offer the possibilities of developing innovative applications. The exploitation of positive synergies and collaborations between space and ICT programmes and their stakeholders can be built up structurally with mutual benefit. Big data and artificial intelligence technologies, as well as the high performance computing and cloud capacities being built at the EU level, have a lot to offer to the Space programme to develop new, innovative products and services.

The European Cloud Initiative (ECI) indicates a necessity to support the exploitation of Earth observation data. The Space Strategy states as well that "(…) the Commission will improve access to, and exploitation of, space data enabling their cross-fertilisation with other sources of data, facilitating the integration with digital research infrastructures, in complementarity with the ECI." A joint stimulus package that aligns various elements within the ECI and Copernicus would leverage notably the user uptake-oriented elements, this to meet another objective of ECI, i.e. enlarging the user base of the European Open Science Cloud (EOSC) to the public sector and to industry (both on the user and provider sides) by possibly offering the opportunity to have the EOSC aggregate the demand of the scientific communities in this domain and then broker commercial services offered through the Copernicus Data and Information Access Services (DIAS) to the scientific communities and beyond. In the longer term, possibility of free open data services from Copernicus with open data services stemming from the EOSC is to be addressed.

In quantum communications, the relevance to the Space programme can be highlighted in particular in two fields: secure communications and space metrology. Quantum technologies are envisaged to increase the security of the space infrastructure, but also a

quantum-capable space infrastructure can enhance the security of terrestrial networks (by providing quantum key distribution services, etc). Optical (laser) communication and quantum cryptography in particular, show very promising prospects in terms of increasing the protection of data communication and the perspective of linking/expanding in space technologies. Many applications would benefit as well from space-based experiments of quantum metrology and sensing that will push the precision of clocks, mass detectors and transducers towards the engineering of novel quantum technologies.

Research

Research in the field of space is currently specifically addressed under the "Leadership in Enabling and Industrial Technologies (LEIT)" part of Horizon 2020 and should continue under Horizon Europe.

As the Union's competence in space increases, notably through the deployment of large scale infrastructure projects of which the Union is the owner, there should be increasing attention to the research in this highly innovative and technological sector. Furthermore given the direct link between space and research in the Treaty, there should be continuity and scale up of the space research actions of the Union through Horizon Europe. This would allow space to profit from tools and schemes promoted through the framework programme for research and innovation.

Indeed, building on the lessons learnt of the Horizon 2020 Interim Evaluation there is a clear case for scaling-up research and innovation efforts in order to address the evolution needs of the EU space actions, ensuring industrial competitiveness and readiness for European infrastructure and in the global markets, promoting entrepreneurship notably for the use of space data and technologies by newcomers, and supporting the efforts of Europe for a safe and secure access to and use of space.

The Space Strategy recognises the need to underpin sustainable supply chains in the space industry sector, to maintain industrial leadership as well as to promote space in education and sciences fostering links among industry, research, universities and public authorities. Such objectives shall be met through European Partnership Initiatives to leverage on stakeholder investment and pool efforts towards the same goals, notably for providing an industrial response to global challenges by means of public private partnering, such as through a joint undertaking but also by means of fostering the innovation triangle among industry, academia and research organisations, such as through a Knowledge and Innovation Community (KIC).

An important element shall be improved coherence between Horizon Europe and the Space programme through:

- an improved structural integration of space research with other parts of Horizon Europe to reach other constituencies
- the possible use of space data and services produced by the Union Space actions for the benefit of research and innovation activities of the Union.

Security

The EU security global strategy set the goals for the EU external policy: The Security of our Union, State and Societal Resilience, An Integrated Approach to Conflicts, Cooperative Regional Orders and Global Governance for the 21st Century.

The global strategy nurtures the ambition of strategic autonomy for the European Union. The EU becoming a major player in space, through Copernicus, Galileo and EGNOS, contributes already to this autonomy.

Space is a domain in which security and defence applications, as well as vulnerabilities, are growing: technological threats, including the dependence of the European Space industry for critical satellite components on overseas suppliers, environmental threats linked to space debris, military threats with the development of various anti-satellite capabilities and the risk of cyber-related threats are the most obvious. Europe's increased reliance on space-based assets, including for telecommunications and internet, creates specific asymmetrical threats to EU security and defence. Ensuring the autonomy, security, robustness and resilience of our space-based services is therefore essential.

Galileo's Public Regulated Service and Search and Rescue are going to contribute to a more secure Union. More precisely, PRS provides position and timing information restricted to government-authorised users, for sensitive applications that require high level of service continuity. SAR represents the European contribution to an international initiative COSPAS-SARSAT on humanitarian Search and Rescue activities. Galileo satellites will be able to pick up emergency signals from emergency beacons carried on ships, planes or persons and ultimately send these back to national rescue centres. From this, a rescue centre can know the precise location of an accident.

GOVSATCOM will enable a wide-range of bodies with public security functions at EU and national level to carry out their critical tasks and missions more effectively. Defence and police forces, the entire maritime community (Coast Guards, Maritime Safety Agencies, fishery- and environmental monitoring services, etc.), border guards, civil protection agencies and humanitarian actors will be better equipped to counter increasing threats and to protect the safety, the security and privacy of citizens. Secure satellite communication is also indispensable to seize new opportunities, from long-range drones to the remote-management of critical infrastructure, or the exploration of natural resources and shipping routes in the Arctic. Finally, secure satellite communication has already been identified as a critical asset in the European Defence Action Plan (EDAP).

The Copernicus service for Security is already today providing support to the EU policies by delivering information in response to Europe's security challenges. This service is crucial in the rapidly changing strategic context in areas such as the migration crisis and maritime surveillance; new requirements for maritime monitoring have highlighted the need for specific space and air capabilities. Crisis management missions including EU CSDP (Common Security and Defence Policy) operation requires round-the-clock observation. In the context of constantly changing challenges and threats and the new technological, economical and policy aspects, Copernicus security service adapts dynamically to the new environment. In the future Copernicus should acquire new capabilities in order to strengthen the current services and propose new solutions to support the European security policies, empower users and respond to their specific needs and governance settings. This would include the scaling-up of the current services and the development of new services: additional reference mapping of EU external borders, activity report and intelligence/analysis services to monitor critical infrastructures, inclusion of vulnerability mapping products, better liaison with national capacities and Emergency Response Coordination Centres, development of Early Warning services and situational awareness.

New processing methodologies (e.g.: machine learning, deep learning, data fusion, geo-intelligence, automatic pattern recognition, etc.) and enhanced data access mechanism

need to be developed and new sources of higher resolution and more timely data should be acquired. Stricter tasking mechanisms and extended use of secured infrastructure and procedures are necessary in order to enable to strengthen the services and answer better the future needs. Better synergies between Copernicus security service and defence users should be established in order to support the EU CSDP.

Annex 6: Examples of applications for Space actions

Responding to natural disasters – In 2017, Copernicus maps showing the extent and magnitude of damage have helped rescue teams in forest fires (Italy, Spain and Portugal), earthquakes (Mexico), and hurricanes (countries hit by hurricanes Harvey, Irma and Maria).
Improved navigation performance – New products from most large smartphone manufacturers (such as Samsung and Apple) include Galileo compatible chipsets, which allow them to improve their performance in navigation, positioning and timing.
Wine production – Terranis, a spin-off of Airbus geo-intelligence, has developed a specific app for wine makers. Based on Copernicus data, it provides information in the weeks before harvest time so that wine makers can adjust cultivation methods.
Support to continuity of services – Galileo is already used in many critical areas of the economy where uninterrupted navigation and timing services are needed such as mobile phone networks, power grid synchronisation, electronic trading, and traffic management.
Renewable – Reuniwatt is a start-up from the island of La Reunion delivering services to photovoltaic electricity producers. Their Copernicus-based forecasts generate 50% more benefits than traditional forecasts.
Emerging new markets – Galileo is key for the development of emerging new markets as connected and automated cars, drones and robots.
Landing Procedures – EGNOS provides a high accuracy giving aircraft the possibility to land with a reduced visibility on certified airports. The "Localiser performance with vertical guidance" (LPV) procedure is as precise as the highest standards of Instrument Landing Systems but for the cost of an on-board EGNOS receiver, to be compared with the cost of a full instrument landing system in each airport.
Fighting bark beetles – a Dutch company Viridian Raven uses Copernicus data to provide an early warning system to forest managers, so they can take timely prevention measures to save trees from an invasion of bark beetles.
Preventing sun burn – HappySun is a smartphone app providing UV radiation forecasts based on the Copernicus Atmosphere Monitoring Service. It provides users with personal sun protection advice based on their skin type and location, helping to prevent skin cancer and encourage safer behaviour.
Automatic emergency response – By 2018, Galileo will be in every new vehicle sold in Europe, enabling the eCall emergency response system to automatically geo-localise cars in case of an accident.
Support to the UN's Global Maritime Crime Programme – Copernicus enhances the capacity of maritime law enforcement agencies to identify & reach targets at global level.
Saving lives at sea – Copernicus supports the European Coast and Border Guard Agency's missions in the Mediterranean, helping spot unsafe vessels and rescuing people.
Search and Rescue Service – Galileo is already helping to shorten the time needed to localise a distress signal through its Search and Rescue service. By end 2018 Galileo will provide a return message to those in need of search and rescue, confirming them that their message has been received by the search and rescue centre. Galileo will be the only GNSS providing such a service.
Fisheries – the Asimuth project uses Copernicus services products to optimise the harvesting schedule of fish and mussel farmers. It can reduce losses from algal blooms by at least 12.5%.
Air quality – Plume Labs, a start-up based in France offers near-real time information on air quality in the main cities over the world, based on products from the Copernicus services.
Monitoring oil spills – The European Maritime Safety Agency (EMSA) uses Copernicus data to spot illegal oil spills.