EUROPEAN COMMISSION
Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs

Space Policy, Copernicus and Defence
Space Data for Societal Challenges and Growth

Operational Implementation Plan

Proposed approach to implement the roadmap and annexes of the Integrated Ground Segment and Big Data Governance Task Force

15 June 2016

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1. EXECUTIVE SUMMARY

Copernicus data and information have successfully attracted a large number of users beyond the core Copernicus services. It has increasingly become clear that there is significant potential in the exploitation of the data and information produced by the Copernicus system.

A number of initiatives were therefore undertaken in recent years to allow and subsequently strengthen the access to the data collected to a broader group of user communities.

Four main lines of action are particularly poignant:

i. Improve data distribution capabilities of the core ground segment of Copernicus (EU funds, through existing Delegation Agreements)
ii. Support additional distribution channels through the collaborative ground segment activities of GSC Participating States (national and ESA funds)
iii. Building on this to store and further process/disseminate the Copernicus data in support, mainly, of national user communities (national funds)
iv. In parallel, independent initiatives are being considered to explore additional Near Real Time (NRT) and/or Quasi Real Time (QRT) products that are not provided within the Copernicus product and service portfolio.

These efforts have already improved the situation related to Copernicus data access significantly. They still fall short of user expectations and the increase in data volume will necessitate a further upgrade of the system. This is compounded by the fact that the sustainability of ESA and nationally funded elements is not guaranteed in the long term while at the same time creating a degree of fragmentation and a level of imbalance throughout the EU in terms of access to Copernicus data and information. Furthermore, the rapid development of technology is opening new opportunities for large-scale exploitation of data, which needs to be taken into account.

In order to address these issues, the Commission has put in place in 2015 a Task Force with Member States & Copernicus participating countries to identify the requirements for an Integrated Ground Segment (IGS) for Copernicus that further improve the ability for user communities in Europe to work with Copernicus. The main objective of the Commission is to create a level playing field throughout Europe for the access to Copernicus data and information and enable commercial and institutional support to the extraction of economic and societal benefits from Copernicus. The Commission is keen to ensure that the uptake of Copernicus data and information is maximised across a broad range of user groups and that Copernicus is able to provide the critical mass and focal point for stimulating innovation and the creation of new business models based on EO data and information. Any solution must be implemented with a minimum of management complexity and respect clear boundaries and governance principles regarding EU, Entrusted Entities and Member States & Copernicus participating countries' elements. Of importance is also the consideration what use could be made of existing investments at Member State level under (ii) and (iii) above.

Through the work of the Task Force, two main lines of action were identified regarding data access: (1) increasing the traditional data and information distribution that is offered by Copernicus and (2) ensure the existence of Copernicus data and information access services to all Member States & Copernicus participating countries on an equal basis, able to draw on the opportunities offered by the Big Data paradigm. It is essential to address both lines of action to mitigate risks inherent to both approaches.

As regards additional national activities related to NRT/QRT products, such initiatives are likely to impact system resources and hence must be considered in the operations planning. They may in particular propose the use of ground stations that are not part of the operational system and require dedicated data download operations where a passive 'listening in' approach is not possible. For those cases a careful trade-off of system resources and constraints is required.

Regarding future NRT/QRT initiatives the Task Force helped to define appropriate principles which will now be included in the High Level Operations Plan to become part of the Copernicus operational baseline. (See Annex 2 of the IGS roadmap). This work was based on an extensive user consultation and has allowed identifying a number of opportunities which will fully materialise once the EDRS service to Sentinels is in full operation.

The Commission on this basis proposes a coherent vision towards an IGS. It applies clear principles to identify the common elements to be financed from the EU budget and offers significant potential of complementarity with Member States & Copernicus participating countries' programmes whether they are implemented through an international agency or nationally. This vision is depicted in Figure 1 that shows the value chain from Copernicus to users vertically with user communities represented at the top. In the middle layer, the distribution element is shown on the left, towards the right the data and information access services followed by the Copernicus services. On the far right the figure incorporates a representation of other distribution and access services, indicating possible synergies.

Improved distribution functionality will expand the capabilities of the current system, including in particular its availability to agreed and measurable levels (as outlined in Annex 1 of the IGS roadmap).

This will be complemented by Copernicus data and information access services (based on section III of the IGS roadmap and accompanying Annex 4) that will address a common need for ICT services to make data available next to computing resources that allow value extraction and *inter alia* be offered on a commercial basis. It is foreseen that industrial actors will play an important role in the provision of the access services in close co-operation and collaboration with public bodies, giving the necessary autonomy and incentives to further develop the service offerings. The service level will be defined such as to optimise usability, to allow for both public and private activities to be encompassed and to maximise opportunities for different providers to offer added value services and stimulate the emergence of the broadest possible range of uses for Copernicus/EO data and information.

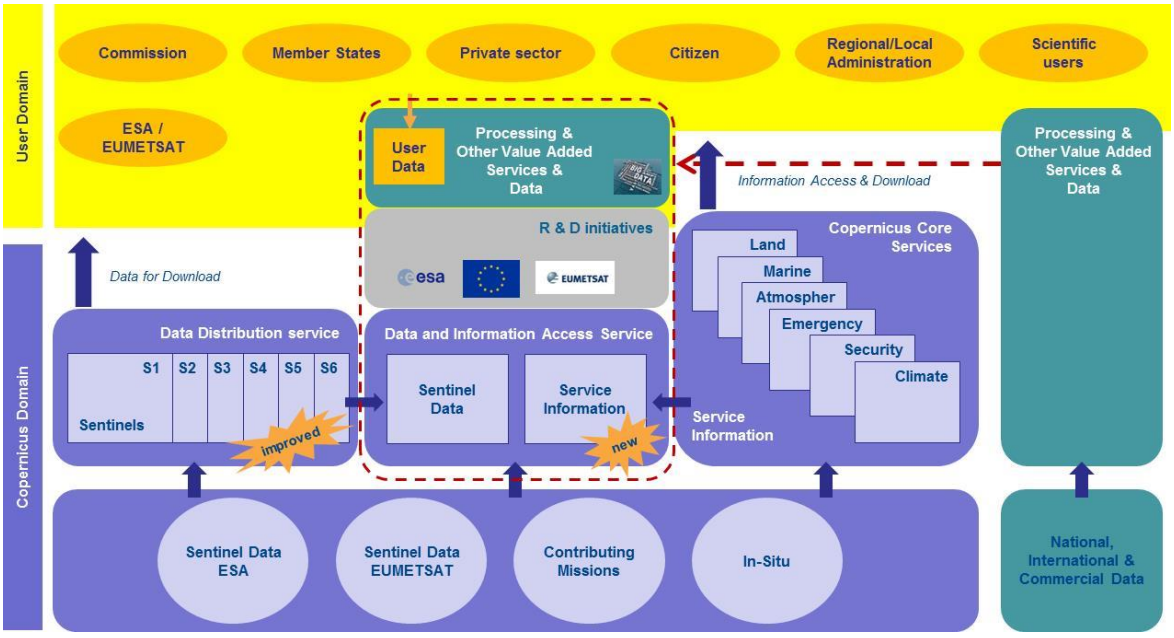

Figure 1 Conceptual overview of IGS

The existence of these services will lower the access and processing burden to all actors, an important factor in particular for Small and Medium Enterprises (SME). It will also allow third parties to offer data and services alongside the Copernicus data and information either for free or as a paid service. Innovation would be stimulated through competition amongst service providers to attract users. Institutional and private actors throughout Europe can easily add supporting initiatives by buying additional services as and when required and making them available to their

communities/customers without having to invest themselves in setting up bespoke data access and processing infrastructures (mutualisation of core costs).

Combining the efforts of all actors the data and information access services would become breeding grounds for innovative applications or "algorithm factories" that would help propel Europe to the forefront of global competition fuelled by Copernicus.

Agreements with the Copernicus Entrusted Entities should ensure the Copernicus data and information access services are used in other initiatives and supported by e.g. other Commission initiatives as well as EUMETSAT and ESA technology efforts, Copernicus services, where appropriate and efforts by the Member States. It is important to note that this initiative is aimed to be fully complementary to the Core services of Copernicus and seeks to increase the uptake of Copernicus service information by different user communities.

In parallel, a clear definition of the boundary between the core services offered by the Copernicus programme and the downstream sector will provide visibility, planning certainty and predictability for private sector investors and further stimulate innovation at all levels.

The implementation of the data and information access services will follow the share of responsibility amongst programme partners as defined in the Copernicus regulation. It is paramount that at any time during the implementation and operations phase overall consistency between the core Ground Segment of Copernicus and the complementary access service efforts remains ensured. A structured coordination through all implementation steps amongst Entrusted Entities will make sure that the data and information access services will support all, including the Copernicus services. It is also foreseen that the definition of technical specifications (favouring open standards) and the setting-up process of the access service will allow for a minimum level of interoperability to be achieved. The Commission will play a co-ordinating role in this exercise and ensure that the interests of all actors are taken into account throughout.

Work on the improved distribution functionality is already underway and is partly described in annex 3 of the roadmap. The Commission proposes a review in autumn 2016 of the achievements and lessons-learnt so far. This review will allow the definition of target performances (with matching user scenarios) to be reached before launching the procurement process for necessary adaptation to the distribution infrastructure that should start in early 2017. Designed fully complementary to this step, the data and information access services should be available for early 2018; they should allow for individual Member States, if they so desire, to integrate these new access services or replace the infrastructure related to parts of the currently nationally funded elements if this is economically and politically sensible.

Finally, it is foreseen that the data distribution and access initiatives will support, enable and complement the overall user and market uptake strategy for Copernicus. The objective is to adopt a partnership approach between the Commission, the Member States and the Entrusted Entities to ensure the mutualisation of core costs related to a basic level of data access and exploitation, allow different actors to focus on the provision of value-added and to combine the supply and demand side approaches in order to ensure critical mass.

The Copernicus data and information access service activities will further strengthen Copernicus partnership with Entrusted Entities and Member States while offering the opportunity to industry to innovate and build successful business models on top of Copernicus world-class assets maximising the societal benefit of the programme.

2. OBJECTIVE OF THE PRESENT NOTE

The present note summarises the Commission's proposed way forward in response to the roadmap for an Integrated Ground Segment, drawn up in the context of the Integrated Ground Segment and Big Data Governance Task Force.

Feedback to the draft roadmap and its annexes has been received early 2016 and these documents are now updated to reflect the outcome of this process. In order to maintain traceability of this process and to avoid additional delays, the Commission has decided to table the present document that responds to the roadmap and proposes implementation steps rather than folding the Commission position and constraints into the documentation.

The Copernicus Committee is asked to provide its opinion on this document.

3. INTRODUCTION

3.1. Background

The Commission has put in place in 2015 a Task Force with Member States to identify requirements for an Integrated Ground Segment (IGS) for Copernicus that further improves the ability for user communities in Europe to take advantage of Copernicus data and information. The result of the related effort is documented in the Copernicus - Roadmap for an Integrated Ground Segment [RD1] and its annexes.

In responding to these requirements, the main objective of the Commission is to improve access and the uptake of Copernicus data and information, to create a level playing field throughout Europe for the access to Copernicus data and information and enable commercial and institutional support to the extraction of economic and societal benefits from Copernicus.

Any solution must be implemented with a minimum of management complexity and respect clear boundaries and governance principles regarding EU, ESA, EUMETSAT, the Copernicus services, and national elements. Of importance is also the consideration of what use could be made of existing investments at Member State level.

During the discussions it became apparent that a clear definition of the guiding principles as well as the terminology used would be required. These elements are included in the Annex to this document.

3.2. Scope

The present document focuses on the requirements identified in the document Copernicus – Roadmap for an integrated Ground Segment [RD1], established during the work of the Task Force and refers back to those.

This document focuses on distribution and access service elements. It does not address issues such as the long term preservation of Copernicus data and information.

Other evolutions are planned in the overall Copernicus and European Earth Observation context both within the EU Copernicus programme and in other areas such as national, EUMETSAT or ESA programmes. While these are not further detailed in this document, their implementation will need to be closely coordinated with the activities proposed herein.

Aiming at drawing maximum benefit of the additional investments proposed, the Commission will engage with the Copernicus services to ensure that Copernicus information are made available on the data and information access services alongside the Copernicus Sentinel and contributing mission data (where compatible with licence agreement). While this may not have an immediate effect on the ongoing work at the level of the Copernicus services, the Commission will seek to exploit the benefit of synergies in the medium and long term where this is appropriate.

3.3. Reference documents

Ref#	Designation
RD1	Copernicus - Roadmap for an Integrated Ground Segment
RD1.1	Annex 1 to the roadmap
RD1.2	Annex 2 to the roadmap
RD1.3	Annex 3 to the roadmap
RD1.4	Annex 4 to the roadmap
RD2	Terms of Reference for the IGS Task Force

Table 1 Reference documents

4. PROPOSED WAY FORWARD

On the basis of the work of the Copernicus Task Force, in consultations with Member States, with the Entrusted Entities, with industry and research organisations the Commission proposes the following way ahead.

4.1. Overview

The Commission will amend the current operations management processes to take into account the work done in the Task Force as regards the Near Real Time and Quasi Real Time domain and press ahead with immediate implementation of the recommendations made by the Task Force for the 2016 revision of the High Level Operations Plan.

As regards the data distribution and access, a fully coherent and complementary approach for the data distribution and data and information access enhancements will be proposed. This will be based on a three-pronged approach of:

- Data-pull (download),
- Data-push (e.g. EUMETCast) and
- Data access and hosted processing (data and information access services).

A particular focus will be put on promoting the data and information access services as this is seen as the most suitable way to mitigate against a most prevalent cause for user dissatisfaction, i.e. the limitation of the available bandwidth connecting the user to Copernicus (wherever this limitation occurs). This approach is also seen as the most promising avenue towards enlarging user communities, and ensures that the technology developments related to data processing and exploitation can be taken advantage of to maximise the socio-economic potential offered by Earth Observation data. By providing users the opportunity to use access services this approach should also free the distribution network as fewer users are likely to need download facilities.

The integration of existing national efforts in the context of the collaborative Ground Segment initiative will be addressed through the data and information access services. More detail on how this will be achieved is provided in section 4.2.3 below. As a consequence the improved distribution function will focus on the Copernicus data and products. It is noted that complementary national or industrial data access solutions can still complement the data and information access services (i.e. the approach proposed as non-exclusive access); the related initiatives and funding are however seen as complementary and outside the Copernicus framework.

The consultation effort in the context of the Task Force has revealed that activities related to all these elements will heavily overlap even in the short term. It is therefore proposed that the differentiation made in the roadmap between short and medium to long term initiatives is

therefore put into effect through two parallel and inter-linked streams of activities: namely the distribution of Copernicus data and information (4.2.1) and the provision of advanced big data functionalities, i.e. access services, (4.2.2).

4.2. Detailed proposals

4.2.1. Distribution of Copernicus data and information (see Annex 1 of the Roadmap)

In order to optimise the data dissemination and access service for users in EU Member States & Copernicus participating countries, further improvements to the distribution infrastructure are proposed. The Commission understands the necessity to strengthen the CSC data distribution. Therefore the Commission will work with all Entrusted Entities and in particular with ESA and EUMETSAT in order to improve the distribution capabilities of the CSC Core ground segment. This line of work will include access to archive data and also address the need to provide a homogeneous user experience across the data distribution facilities provided by EUMETSAT and ESA.

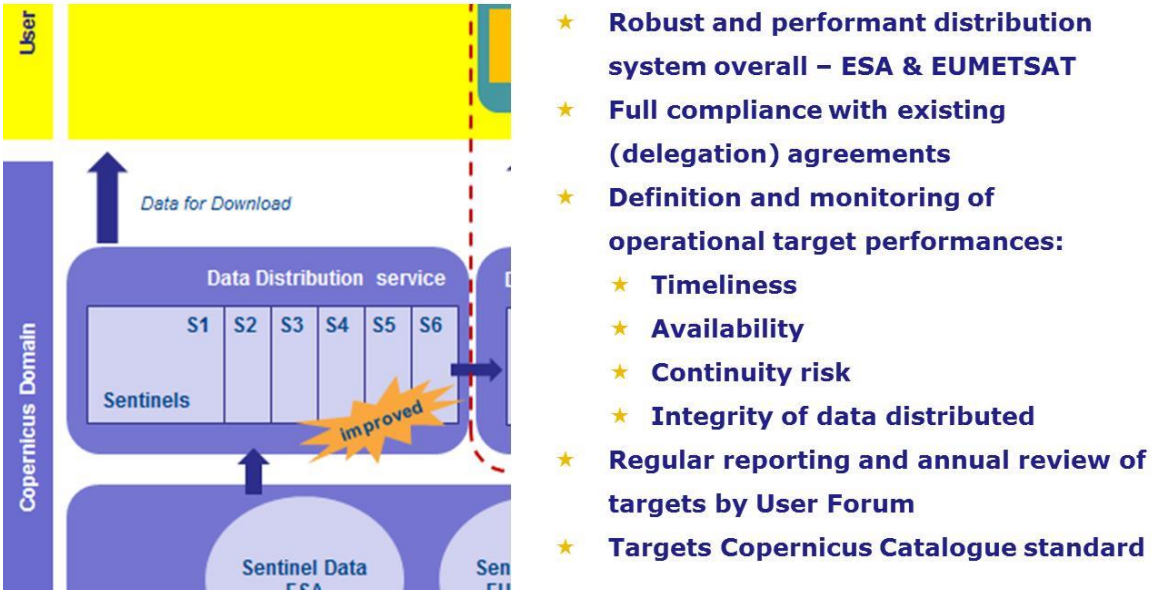

Figure 2 Distribution system

The Commission proposes to:

- Ensure that the high bandwidth connection of the Copernicus Core to the GÉANT network that is already linking all Member States' research infrastructures and which has been commissioned to routine operations in May 2016 and must be exploited to its fullest capacity.
- Adjust the definition of the user 'typologies' to (i) group the Member States & Copernicus participating countries access and the ESA member states access under the same category[1] and to (ii) take into account any decision the Commission may take regarding Copernicus Data and Information access services for Europe which may need high bandwidth access[2].
- Formally re-assess the performance and architecture of the Copernicus core distribution capabilities in light of (i) improvements recently brought such as the GÉANT connection mentioned above, (ii) the anticipated growth of the user community and data to be

[1] Taking into account the distinction for countries which participated in the GSC programme and do not fall into the category of Member States and Copernicus participating countries

[2] Reference is made to Annex 4 to the Integrated Ground Segment Roadmap

handled (future Sentinels) and (iii) the proposed deployment of data and information access services.

- On this basis and as necessary, improve the CSC data access to measurable target levels that would be specified for each user 'typology'. This will in particular aim at increasing the availability and continuity of download services as well as ensuring that the integrity of the Copernicus core products distributed can be verified.

These items, serving a common interest of all users, would be covered by Copernicus to the extent possible within the limits of its budgetary appropriation.

In addition, and in the context of facilitating user access to Sentinel data irrespective of the entity in charge of the operation:

- An expansion of the data push functionality for time-critical data and products distributed under ESA responsibility will be considered. Building on what exists one would use of the GÉANT network to allow multipoint terrestrial broadcast as already implemented by EUMETSAT through its EUMETCast service. This approach to higher distribution capabilities will be assessed in the overall context of data and information distribution and a decision for its activation will be taken by the Commission.
- General improvements of the user experience will be pursued (e.g. interoperability of catalogues between EUMETSAT and ESA).

If selected for implementation, participation by Copernicus to the related cost could be considered.

The Commission stresses the point that before investing in any new infrastructure element the benefit and draw back from using the GÉANT connectivity must be thoroughly assessed.

4.2.2. Providing advanced big data functionalities (Copernicus data and information access services)

The Big Data paradigm shift opens new opportunities to add value through accessing and processing data and information using a repository and computing service in close proximity, typically in a cloud environment.

The Commission proposes to afford these opportunities to different user groups in the EU by enabling the emergence of European data and information repository and computing services (based on section III of the roadmap).

The Commission proposes to make available/facilitate several parallel services through contracted data and information access service providers[3]. It is proposed to achieve a maximum level of commonality in the technical specifications for the above in order to achieve a maximum level of inter-operability (essentially option 3 of Annex 4 of the IGS roadmap combined with elements of option 5). Each of them will be offering the complete set of Copernicus data (accessibility and volume details to be determined in the technical specifications development process) as well as information from the Copernicus core services.

These services will enable exploitation of Copernicus data and information by any value adding third party either public or private.

Access to the services will be free and open at the Commission enabled service level to all EU Member States and Copernicus participating countries on a non-discriminatory basis within the limit set by the budget available for this activity. Additional services beyond the Copernicus-enabled service-level can be provided either free-of-charge or on a commercial basis depending on the different models adopted by the respective access service providers (e.g. free offer for

[3] Terminology adopted to differentiate these from "Copernicus service providers"

basic processing, pay as you use for higher processing, software, storage services). A conceptual overview of these services and functionalities is shown in Figure 3.

In order to stimulate industrial initiatives and in line with the approach pursued by some of the MS for their national collaborative ground segments, the Commission, in close cooperation with all Entrusted Entities and in the context of the Copernicus programme, will work with European industry to ensure that such services are available in the shortest possible timeframe. The target for the availability of operational services will be early 2018 with the necessary flexibility to allow for an orderly and controlled transition.

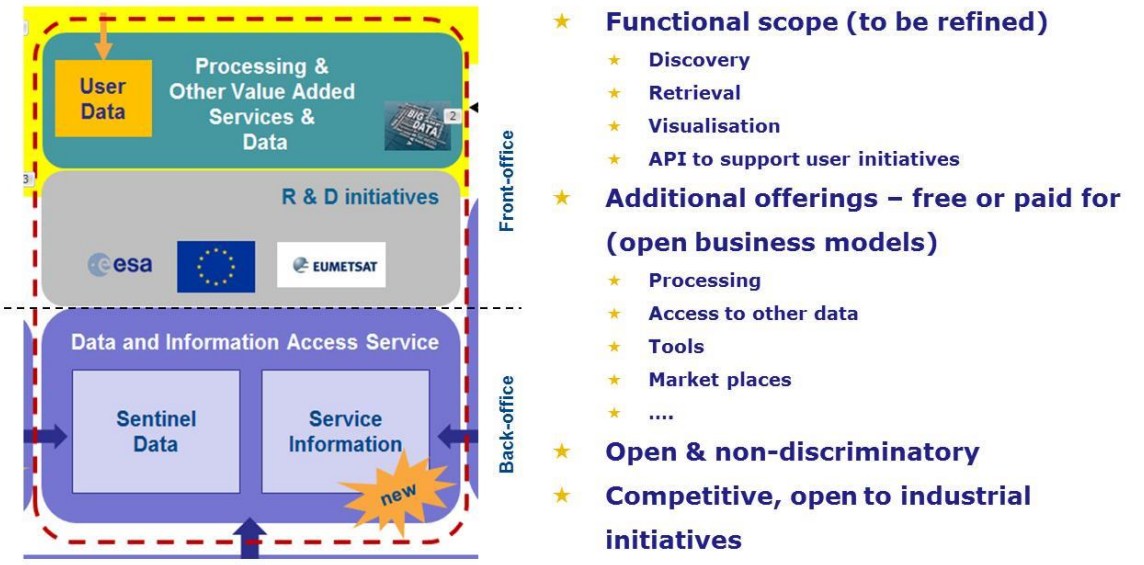

Figure 3 Data and information access service

The Commission will trade off appropriate service levels to enable a maximum of opportunities for added value actors while offering a good value for money to the Commission when supporting the services over time. Given the limited size of space data markets, such an approach should also provide the necessary predictability and planning certainty for industrial initiatives to develop and for different data exploitation models to emerge.

Without anticipating the precise definition of the service levels the following distinction is made on a functional level (see also Figure 4):

- A back office service essentially ensuring access to Copernicus data and information and offering storage and processing capacities alongside this service.
- Building on this, a front office service that allows addressing the needs of intermediate or final users via appropriate tools for e.g. search, processing, visualisation and animation of user communities, etc.

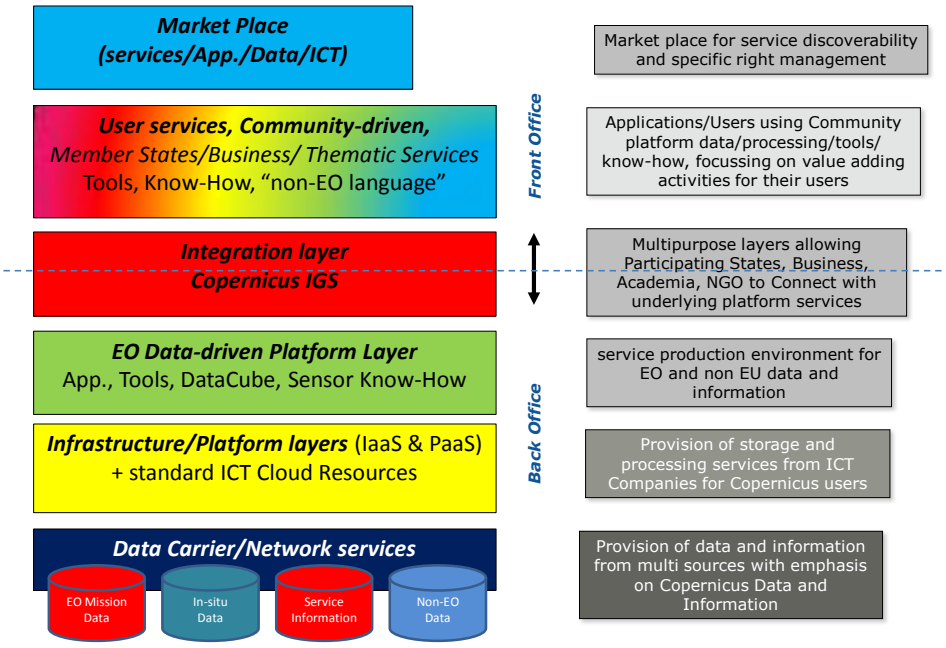

Figure 4 An example presentation of the scope of data and information access service

The Copernicus Programme would finance to enable the availability of the back office services and make sure - through appropriate functional and operational specifications of the service - that front office applications can be built on top of this layer by third parties (MS & Copernicus participating countries, Entrusted Entities, private companies of the downstream sector, etc.).

Key features of this approach are as follows:

- The proposed approach will allow providing a basic public service throughout Europe that will alleviate the burden related to data holding[4] and associated services for all Copernicus users, including Member States (mutualisation).
- The proposed approach aims at preserving the existing links between EO service providers (public, private or research related) and their users while promoting the emergence of innovative features attracting new users.
- The service would be available to support current Member State efforts in a timeframe compatible with current national funding horizons. The Member States will be able to "migrate" or deploy their value adding services on top of the basic European services and serve the needs of their own user communities (see 4.2.3 below).
- The implementation seeks to promote the participation of different user groups on the same Copernicus data and information access services to foster information exchanges and ease the transition from research to commercial activities[5].
- A co-ordinated implementation approach should allow for a minimum level of inter-operability and commonality to emerge.
- The Copernicus data and information access services will lower the entrance barrier for the development of Earth Observation related business as well as for research and development activities and allow for an increased proportion of effort to be devoted to the development of value-added activities.

[4] The data archive function will remain under the responsibility of ESA and EUMETSAT as part of the CSC Core Ground Segment.

[5] Specific provision for conducting Horizon 2020 R&D at favourable conditions on such platforms should be part of an expected service offer.

- In particular, initiatives to stimulate the use of Copernicus data and information can easily be put in place and scaled and this at all levels, local, regional, national and European.
- Flexibility and scalability of the service will reduce risks for service customers; this should allow for the emergence and validation of different value-chains.
- Combining the efforts of all actors, public and private, the data and information access services would become breeding grounds for innovative applications or "algorithm factories" that would help propel Europe to the forefront of global competition fuelled by Copernicus.
- Competition at the level of services will allow the market to auto-regulate and is expected to stimulate innovation in and around the service offerings. In particular it is expected that each of the IT service providers would incentivise the emergence of additional services/applications in cooperation with EO industry and institutional as well as private R&D organisations.
- The competitive environment will also prevent lock-in effects and mitigate the impact of a possible failure of one of the service providers.
- The approach will provide for a clear perimeter of the Commission's involvement and a related commitment to the European Citizen.
- The solutions put in place should ensure predictability of the availability of resources (data and information, storage, processing) for the users and sustainability as the access services will be incentivised to progressively add revenue streams from business users. Performance indicators will be included to ensure a satisfactory level of service.

Access to the back office services should be free and open at the Commission-enabled service level to all EU Member States & Copernicus participating countries on a non-discriminatory basis. Front office services beyond the Copernicus-enabled service level can be provided either free of charge or on a commercial basis depending on the different models adopted by the respective access service providers or new providers of front offices. The emphasis of the system design will be on ensuring fully open access to different user groups.

4.2.3. Envisaged scenarios including the transition of Member State initiatives that are underway or already in place

The core value of the current MS initiatives is seen in the stimulation of the use of Copernicus in a context of research and development and in business. The Commission recognises the need to support continuity of this effort.

On a functional level this will be enabled by the complementarity between the front and back-office services. This will see the back office service provide heavy duty infrastructure to a multitude of front office service instantiations, each engaging with its own user community. This approach will allow Member States & Copernicus participating countries, institutional users, private companies, etc. to access the Copernicus-enabled services under two typical scenarios.

1. Accessing back office services facilitated by the Commission and front office services rendered by a commercial added-value provider.
2. Accessing back office services facilitated by the Commission while engaging with its own users through its own front office.

Obviously, some users may not want to use the front office nor the back office services and rely on the distribution service and own capacity to store and process Copernicus data and information (especially in the early implementation phase). The proposed approach is non-exclusive and will, a-priori, not affect any additional approaches in the transition process.

In its approach to ensuring the availability of the back office services throughout Europe and respecting fairness and value for money, the Commission will therefore seek to facilitate the transition of relevant parts of the existing collaborative infrastructure services to the back-office services.

This would be done along the following lines:

As part of the requirements, each candidate IT service provider will be requested to propose the necessary APIs allowing the integration of service elements from national initiatives. This is done with the objective to build on existing investments by integrating the distributed efforts at Member State level in as many areas as possible.

Member States will be asked to declare their interest to see parts of their collaborative elements integrated into the Commission enabled services. Member States without collaborative GS will be invited to build their own EO exploitation activities on top of the back office of their preference.

The transition phase will be managed according to a structured migration process that will be included as a key part of the functional specifications for the Copernicus data and information access services.

Without prejudging individual choices to be made and agreed, the transition phase of existing collaborative ground segment (or *mutatis mutandis* Copernicus services) may see different hypothetical scenarios, among which:

- An existing collaborative ground segment infrastructure would continue to offer services autonomously while a national front office is progressively set up/migrated on top of the Copernicus back office services;
- Depending on the APIs put in place, an existing collaborative ground segment infrastructure may be recast as a powerful front office benefiting from processing and storage capacities for heavily demanded data and information without the need to host the full Copernicus data and information archive stored in the Copernicus back office services,
- An existing collaborative ground segment infrastructure may be included in an industrial offer for the Copernicus back office services (subject to applicable legal rules)
- ...

4.2.4. Financial aspects of the scenarios

The elements that will be financed by Copernicus will be progressively defined against the functional specifications of the access services. The hosting of the full set of Copernicus Sentinel data and service information, the availability of processing facilities and the possibility to host a national/business/... front office on top of the back office offered by the access service providers will be part of the necessary conditions requiring some Copernicus funds. Where software elements need to be developed to offer such facilities and paid by Copernicus, it will be made available under an open source licence wherever possible to ensure further uptake by interested users. The Commission estimates that the cost of the data and information access services will be of the order of 10 to 15 M€ per year.

The cost of a front office itself will be left to the party willing to setup one. Similarly any provider willing to host its own data and information in the access services would do it at its own cost. The investments made to host large amount of data and information should considerably lower the marginal cost of additional data hosting and processing consumption for the access service users.

It is worthwhile noting that the Commission intends to focus future stimulus initiatives on the use of the Commission-enabled services and will seek to coordinate with Member States and the Entrusted Entities to do the same in their respective programmatic contexts (it is expected that arrangements to this effect will be pursued).

4.2.5. Near Real Time and Quasi Real Time aspects

The Commission accepts the recommendations made by the Task Force regarding this aspect and will ask ESA to amend the High Level Operations Plan and any other formal documentation that may be affected in line with annex 2 to the roadmap.

Approval of the HLOP will then be in line with the stipulations of the Copernicus regulation in force. The document will be submitted before end of 2016 to the Committee. For the exercise of elaborating operational scenarios throughout 2016, ESA will be asked to take the recommendations of annex 2 to the roadmap into account.

Following advice by the Task Force, the Commission will initiate reviews of the ground station configuration of the core ground segment at appropriate junctions. These reviews will – *inter alia* – consider operational and programmatic aspects pertaining to the ground station network and its operational use.

5. GOVERNANCE

5.1. Overall

The implementation of the proposed activity is foreseen to follow the governance of Copernicus as defined in the Copernicus regulation and make use of the various agreements already in place with delegated entities (Entrusted Entities). As the Member States have repeatedly asked for increased commonality and co-ordination between the activities of the Commission in the context of Copernicus and those of ESA, it is foreseen that the Entrusted Entities (ESA and EUMETSAT, in particular) will play a central role in the setting up of Copernicus data and information access services for hosting and processing Copernicus data and information for the benefit of all stakeholders. The EU SatCen, as entrusted entity of Copernicus SEA, can play a role supporting the definition of access services for hosting and processing Copernicus Data and information for security needs.

Currently, it is foreseen that the Commission and ESA will – under the Copernicus delegation agreement – pursue the setting up of the Copernicus data and information access services. Should other Entrusted Entities (e.g. EUMETSAT, ECMWF, Mercator Océan) confirm the interest they have expressed in taking a lead role in the setting up of a data access service[6], the Commission is open to such an approach (subject to it being compatible and aligned with the approach and principles contained in this Operational Implementation as well as the Task Force roadmap and annexes) and will ensure the necessary level of co-ordination. In any case, the Commission considers it essential that there is a close and permanent involvement of the entire Copernicus community throughout the process not least because the data and information access service should maximise the uptake of Copernicus Service information, ensure the active participation of the thematic user communities and contribute to the cross-fertilisation of different data and information. Consequently, the Commission intends to adopt a key role in ensuring the full involvement of all parties in a transparent and open manner.

In light of the Member States' requests to ensure overall co-ordination and consistency between the Commission's and ESA's activities, a joint approach will be presented with a clear delineation of different funding sources. This will be based on the principle established above: i.e. the Copernicus data and information access services will play an overall enabling role and form the core of the mutualised back-office, which will allow for a variety of tools and value-added elements to be built on top, including – *inter alia* – ESA's stimulating and outreach elements as described in the EO Innovation vision as well as the initiatives currently being considered by EUMETSAT, ECMWF and Mercator Océan.

The flexibility of the platform service model should allow the financial participation of other public and private entities investing in data storage and processing, platform features and additional services.

[6] EUMETSAT, ECMWF and Mercator Océan have agreed to investigate the potential of the data and information access service to bring together distributed capabilities and centres of expertise, with the aim to provide by the end of 2016 an overall concept covering Marine, Atmosphere and Climate covering the scope, the architecture, the implementation approach and related budget inputs.

5.2. Activities of the Task Force

The Commission proposes to continue and re-focus the activities of the Task Force on the follow up of the implementation activities. In particular, the support of the Task Force to the proposed technical reviews would be of importance. In the Task Force, Member States & Copernicus participating countries will be able to play their role in the evolution of the IGS with the right degree of technical expertise this subject requires. In this context the Commission will ensure that potential conflicts of interest are avoided.

It is currently foreseen that two further meetings of the Task Force should be convened before the end of 2016: a first one in late autumn to take stock and appraise the maturity of functional specifications for the distribution and access services established by the Commission and a second one in December, to review the progress made in the technical work undertaken in the execution of the present operational implementation plan (if appropriate one of these meeting could be replaced by a written consultation process).

The role of the Task Force should, *inter alia*, include providing feedback on the content of the functional specifications, the proposed target performance levels and the scope of the services to be rendered. The Commission proposes to amend the current Terms of Reference (ToR) accordingly and to propose the amended version for endorsement by the Committee.

5.3. Regulatory aspects

In parallel to the technical and operational work foreseen in the second half of 2016, an analysis of the applicable legal framework will be conducted (e.g. procurement, competition and IPR law as well as governance) to ensure the full compatibility of the data and information access services therewith.

6. IMPLEMENTATION ASPECTS

In line with the overall vision defined in the roadmap, the current Core GS will continue its evolution to become a fully Integrated Ground Segment in the coming months and years. To achieve this, a staggered approach will be pursued to minimise risks and to take into account resource and procedural constraints. The overall orchestration of the evolution process will be done in such a way as to ensure timely availability of quality Copernicus data and information to users at all time.

In 2016 access to Sentinel data will continue to improve rapidly. This will be achieved on the basis of the functional specification for the IGS that will cover both the data distribution and the data and information access services. This specification will be drawn up by a team led by the Commission (in particular DGs JRC and GROW) in summer 2016. Against this, a thorough review of a revised Ground Segment data access and dissemination architecture[7] will be conducted.

In the early phase leading to the successful closure of the Ground Segment data access and dissemination architecture review, a particularly close interaction between European Commission and ESA/EUMETSAT teams will be put in place to ensure convergence and full alignment with the programme objectives. At all stages, the European Commission will ensure through appropriate means (consultation, direct involvement) that the needs of other Entrusted Entities (EE) are taken into account.

The review will result in a coherent reference architecture for the IGS as well as a high level workplan for its deployment; measurable performance targets will be associated to each step of

[7] Revision to respond to the functional specifications by means of introducing appropriate solutions as described in Annex 1 to the roadmap. The revision will also allow introducing the necessary interfaces to support the future data and information access services as well as to explore avenues to harmonise data access across Sentinel missions.

the deployment and should be fulfilled by the access service providers and consolidated by the EE in charge.

In parallel the legal work to enable the emergence of the Copernicus data and information access services will be prepared with the objective to releasing the specification package by beginning of 2017. It will be ensured that the necessary communication and information activity towards the relevant communities (e.g. ICT, EO, thematic areas) is undertaken. The proposed approach features the gradual deployment of the IGS including the Copernicus data and information access services and their innovative architecture and operations approaches. The parallel deployment of enhancements to the data distribution services will ensure independent access to the Sentinel data at all times. The appropriate orchestration of the two initiatives represents a mitigation measure against the inherited risks associated to either of the two initiatives.

Within the framework of existing working groups of the Copernicus committee, the User Forum and the Task Force, dedicated reviews will be performed in 2016 and 2018/2019 to agree on a reference configuration and related deployment and performance objectives (in 2016) and to address the progress of the IGS deployment against the previously agreed milestones, take into account lessons-learnt and decide on further enhancements if necessary (2018/2019). These reviews will involve representative users of the services.

6.1. Implementation schedule

A preliminary definition of the implementation timeline is shown in the following table. This schedule will be re-evaluated and amended as necessary after each review.

Timing	Activity
Q2/2016	The Commission – in close co-operation with the Member Stats – decides on its implementation approach for the IGS, including Copernicus data and information access services. This will include the definition of user groups to be served and be based on the on-going consultation of Copernicus Programme participants and industry.
Q3/2016	Task Force meeting/written consultation to present the functional specification for the IGS.
Q4/2016	Start Ground Segment data access and dissemination architecture review to achieve: • Agreement of overall architecture of IGS • Agreement on the high-level requirements for the Copernicus data and information access services (focus on functional and operational requirements) • Agreement on the high-level requirements for the enhanced distribution services (focus on functional and operational requirements) • Agreement on interfaces between those two elements of the IGS • Agreement on main milestones and reviews This review is jointly executed by EUMETSAT and ESA. It is chaired by the Commission and with the full involvement of all Copernicus Entrusted Entities. Based on activities already underway, an initial prototype Data distribution Network phase is deployed, connected to the collaborative hub (as this is based on currently on-going initiatives it will not yet be taking on board the outcome of the architecture review).
Q4/2016	Task Force meeting to report on the outcome of the review, the status of preparation for the procurement specification package(s) and the overall

Timing	Activity
	workplan.
Q4/2016	Finalisation and release of the specification package for: • the Copernicus data and information access services. • the enhanced distribution services Both packages will be developed by ESA and EUMETSAT as applicable on the basis of the architecture review. This information will allow all (commercial and public) entities to discern the need for complementary developments in order to allow use of the Copernicus data and information access services as soon as they are operational.
Q1/2017	Launch of the required legal procedures to acquire the data and information access services
Q4/2017	Enhanced distribution services start operating Initial Copernicus data and information access services start operating
Q1/2018	IGS Phase 1 operations start formally
2018-19	IGS 2 preparation. This includes an IGS phase 1 achievements review and subsequent alignment of IGS where required to ensure targeted services are available.
2020	IGS routine phase 2 starts

6.2. Complementarity with other initiatives

6.2.1. Member States;

National collaborative ground segment initiatives will be able to build upon the Copernicus IGS and in particular the data and information access services to offer national added value initiatives to their user constituencies. This will allow foregoing financial efforts related to bespoke national data and information access services and use the Copernicus ones instead.

6.2.2. ESA initiatives

As an element of its ground segment evolution strategy ESA is promoting with relevant stakeholders the adoption of the "EO Innovation Europe" vision, a European network of EO capabilities from different sources. This comprehensive vision aims at federating different ground segment infrastructures making possible the exploitation of different mission data using big data technologies. Developments towards this vision will be submitted to ESA Member States for funding at the next ministerial council meeting as part of the Earth Observation Envelope Programme (EOEP). The possible synergies between this initiative and the IGS are such that their success will be interdependent. Notably the Copernicus data and information access services are expected to play a key role as the enabling element of the EO innovation Europe strategy.

It is agreed with ESA that the activities within their programmes will make maximum use of and support the further development of the Copernicus data and information access services through a fully complimentary partnership approach.

6.2.3. EUMETSAT initiatives

EUMETSAT has prepared for approval by its Council in June 2016 a set of internal Pathfinder projects based on new big data technologies for the upgrade of its EUMETSAT multi-mission ground segment infrastructures, including storage and dissemination facilities. They will enable

EUMETSAT to deliver enhanced data services to its Member States from 2017. Some features addressed by EUMETSAT as part of these Pathfinder projects might be of relevance to the implementation of the IGS such as online data access, hosted processing, advanced web services and toolboxes, push service over GÉANT.

EUMETSAT has started work towards establishing, together with Mercator, a European Marine platform, building upon the existing capabilities of EUMETSAT, Mercator Océan and the EUMETSAT Ocean and Sea Ice SAF, with the aim to improve the access and usage of data, products and information related to the Marine Service. Similar discussions have also started with ECMWF concerning the Atmosphere and Climate Monitoring services.

EUMETSAT, ECMWF and Mercator Ocean have agreed to investigate the potential of the data and information access service to bring together distributed capabilities and centres of expertise, with the aim to provide by the end of 2016 an overall concept covering Marine, Atmosphere and Climate covering the scoop, the architecture, the implementation approach and related budget inputs.

6.2.4. Operators of Copernicus services

ECMWF is deeply involved in big data technologies for both the Copernicus services it is in charge of and its core activity. Many other services are also moving towards the use of cloud and hosted processing to offer advanced services.

The Marine Service supports the strong move towards big data functionalities and underlines the need to preserve the dynamics of the value chain in services such as Marine or Atmosphere. During the past years, MyOcean/CMEMS has progressively focussed on the "marine" value (ie "marine information" integrating different sources of data) to reach user communities beyond the EO community. The strong majority of the service users are downloading "integrated marine information" preferentially to data only. This is also true for companies developing commercial downstream services. Mercator Ocean therefore suggests designing a marine platform contributing to the IGS framework but consistent with CMEMS users demands.

SatCen is is involved in the development of Big Data and Cloud Computing based solutions (such as Virtual Research Environments) to improve the capabilities of the Space and Security community. The current challenge in the Space and Security domain is to improve the capacity to access and analyse the increasing amount of data produced with high velocity by a variety of sources to timely provide decision-makers with clear and useful information (the datasets needed for Security applications are composed not only by EO data but also by data coming from collateral sources).

SatCen is a Participating Organization of GEO involved in key GEOSS tasks and currently leading the Space and Security Community Activity.

6.2.5. Other Commission activities

The Commission will coordinate within its own services to draw maximum benefit from the following initiatives.

DG RTD launched a number of initiatives and calls for proposals for platforms exploiting EO data. In particular in the framework of its support to GEOSS there has been a call for proposal for a European data hub of the GEOSS information system. The Commission services will ensure that a strong collaboration is established between initiatives.

ERA-Planet is another initiative launched by DG RTD with which bridges need to be built. The project aims to bring together and strengthen the European, national and regional R&D programmes in the domain of EO.

DG RTD in collaboration with DG Connect is seeking to establish a European Open Science cloud and the creation of a European Data Infrastructure which would eventually offer super-computing capacity, fast connectivity and high-capacity cloud solutions.

DG JRC is directly supporting many Copernicus services and activities. It is also involved in many connected initiatives like INSPIRE and GEOSS. DG JRC is investigating big data activities for Earth observation to serve Commission needs.

DG Connect is pursuing the development of Big Data technologies including for Earth Observation applications. It was instrumental in launching the Big Data Value Chain PPP with industry. The services in charge of e-Infrastructure are laying down operational tools to connect the different ICT infrastructures needed by the European research Institutions (network, data, cloud, HPC, etc.). Under the Horizon 2020 programme DG Connect launched the ICT 15 call for proposal which is directed to Large Scale Pilot actions in sectors best benefitting from data-driven innovation, including Earth Observation data. It calls for projects which show concrete applications of Big Data.

In DG GROW a number of research activities under Horizon 2020 will support Copernicus data and information access service and will ensure that research on Big Data for EO serve the need of Copernicus big data initiatives.

6.2.6. GEO (Group on Earth Observation)

Several GEO foundational tasks and activities are in place to foster (open) data exploitation. GEO activities are strongly supported by EU Member States, the Commission, notably by DG RTD and DG JRC and many other Copernicus stakeholders. A strategic plan for the period 2016-2025 has been decided to further implement GEOSS (see above the Commission's DGs involved).

6.2.7. CEOS

In this context the recently set-up Ad-Hoc Team on Future Data Architectures under the CEOS Working Group on Information Systems and Services (WGISS) should be mentioned.

7. CONCLUSION

The Task Force on the Integrated Ground Segment and Big Data Governance and the Copernicus Committee are invited to provide their opinion on this document and to give further guidance as to its implementation.

ANNEXES

1. GUIDING PRINCIPLES

Copernicus – as an EU programme – must serve the general interest of the Union and all its Member States. The Programme is managed by the Commission and its implementation follows EU rules and regulations. Consequently, any future evolution must remain fully compliant with the rules of the Internal Market and respect the principle of non-discrimination.

Further main guiding principles are listed below. It is likely that further trade-offs between them may prove necessary during the design and implementation phases.

Re-assertion of core objectives:

- Define and establish a clear and stable public service including risk management, guaranteed service levels and transparent boundary settings.
- Define and deliver a well-functioning, operational system covering Sentinel data and Copernicus information and ensure equal access to all European citizens as well as ensuring the availability, continuity and integrity of the related services.
- Ensure that all Copernicus data and information access services support the principle of multi-lingual operation.
- Maximise the societal and economic return on investments in Copernicus by responding to European user needs in the domains of distribution, access and processing of information.

Economic/ competitiveness dimension:

- Promote private investment, competition and the creation of jobs and economic benefit in Europe by challenging the entrepreneurial energy of European industry. The principle of an industry-enabling approach should be adopted where possible.
- Create a secure investment environment for the private sector and hence enable private initiative and investment through the definition and enforcement of clear lines of demarcation between public and private activities.
- Avoid dependency. Where possible and appropriate, aim at creating a competitive environment, pre- and post-award. This should foster innovation in all domains while competition should contribute to avoiding lock-in situations and monopolies.
- Minimise the cost and complexity of the exploitation of data and information. Where appropriate, the mutualisation of scalable common elements should be used to reduce the cost related to making use of Copernicus data and information in particular for innovative SME.
- Ensure the complementarity of Copernicus investments with related institutional activities at European, national and regional levels.
- Consider sustainability: a data and information access service requires critical mass (of users as well as quantity and quality of data, computing power and services) for being successful and ensure operational continuity.

Implementation aspects; link to other initiatives:

- Establish the main priorities for improvements the European user community requires most and the most urgently. In light of strong international competition, time is of the essence.
- Provide the possibility to Member states or any commercial and institutional entity to provide added value services accessing Copernicus data and information
- Leverage pan-European resources where possible in order to avoid duplications and minimise cost to taxpayer.

- Support and further develop user communities (either those related to the Copernicus services or others). Foster the emergence of new communities in Europe and internationally.
- Retain and expand on existing European know-how.
- Remain open to use EU contributions/ initiatives where appropriate (e.g. GEANT, Big Data PPP, research projects etc.)
- Encourage and stimulate innovative approaches where they can bring additional benefits.
- Consider aspects of transition from existing operational systems throughout the evolution process.
- Include a systematic assessment of all initiatives with regard to legitimate aspects of European security.

Technological elements:

- Maintain flexibility to allow continuous adaptation to technological development.
- Ensure that adapted implementation solutions emerge that are responding to the needs of different user types.
- Allow cross-fertilisation with non-Copernicus data/information: support interoperability and standardisation efforts where appropriate and encourage the emergence of standards in commercial, competitive environments.
- Recognise the value of diversity to test novel approaches, even where disruptive.
- Promote open source approaches: once developed for/inside Copernicus, solutions should be re-useable.

Boundary conditions - programme management related:

Establish a clear, simple and effective governance scheme. The industrial sector needs to be involved to reflect the level of contribution expected. The governance must be in line with:

- Copernicus Regulation[8] and Copernicus data policy Regulation[9]
- Existing (delegation) agreements with entrusted entities
- Multiannual Financial Framework (MFF) Mid-term review[10]
- Copernicus - Terms of Reference for the Task Force on Copernicus Ground Segment and Big Data Governance[11]

Other pieces of legislation are relevant to data access and distribution as referred to in the Copernicus data policy Regulation, in particular:

- Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)[12]
- Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information[13]

8 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014R0377
[9] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013R1159
[10] http://ec.europa.eu/budget/mff/index_en.cfm
[11] Cf document TF-2015-02
[12] http://inspire.ec.europa.eu/

[13] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:345:0090:0096:en:PDF

2. DEFINITION OF TERMS AND ACRONYMS

2.1. Definition of terms

The following terms are used in the document. The use of these terms is specific to the context. Their definition is therefore an essential element to help understand the proposals made.

Term	Description
Big Data	In this context refers to technologies which provide solutions to rapidly (velocity) extracting value from data through the access and use of large volumes of high quality (veracity) EO data and information, possibly in conjunction with other data sources (variety).
Collaborative Ground Segments	Scheme set up by ESA and financed by individual ESA Member States, addressing different aspect of the Ground Segment, aiming at complementing the Copernicus Core Ground Segment for the benefit of some national communities.
Copernicus Core Ground Segment	Comprises the operation of the dedicated satellites or payloads (Sentinels), the capturing and processing of the payload data to defined product levels including the related quality control. Purchase or provision of data from contributing missions. Also covers the archiving and disseminating of data and products to defined user typologies. The Union has entrusted the activities for development and operation of these elements to ESA and EUMETSAT.
Copernicus data and information access service	The term "Copernicus data and information access service" denotes the set of platform services procured from the EU Copernicus budget. The exact perimeter of these services will be refined and agreed through the Copernicus governance mechanisms.

Term	Description
Copernicus.eu	A web Portal that has the objective to: Project the role of the EU as overall Programme Manager and owner of Copernicus, represented by the Commission. Provide information about the programme, its objective and its evolution over time. Provide a simplified access path to Copernicus data and information and their visualisation. Provides its users with links to all (or a maximum of) Copernicus related/enabled services and data access points – a Copernicus advertising space. Provides access to customer care (user support). Provides news links for opportunities related to Copernicus. Serves as communication portal The Copernicus.eu portal would be expected to rely on the various distribution and access facilities provided by Copernicus for its operation.
Copernicus participating countries	Countries or International organisations having signed an agreement to participate in Copernicus in accordance with Art. 26(1) of the Copernicus Regulation
Data	Earth observation data (most often in this context: remote sensing data)
Distribution	The provision of data and information through a download service.
Earth Observation Big Data enabled services	This term encompasses services rendered on top of the data and information access service (midstream/tools, EO added value services, EO enabled added value services).
GSC Participating States	States having funded the GSC programme
Information	Value-added products provided by Copernicus services
Infrastructure as a Service (IaaS)	The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).
Member States	In the context of this document, the term 'Member States' denotes Member States of the European Union and countries participating in Copernicus. When referring to ESA Member states this is explicitly mentioned.

Term	Description
Platform	In the context of this note: a functional element encapsulating all necessary components to facilitate access to Copernicus data and information, stimulate innovation and lay the foundation for the extraction of added value from Copernicus. In technical terms a platform describes a set of IT services providing: • Data access • Computing resources • Software tools for handling EO data, user management, accounting and monitoring • User services related to these services (help desk, account maintenance, ...) For any platform, these services may be physical, virtualized, or a mix of both.
Platform as a Service (PaaS)	The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.
Product	Value added output provided by the EO downstream sector (for Copernicus services the term information is used instead)
Service	In this document, depending on the context it can refer to: • Copernicus services • EO applications services (e.g. provision of change detection product in a time series of observation data) • Copernicus data and information access services • ICT services (e.g. storage or processing)
Software as a Service (SaaS)	The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Term	Description
User	The recipient of a product (data/information) or service within a value chain. In the present context, users are cast in typologies to match service levels to their needs. In this document the term users is meant to represent the next lower (downstream) actor in a simplified EO value chain: typically value-added providers (public or private) and the scientific community. Copernicus has vocation to directly or indirectly (through public or private value-adding service providers) serve all types of users

Table 2 Definition of terms

2.2. Definition of acronyms

Acronym	Description
EE	(Copernicus) Entrusted Entities
EO	Earth Observation
ESA	European Space Agency
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
GEO	Group for Earth Observation
GEOSS	Global Earth Observation System of Systems
GS	Ground Segment
ICT	Information and Communication Technologies
IGS	Integrated Ground Segment
JRC	Joint Research Centre
MS	Member States
NRT	Near Real Time
QRT	Quasi Real Time
SME	Small and Medium Enterprises
ToR	Terms of Reference

Table 3 Acronyms used