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|  | Ionosphere Prediction Service  Progress Report |

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# Introduction

This document provides the project status till the PRR milestone.

## Applicable Documents

| Id. | Title | Reference | Ver. | Date |
| --- | --- | --- | --- | --- |
| [AD-1] | European Commission Invitation To Tender: | Brussels, GROW/L2/DT/vw/Ares(2015)1990179 |  |  |
| [AD-2] | Tender Specification | 434/PP/GRO/RCH/15/8381 |  |  |

## Acronyms

| **Acronym** | **Explanation** |
| --- | --- |
| CDD | Concept Definition Document |
| CRR | Core Research areas Report |
| CCP | Coordination and Communication Plan |
| DDD | Design Definition Document |
| DJF | Design Justification File |
| DVP | Development plan |
| EXS | Executive summary |
| PDR | Preliminary Design Review |
| PRR | Preliminary Requirement Review |
| RPF | Remote Processing Facility |
| SDR | System Requirement Document |

# Project status report

The project Final Report provides the synthesis of all the different tasks carried out during the project execution.

The report includes the following information:

* list of all submitted deliverables
* list of all meeting attendance
* status of all accomplished work (for each task foreseen in the project)
* list of all problems, limitations or unexpected points
* assessment of the risk management
* list of all coordination issues.

## List of all the submitted deliverables

|  |  |  |
| --- | --- | --- |
| **Milestone** | **Task** | **File name** |
| **PRR** |  |  |
| Coordination and Communication Plan | Task | SSA-SN-IPS-CCP.00.10.docx |
| Progress Report | Task 1 | SSA-SN-IPS-REP-01.00.10.docx |
| Review of State of the Art | Task 2 | SSA-SN-IPS-RSA.00.10.docx |
| Review of Institutional Landscape | Task 2 | SSA-SN-IPS-RSI.00.10.docx |
| Research Plan | Task 3 | SSA-SN-IPS-RSP.00.10.docx |
| Technology Gap Assessment | Task 3 | SSA-SN-IPS-TGA-01.00.10.docx |
| Core Research areas Report | Task 3 | SSA-SN-IPS-URD.00.10.docx |
|  |  |  |
| **PRR second issue** |  |  |
| User Requirement Document | Task 2 | SSA-SN--IPS-URD.00.11.docx |
| Progress Report |  | SSA-SN-IPS-REP-01.00.11.docx |
| Review of State of the Art | Task 2 | SSA-SN-IPS-RSA.00.11.docx |
| Review of Institutional Landscape | Task 2 | SSA-SN-IPS-RSI.00.11.docx |
|  |  |  |
| **PDR** |  |  |
| Concept Definition Document | Task 4 | SSA-SN-IPS-CDD-00.10.docx |
| Development Plan | Task 4 | SSA-SN-IPS-DVP-00.10.docx |
| Progress Report |  | SSA-SN-IPS-REP-02.00.10.docx |
|  |  |  |
| **CDR** |  |  |
| Appendix to the Design Definition Document | Task 5 | Appendix\_to\_the\_DDD\_IPS Web\_Portal\_01.00.doc |
| Coordination and  Communication Plan | Task 8 | SSA-SN-IPS-CCP.01.00.docx |
| Core Research areas Report | Task 3 | SSA-SN-IPS-CRR-01.00.docx |
| Design Definition Document | Task 5 | SSA-SN-IPS-DDD-01.00.docx |
| Design Justification File | Task 5 | SSA-SN-IPS-DJF-00.03.docx |
| Executive Summary | Task 8 | SSA-SN-IPS-EXE-00.01.docx |
| Progress Report | Task 1 | SSA-SN-IPS-REP-03.00.10.docx |
| System Requirement Document | Task 5 | SSA-SN-IPS-SRD-01.00.docx |
|  |  |  |
| **Delta CDR** |  |  |
| Coordination and Communication Plan | Task 8 | SSA-SN-IPS-CCP.01.00.docx |
| Core Research areas Report | Task 3 | SSA-SN-IPS-CRR-02.01\_FINAL.docx |
| Design Justification File | Task 5 | SSA-SN-IPS-DJF-01.20.docx |
| Progress report | Task 1 | SSA-SN-IPS-REP-03.00.20\_FR\_revEG.docx |
| System Requirement Document | Task 5 | SSA-SN-IPS-SRD-02.00\_V1.4\_FINAL.docx |
| Technical note | Task 5 | SSA-SN-IPS-TEC-1-02.00.docx |
|  |  |  |
| **QR** |  |  |
| Interface control document | Task 6 | SSA-SN-IPS-ICD-00.09.00.docx |
| Prototype User Manual | Task 6 | SSA-SN-IPS-PUM-00.00.10.docx |
| Qualification Procedure Map | Task 6 | SSA-SN-IPS-QPM-00.06.00.docx |
| Progress report | Task 1 | SSA-SN-IPS-REP-04.00.00\_draft.docx |
|  |  |  |
| **AR** |  |  |
| Leaflet | Task 8 | Tes119\_Leaflet IPS\_240718.pdf |
| Core Research areas Report | Task 3 | SSA-SN-IPS-CRR-03.10.docx |
| Second issue of the Interface Control Document | Task 6 | SSA-SN-IPS-ICD-00.10.00.docx |
| Implementation Roadmap | Task 7 | SSA-SN-IPS-IMP-00.01.00\_v6.docx |
| Operational procedures and maintenance plan, V1 | Task 6 | SSA-SN-IPS-OPM-00.01.00\_v4.docx |
| Prototype User Manual | Task 6 | SSA-SN-IPS-PUM-00.20.docx |
| Qualification Procedure Map | Task 6 | SSA-SN-IPS-QPM-00.06.docx |
| Progress Report | Task 1 | SSA-SN-IPS-REP-04.01.00\_revEG\_mod.docx |
| Ionospheric prediction service prototype, V1 | Task 6 | Delivered source code |
|  |  |  |
| **FR** |  |  |
| Ionospheric prediction service  prototype, V2 | Task 6 | Delivered source code |
| Operational procedures and maintenance plan, V2 | Task 6 | SSA-SN-IPS-OPM-00.03.00 |
| Observation and Anomalies Report | Task 9 | SSA-SN-IPS-OAR-00.01.03 |
| User Feedback Report | Task 9 | SSA-SN-IPS-UFR-00.01.03 |
| Executive Summary | Task 8 | SSA-SN-IPS-EXE-01.00.00 |
| Technology Gap Assessment | Task 3 | SSA-SN-IPS-TGA-00.01.01 |
| Final Progress Report | Task 1 | This document |

## List of all meeting attendance

|  |  |
| --- | --- |
| **Date of the meeting** | **Subject of the meeting** |
| February 2nd, 2016, EC, Avenue d'Auderghem, 45, Brussels, Belgium | Kick off Meeting |
| June 14th, 2016, Telespazio Roma DG | Preliminary Requirement Review |
| Informal meeting on September 2016 | Preliminary Architecture overview |
| October 18th, 2016, Telespazio Roma DG | Preliminary Design Review |
| February 21st-22nd, 2017, INGV premises | Critical Design Review |
| February 27th-28th, 2018, TPZ RomeDG premises | Qualification Review |
| 27 March 2018 – Videoconference | Videoconference with EC and GSA about Implementation plan |
| Brussels, June 6, 2018 Auditorium Breydel building (DG GROW), avenue d'Auderghem, 45 | Workshop on Horizon 2020 EGNSS Mission And Services |
| June 11th-12th, 2018, TPZ RomeDG premises | Acceptance Review |
| 29th and 30th November 2018 Telespazio Premises | A dedicated meeting was organized in Telespazio with EC and JRC with the objective to provide clarification for the installation of the IPS platform and details on the documentation. |
| January 29th 2019, JRC premises (Ispra) | IPS User Workshop |
| January 30th – 31th 2019, JRC premises (Ispra) | Training in JRC premises |
| January 31th 2019, JRC premises (Ispra) | Final Review |

### Task 2 status

Task 2 is completely accomplished. Review of the state of the Art and Review of the Institutional landscape were carried on by Telespazio with the contributions of the Research Centres.

For the definition of the contributions and the overall coordination, two internal meetings took place during the period, on 31 March 2016 and on 3 May 2016 in Telespazio premises.

User requirements collection was carried on by NSL with the support of Telespazio. In particular, NSL carried on the analysis concerning aviation and high precision communities and Telespazio carried on the analysis concerning the mass market and critical infrastructures domains.

The analysis was carried on sending a questionnaire and collecting interviews with the potential users. Few answers were have been received before PRR.

Telespazio and NSL were coordinating through frequent teleconferences and mail exchange.

### Task 3 status

Task 3 started at PRR; the Research centres during this period, coordinated by Telespazio, provided input for the definition of the Architecture of IPS.

The task 3 main delivery for the CDR is the CRR with the preliminary validation of the algorithms. The CRR was reviewed and it was decided after the CDR meeting for a new issue of the document at the Delta CDR (see Task 5 status) in order to solve the remaining missing details. The new issue was delivered on 25 May 2017.

The second issue of the CRR was due at the AR that took place on June 11th-12th 2018. Details about the work done in the CRR are reported in the task 6 because strictly linked with the progress of the development of the platform and the related validation.

### Task 4 status

Task 4 started on May 2016, and it was carried on essentially by Telespazio, trying to define in this early stage the first high level architecture of the system. The objective was to highlight problems or constraints that need to be shared with the other partners as soon as possible to avoid any problem in the development of the platform.

A first iteration was carried on with the partners on 3 May 2016 during the second internal meeting in Telespazio.

A second iteration informally was carried on with the European Commission (teleconference on 13th September 2016) to present the preliminary architecture of IPS and the service concept and collect suggestion for a better design of the prototype.

A further consultation with the partners took place on wed 14th September 2016 to consolidate the inputs for the CDD and DVP and coordinate the next contributions.

Two separate meetings took place with INGV and UNOTT on 27th September 2016 about RPF 2 and 3 and with UTOV on 28th September 2016 about RPF 1.

The interaction with the Research Centres allowed to better understand the conditions and any possible constraints in the use of the data sources that are the most important elements of the Sensors network of IPS prototype.

Finally another intermediate draft of the CDD was sent to EC on 30th September 2016 for further comments before the official delivery during the PDR that took place in Telespazio premises on 18th October 2016.

### Task 5 status

Task 5 was fully accomplished. It started on October 2016, and it was carried on essentially by Telespazio with the inputs of the Research Centres.

Regarding the development of the IPS Web Portal, since it is a very specific sw development activity, Telespazio sub contracted this task to an external provider (Inter-Consulting). This decision was taken in order to support Telespazio for the design and development of a full fledged portal, characterized with the newest technological solutions that, even if used for a prototype, can be still evolved to support the final service.

The main objectives are:

* The definition of the system requirements, including the traceability between the User requirements (as output of the task 2) and the IPS services and products.
* The definition of the detailed design of the IPS system, namely the SRD and DDD documents. Starting from the CDD document, each element is further analysed and decomposed in its main functions. A specific annex is dedicated to the design of the Web Portal; to carry out this activity Telespazio is supported by the above mentioned sub contractor that is carrying out the design of the web components under the coordination of Telespazio itself.

The SRD and DDD activities required a strong interaction among the partners especially with the Research Centres in order to design the RPF to be able to run the algorithms and to exchange the products.

* The Justification file that includes the retrovalidation explanation for each RPF. The choice is to define specific functions in the IPS architecture devoted to the retrovalidation service of some products (only the products that will be provided directly to the user and that the user can analyse).

Two separate meetings/teleconference took place with INGV, UNOTT and UTOV on November and December 2016 about RPF 1, 2 and 3.

A specific analysis about SW and HW standards in the GSC is requested as part of the DDD. Since there isn’t officially public GSC programme documentation, the SOW for the set up of the GSC and a recent paper published in the ION 2015 were used as main reference

The main output of the Task 5 was the SRD, the other outputs were the DJF, CCP, EXS and a technical note explaining the concept of the retro-validation of the forecasts.

After the CDR meeting held on 21 - 22 February 2017 at INGV premises, EC invited the consortium to complete and improve the SRD document since several functions were missing or not fully described, and to better specify in it the requirements in order to remove any possible ambiguities in their interpretation.

Therefore it was decided to introduce an intermediate milestone, the delta CDR. A number of interactions with EC and JRC took place in this delta phase to steer the delta CDR and lead it to a successful completion, notably by collecting comments and suggestions and complete in the best way the documents.

The new SRD was delivered by the consortium on June 19th 2017. EC reviewed it, expressed its satisfaction over the improvements made, and approved the conclusion of task 5 and of the CDR milestone overall.

### Task 6 status

The task 6 was fully accomplished at the AR.

The main task before QR was the development and functional tests of the IPS prototype platform.

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During the development phase several critical issues were solved in particular the integration between the RPF 2 and RPF 3, due to the difficulty to schedule and synchronize correctly the operations of the two processors.

The final solution was the tight integration of the two SW and the use of a single scheduler.

Therefore RPF 1, 2, 3, 4 together with Alert generator and statistics generator were working since early February.

RPF 4 development started with delay during November 2017 and the development of the algorithms finished before the QR. Initially the RPF 4 was not requested by the SOW nevertheless Telespazio proposal suggested the importance of such products to complete the IPS offer and better cover the aviation community requirements.

Finally the Web Portal requested very specific sw solutions to better the overall user experience and to implement all the features for the access to the IPS products.

The Qualification review (QR), nominally 6 months after the conclusion of the CDR, took place in Rome on 27 – 28 February 2018.

The project at the QR had 8 months of delay, 6 months before the beginning of the task 6.

The delay at the end of the development phase was a total of 8 months (i.e. 2 months accumulated during the development).

The development was concluded with minor bugs to be solved

The main task between the QR and the AR was concerning the validation of the end to end service.

The validation was carried out through two different strategies. The first provided a statistical characterization of the behaviour of the service using the “retro-validation” IPS products, measuring the discrepancy between the prediction and the actual value of the specific event.

A sufficient number of retro-validation realizations can be used to derive a statistic of the specific product. The historical data of IPS will be retained in order to enrich such statistics in benefit of the users.

The second method was based on the direct comparison of the IPS forecasting and nowcasting products against external ones (i.e. coming from other services). Typical external sources are IGS real time products, against which the IPS predictions are compared.

Since IPS development was carried out in a period of quiet solar activity, historical analysis is needed in order to provide evidence of the behaviour of the service in presence of events of different magnitude.

The activity was carried out following the recommendations of EC and JRC and the methodology agreed at the QR.

Each Research Centre provided within the weeks following the QR a preliminary report with the results of the activities. After few iterations the complete task was performed and the results were included into the CRR.

In general the results were satisfying and in line with the expectations and several details were provided to EC and the JRC during this phase.

At the same time the service was continuously running and EC and JRC were provided with full access to the features of the platform.

Comments and suggestions were provided and they were implemented bringing the IPS prototype to the sufficient maturity to be ready for operations.

The task 6 ended at the AR.

### Task 7 status

The task 7 was fully accomplished at the AR. During the period between QR and AR a videoconference was organized with the GNSS Service Centre to present possible strategies for the deployment of IPS at the GSC and collect suggestions for the analysis.

The same suggestion were useful for the deployment of the IPS platform at JRC premises.

### Task 8 status

The objectives of the task 8 were to coordinate with other initiatives and to disseminate as much as possible results and concepts behind IPS in order to collect feedbacks from final users and other parallel initiatives.

A first contact tool place in 2016 with another H2020 project (MISW) where a clearer view of the real outputs of MISW and its relation with the IPS framework were obtained. Contact was taken with prof. Biagio Forte who is the coordinator of MISW. The objectives of the respective programmes were shared.

In parallel, contacts with the Finnish Meteorological institute (FMI) were organized. Telespazio will exchange info about the research when it will be more mature. FMI forwarded to TPZ an alternative contact inside the National Land Survey (NLS) to exploit the possible use of an open national reference network (FINREF). This network is part of the EUREF network.

Regarding the networking activities with European actors and initiatives in the framework of IPS, it has to be highlighted that at URSI GASS 2017, G. De Franceschi has been appointed as the new URSI Commission G Vice –Chair (Chair: Pat Doherty) in the period 2017-2020 (see the link http://www.ursi.org/commission.php?id=G). Among the others, the involvement and role of G. De Franceschi in IPS has been considered of interest to serve within the URSI ionospheric forecasting community.

IPS was of great interest within the TREASURE project (Training Research and Applications network to Support the Ultimate Real Time High Accuracy EGNSS solution), 2017-2021, funded by EC - H2020 Marie Sklodowska Curie Actions. The project developed advanced models and algorithms to achieve real time high accuracy positioning, starting from the research carried out in IPS among the others, through research that will be conducted by 13 early career Fellows. Two of these Fellows (named ESR1 and ESR11) were involved in “TEC and scintillation forecasting models” and “ICT technical feasibility study”, respectively, under the supervision of INGV where they are hosted for 3 years (2017-2020).

Moreover Telespazio supported EC for the preparation of papers to be submitted to the ICAO NAV panel Navigation Systems Panel (NSP), informing the ICAO authorities about the development of a ionospheric prediction service that is of interest for the aviation community.

A first information paper has been submitted on ICAO NSP in October 2017 to present for the first time the initiative and its relevance for aviation users (refJWGs/2-WP/02,07/05/2017).

A second paper on April 2018 followed on that of 2017,and described the state of play of the prototype, compared its ergonomic with existing similar platform, discussed the validation approach and introduced the first results of the predictions generated. The paper has been very well received and fits well within current discussions aiming at setting a similar service at international level.

The achievements of the task 8 related activities along the entire duration of the project is summarized by the following table. In the Note Column there are some comments about the results of the specific dissemination event.

All the publications are also downloadable from the IPS web portal.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Id** | **Conference** | **Title** | **Type** | **Notes** |
| 1 | Participation to the NAVITEC 2016 conference in ESA ESTEC on 14-16 December 2016. | Ionosphere Prediction Service | Paper and Poster |  |
| 2 | Participation to the International School of Space Science (ISSS) - L’Aquila 2016 – Director Prof. U. Villante (<http://www.cifs-isss.org/>) and “Ground based and space instruments for researches in Solar-Terrestrial physics” Directors: F. Berrilli (UNITOV), S. Jefferies (GSU), C. Scotto (INGV) | Telespazio held a presentation with the title “A Ionospheric Prediction service” on Friday, 10th (Chairs: F. Berrilli, S. Jefferies, C. Scotto) | Oral presentation | Location: Gran Sasso Space Institute – GSSI (http://www.gssi.infn.it/)  The School is organized by the Consorzio Interuniversitario per la Fisica Spaziale (C.I.F.S.) which joins several Italian Universities active in the field of Space Science (Catania, Firenze, L'Aquila, Milano, Roma "La Sapienza", Roma "Tor Vergata", Torino, Trieste) and Istituto Nazionale di Astrofisica (INAF). Since foundation ISSS is directed by prof. U. Villante. |
| 3 | IAU Symposium 335 EXETER | Ronchini et al., 2017, IPS | poster |  |
| 4 | NAVIGATION SYSTEMS PANEL (NSP) JOINT WORKING GROUPS MEETING Montréal, 13 June – 23 June 2016 Agenda Item 2 f) Other Issues | “Ionospheric Prediction Service for GNSS users” (Presented by Eric Châtre)  (Prepared by Eric Guyader, Filippo Rodriguez, Roberto Ronchini, Stefano Di Rollo) | Paper and presentation |  |
| 5 | (International Space Weather Initiative) ISWI Workshop in Boston, Boston College, August 2017 | "Italian Contributions to SW studies: recent progress", by Y. Migoya-Orue, V. Romano et al. (including F. Rodriguez, C. Cesaroni, G. De Franceschi, L. Alfonsi) | Poster |  |
|  |  |  |  |  |
| 6 | ISWI Workshop in Boston August 2017 | "Ionospheric prediction tools in IPS EU-Project" by V.Romano, C. Cesaroni, L. Spogli, G. Defranceschi, I.Hunstad, F. Rodriguez | Presentation | ISWI (International Space Weather Initiative) is an international initiative supported by NASA and UN.  Visit the link to consider the high-level audience and to download the pdf. http://www.unoosa.org/oosa/en/ourwork/psa/schedule/2017/2017-un-usa-workshop-on-international-space-weather-initiative-presentations.html |
| 7 | URSI GASS Montreal 2017 (http://www.ursi2017.org/) | Cesaroni et al., 2017 THE IONOSPHERE PREDICTION SERVICE PROJECT, | poster #2866 | Two poster sessions have been organized from 16.00 to 19.00 without overlapping with oral sessions. This allowed successful discussions and interactions among scientists, more than during oral presentations. The poster on IPS has been discussed with about 20 colleagues, among them: P. Doherty (Boston College, USA), I. Galkin (Center for Atmospheric Research, UMass Lowell, USA), E. De Paula (INPE-EMBRACE, Br), N. Bergeot (GNSS at ROB, Be), F. De Gasperin (LOFAR, Univ Leiden, Nl), D. Bilitza (NASA/GSFC, Heliospheric Physics Lab, and Space Weather Lab., George Mason University, Fairfax, USA). |
| 8 | ESWW14 2017 Ostend, Belgium (<http://www.stce.be/esww14/>) | Cesaroni et al., 2017 The Ionosphere Prediction Service Project | e-poster |  |
| 9 | IIN (Istituto Navigazione Italiano) | November 2017 Oral Presentation by Telespazio | Oral presentation | Rome Ministry of Transportation |
| 10 | J. Space Weather Space Clim. 2018, 8, A11 ( | A probabilistic approach to the drag-based model by Napoletano, Forte, Del Moro, Pietropaolo, Giovannelli, Berrilli https://doi.org/10.1051/swsc/2018003) | Oral presentation |  |
| 11 | IAGA Italy meeting, 22 February 2018, Italy, Rome | Oral presentation by University of Tor Vergata | Oral presentation |  |
| 12 | Fourteenth European Space Weather Week, 27 November 2017, Belgium | Oral presentation by University of Tor Vergata | Oral presentation |  |
| 13 | Journal of Space Weather and Space Climate 2018, 8, A11 | A probabilistic approach to the drag-based model by Napoletano, Forte, Del Moro, Pietropaolo, Giovannelli, Berrilli | Peer Reviewed Paper | https://doi.org/10.1051/swsc/2018003  Download at: https://www.swsc-journal.org/articles/swsc/full\_html/2018/01/swsc170019/swsc170019.html |
| 14 | IAGA Italy meeting, 22 February 2018, Italy, Rome | A probabilistic approach to the drag-based model by Napoletano et al. | Oral presentation | http://convegnoiaga.roma2.infn.it/?page\_id=7 |
| 15 | IAGA Italy meeting, 22 February 2018, Italy, Rome | P-DBM model for CME propagation by Del Moro et al. | Poster #P05 | http://convegnoiaga.roma2.infn.it/?page\_id=667 |
| 16 | Fourteenth European Space Weather Week, 27 November 2017, Belgium | P-DBM: A probabilistic implementation for the Drag-Based Model by Del Moro et al. | Oral presentation #S2-O2-03 | http://www.stce.be/esww14/contributions/public/S2-O2/S2-O2-03-DelMoroDario/delmoro.pdf |
| 17 | ENC 2018 | May 2018 | Oral Presentation |  |
| 18 | TREASURE Training Research and Applications network to Support the Ultimate Real Time High Accuracy EGNSS solution | April 2018 | Oral presentations (Telespazio and INGV) |  |
| 19 | 2nd URSI AT-RASC, | Gran Canaria, 28 May – 1 June 2018 | Paper + oral presentation (INGV) |  |
| 20 | European Geosciences Union General Assembly | Vienna, Austria on 8–13 April 2018 | 3 Posters (Telespazio, INGV and UoN) |  |
| 21 | 42° Assembly COSPAR, | 15-22 July 2018 | Pasadena (USA) | Presentation (INGV) |
| 22 | ION GNSS+ |  | Miami | Paper (accepted) and presentation (UNOTT) |
| 23 | ITSNT | November 13-16 | Toulouse | Oral presentation |
| 24 | European Space Weather Week ESWW15 | 2018 |  | Presentation accepted Abstract submitted by TPZ as session 10. The presentation was carrier out by EC instead of TPZ due to a parallel event (Innovation award ceremony)  Abstract submitted by Tor Vergata (other session) |
| 25 | Navitec | December 5-7 | ESA ESTEC | Oral presentation and poster |
| 26 | SoHe3 meeting | October 2018 | Italy | Participation (Tor Vergata) |

Table 2‑1 : presentations, papers and posters

#### Telespazio Innovation Award and Leonardo Innovation Award

During the project IPS was also proposed in the Telespazio contest for the Innovation Award.

The same was done for the parallel contest in the Leonardo Group.

IPS was awarded in both the contests as radical innovation and in the Leonardo contest was chosen among 750 other proposal coming from the entire Leonardo Group.

### Task 9 status

The IPS platform has been published on internet on the 13th of July 2018, following green light by EC project officer. Regular teleconferences took place on a 3-weekly basis to follow-up the operation phase.

During this phase EC decided to start the deployment of the IPS platform in JRC premises.

Therefore several interactions took place among EC, JRC and Telespazio in order to organize the deployment activities.

During the operation phase about 60 users registered to the IPS portal, starting on September (due to the holiday period) and with tow peaks corresponding probably to the most important events/conferences where IPS attracted more interest.

A dedicated meeting was organized in Telespazio with EC and JRC on 29th and 30th November 2018 with the objective to provide clarification for the installation of the IPS platform and details on the documentation.

The source code of the RPF 1-4 and the backend-front end were delivered before Christmas holidays.

Telespazio continued to provide support to JRC for the technical activities concerting the building, installation and configuration of the service.

## Problems, limitations or unexpected points

* The PRR milestone was delayed by 2 months to consolidate the user requirements through additional contacts of potential users.
* The accumulated delay at the Delta CDR, at the beginning of the development activities, was close to about 6 months. (Delta CDR is considered closed at mid-June), as 4 additional months were necessary to complete and improve the SRD document since several functions were missing or not fully described, and to better specify in it the requirements in order to remove any possible ambiguities in their interpretation.
* At the QR early 2018, 2 additional months of delay were added, due to the development delays in task 6.
* The planned duration of the AR tasks was originally 2 months but another shift of 2 months was necessary to finish the validation phase coupled with the difficulty to find a time window in the month of May where most of the partners were unable to participate to the AR meeting. The reason was mainly the large amount of conferences and teaching and exams commitments with exams that took place during the same month.
* The start of the task 9, so the beginning of the IPS operations, was on 13th July 2018. Therefore the end of the project was set on January 2019.

In the figure below a sketch of the new schedule is reported.



* In red: the tasks that were accomplished.
* In blue: the extension that was necessary to close the milestone (at PRR, at CDR and at QR). In particular the FR milestone was fixed at the end of January.

Analysis: Delay in the T3 activity had little incidence on the execution of the rest of the project (development phase, under tasks 6, 7 and 9), T3 activities being more of a continuous research nature.

Delays affecting T2 (2 months) and T5 (4 months) were deemed necessary to come to a more mature stage in the understanding of the user needs (T2) and in the specification of the system (T5).

Delays during task 6 (4 months) were due to the combination of some issue during the development (due to the web framework used for the front end, some unexpected inefficiency of processors that required workarounds) and the time spent for the validation. At the end of the task 6 there were no pending problems and the platform was ready to be put in operations.

## Risk management assessment

No major risks were foreseen during the project and no specific limitations or unexpected points (that could put in danger the success of the initiative) were encountered.

This risk has been mitigated through the interaction with EC before the official deliveries in order to collect by time any possible suggestion and indication to be included in the documentation.

Regarding the delay of 8 months as stated in the sec 2.3 delays affecting T2 (2 months) and T5 (4 months) were deemed necessary to come to a more mature stage in the understanding of the user needs (T2) and in the specification of the system (T5).

The remaining 2 months were necessary to solve some critical bug and to carry the IPS prototype platform to the right maturity.

Some refinement and tuning were still requested after the first delivery and during the 2 months of testing (between QR and AR). This process continued as debugging also in the next Task 9 (operation period) phase as foreseen by the SOW.

Another risk could be the delay in the activation of the demonstration phase, but also in this case there were no specific problems. Users started to register to the portal especially after the holiday period reaching 60 units. Positive feedbacks were collected and no major issues were communicated by users during operations.

Workshop, presentations and dissemination were important in the all duration of the project to mitigate the risk of a decrease of the interest in the IPS initiative due to the longer time then expected to publish the service and maintain the interest. In addition, recent developments at ICAO level on the rapid set up of a worldwide centre for space weather monitoring had suddenly attracted a renewed attention on ionospheric prediction services.

No major risks were foreseen during the operations phase.

Periodical teleconferences have been established on a 3-week basis to report EC and JRC about the operations and the status of the service. First teleconference was scheduled on 9th August 2018.

Some teleconferences and meetings/visits were organized involving EC/JRC and the consortium partners to discuss the deployment of the platform at the final location (JRC) to minimize unexpected problems and let the handover be ready for the FR. During this period TPZ and the partners supported EC and JRC in order to let JRC be autonomous in operating the system after the FR.