



**Project acronym: CS3MESH4EOSC**

**Deliverable D5.2: Interim report on dissemination and exploitation of project results**

Contractual delivery date	30-06-2021
Actual delivery date	09-08-2021
Grant Agreement no.	863353
Work Package	WP5
Nature of Deliverable	R (Report)
Dissemination Level	PU (Public)
Lead Partner	Trust-IT Services
Document ID	CS3MESH4EOSC-21-010
Authors	Marialetizia Mari, Jacopo Mariani, Rita Meneses (Trust-IT Services), Angelo Romasanta (ESADE)

**Disclaimer:**

The document reflects only the authors' view and the European Commission is not responsible for any use that may be made of the information it contains.



*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 863353*

# Versioning and Contributions History

Version	Date	Authors	Notes
<b>0.1</b>	27.04.2021	Rita Meneses (Trust-IT Services)	ToC definition
<b>0.2</b>	21.05.2021	Angelo Romasanta (ESADE)	Chapter 6
<b>0.3</b>	10.06.2021	Rita Meneses (Trust-IT Services)	Chapter 1, 4 and 5
<b>0.4</b>	11.06.2021	Jacopo Mariani (Trust-IT Services)	Chapter 3
<b>0.5</b>	14.06.2021	Marialetizia Mari (Trust-IT Services)	Chapter 2
<b>0.6</b>	14.06.2021	Rita Meneses (Trust-IT Services)	Chapter 2 and Ariana 6 revision
<b>0.7</b>	15.06.2021	Rita Meneses (Trust-IT Services)	Chapter 3 and 5 revisions. Conclusion
<b>0.8</b>	20.06.2021	Marialetizia Mari (Trust-IT Services)	General contributions
<b>0.9</b>	21.06.2021	Angelo Romasanta (ESADE)	Chapter 6 revisions
<b>0.10</b>	23.06.2021	Rita Meneses (Trust-IT Services)	Chapter 8 and Executive Summary
<b>0.11</b>	29.06.2021	Pedro Ferreira (CERN), Ron Trompert (SURF), Marcin Sieprawski (Software Mind), Guido Aben (AARNet), Holger Angenent (University Muenster)	Overall revision, contributions to chapter 4
<b>0.12</b>	30.06.2021	Rita Meneses (Trust-IT Services)	Overall editing & version for WP5 and STC comments
<b>0.13</b>	29.07.2021	Rita Meneses (Trust-IT Services), Pedro Ferreira and Jakub Moscicki (CERN)	Last revision and small edits in several sections
<b>1.0</b>	30.07.2021	Rita Meneses (Trust-IT Services)	Overall content review and final version for submission

# Index

<b>Executive Summary .....</b>	<b>7</b>
1.1 The CS3MESH4EOSC Services .....	8
1.1.1 Science Mesh.....	8
1.1.2 Technologies.....	11
1.2 The CS3MESH4EOSC Community .....	14
1.3 Future engagement plans.....	16
<b>2 Main Outreach and dissemination achievements from M1-M18 and future plans ....</b>	<b>17</b>
2.1 Editorial Plan .....	17
2.2 Website and Social Media .....	18
2.2.1 Website .....	18
2.2.2 Social Media.....	20
2.3 Communication Materials .....	23
2.4 Newsletters .....	25
2.5 Journals, publications and the press .....	25
2.6 Future Plans .....	26
<b>3 Events .....</b>	<b>27</b>
3.1 CS3MESH4EOSC events .....	27
3.1.1 Science Mesh Workshop .....	27
3.1.2 Webinars and Podcasts .....	31
3.2 Third-party events .....	33
3.3 Future plans .....	34
<b>4 CS3MESH4EOSC and the EOSC Ecosystem .....</b>	<b>34</b>
<b>5 Synergies with national and international networks .....</b>	<b>36</b>
5.1 Future Plans .....	39
<b>6 Exploitation Plan: Making use of CS3MESH4EOSC Results .....</b>	<b>39</b>

6.1	Overview.....	39
6.1.1	The cloud storage landscape.....	39
6.1.2	Science Mesh as a solution.....	40
6.1.3	Alternate solutions .....	41
6.2	Functionalities.....	42
6.2.1	Frictionless sync and share .....	43
6.2.2	Remote data analysis .....	43
6.2.3	Collaborative editing .....	44
6.2.4	Open Data Systems .....	44
6.3	Stakeholder analysis .....	44
6.3.1	End-users & research communities .....	45
6.3.2	Institutional operators of services.....	45
6.3.3	Cloud Vendors .....	46
6.3.4	Software developers .....	46
6.3.5	Policy makers and citizens .....	46
6.4	Next Steps.....	47
7	<b>Key Performance Indicators Achieved .....</b>	<b>48</b>
8	<b>Timeline of Action Plan of activities from M19 till end project .....</b>	<b>50</b>
9	<b>Conclusion .....</b>	<b>52</b>
10	<b>References .....</b>	<b>53</b>

## Index of Figures

Figure 1	Science Mesh logo.....	9
Figure 2	Reaching stakeholders on Twitter by promoting webinars (left) and presence at third-party events (right) .....	10
Figure 3	Full Technology Deployment of the Science Mesh.....	11
Figure 4	Promoting REVA, CS3APIs and OCM on social media.....	12
Figure 5	Countries of CS3MESH4EOSC community database members .....	15
Figure 6	Stakeholders Categories part of the Science Mesh .....	15
Figure 7	CS3MESH4EOSC communication roadmap and activities focus from M19.....	16
Figure 8	CS3MESH4EOSC Homepage as at June 2021.....	19
Figure 9	Example of LinkedIn post.....	20
Figure 10	Job Functions of visitors to the LinkedIn page 30/11/2020-30/05/2021 .....	21
Figure 11	Example of Tweets promoting project activities .....	21

Figure 12 CS3MESH4EOSC YouTube Channel.....	22
Figure 13 Flyer November 2020 .....	23
Figure 14 & Poster April 2021.....	23
Figure 15 Top of one of CS3MESH4EOSC Newsletters details.....	24
Figure 16 Article published In the CONNECT magazine.....	25
Figure 17 "Science Mesh Workshop - Moving Towards the Adoption Phase for Science Mesh" promotional image.....	26
Figure 18 Science Mesh Workshop Official page (top part) .....	27
Figure 19 CS3 2021 Virtual Venue on Gather.Town before Its opening (lobby area).....	29
Figure 20 CS3 Conference attendees gathering together in the Speakers Room (Note: Names and Faces removed in the image due to privacy issues) .....	29
Figure 21 CS3 Conference attendees at a company booth (left - note: Names and Faces removed in the image due to privacy issues)) and User Guide (right).....	30
Figure 22 Tweet promoting the 1st podcast episode.....	31
Figure 23 CS3MESH4EOSC Virtual Stand at the "Building a FAIR research data landscape " virtual event.....	32
Figure 24 EOSC High-level architecture .....	34
Figure 25 The fragmented cloud storage landscape .....	38
Figure 26 Approaches to solving fragmentation. ....	39
Figure 27 Website and Social Media Dashboard.....	48
Figure 28 CS3MESH4EOSC Draft Plan of Activities from M19 (July 2021) till M36 (December 2022).....	49

## Index of Tables

Table 1 CS3MESH4EOSC services vs Stakeholders.....	8
Table 2 Connected sites in the Science Mesh.....	9
Table 3 Different Services from the Science Mesh.....	10
Table 4 The technologies setting the boundaries of the Science Mesh.....	12
Table 5 Third-party technologies being integrated in the Science Mesh.....	14
Table 6 CS3MESH4EOSC Community members .....	15
Table 7 News pieces published in the website.....	18
Table 8 Website results and KPIs.....	18
Table 9 Social Media Statistics.....	20
Table 10 CS3MESH4EOSC Communication materials by M18.....	22
Table 11 CS3MESH4EOSC Papers .....	25
Table 12 Science Mesh Workshop draft agenda .....	27
Table 13 Formats to promote Science Mesh Workshop and engage with end-users.....	28
Table 14 Webinar Statistics as of June 2021.....	30
Table 15 Podcast statistics.....	31
Table 16 CS3MESH4EOSC presence at third-party events.....	32
Table 17 EOSC Working Groups relevant for CS3MESH4EOSC.....	34
Table 18 CS3MESH4EOSC synergies by M18.....	37
Table 19 Applications of the mesh and early adopters .....	41
Table 20 Key stakeholders for CS3MESH4EOSC .....	43
Table 21 Difficulties of FAIR data with the fragmented ecosystem.....	45
Table 22 Roles of partners for the mesh's exploitation.....	46
Table 23 KPIs achieved by M18 and KPIs for M36.....	47

# Glossary

Acronym	Name
COVID-19	Coronavirus form 2019
CS3	Cloud Storage Services for Synchronization and Sharing
EFSS	Enterprise File Synchronization and Sharing
EOSC	European Open Science Cloud
EU	European Union
FAIR	Findable, Accessible, Interoperable and Reusable
KER	Key Exploitable Results
KPI	Key Performance Indicator
OCM	Open Cloud Mesh
TRL	Technology Readiness Level
WP	Work Package

## Executive Summary

The main goal of CS3MESH4EOSC is to create an interoperable federation of data and higher-level services to enable friction-free collaboration between European researchers. This will be achieved by capturing the momentum of recent cloud service provisioning and uptake in National Research and Education Networks (NRENs) and public research sector providers across Europe. In particular, the availability of Enterprise File Synchronisation & Sharing (EFSS) services has led to an increase in data storage and collaboration opportunities for mid- to long-tail science, which we hope to further empower through a shared ecosystem of distributed research tools.

The main goal of WP5 is to develop and implement a stakeholder-oriented dissemination and engagement strategy, to ensure CS3MESH4EOSC results are captured, disseminated and exploited. For this, the WP5 team interacts continuously with all project WPs and prepares consistent and content-rich outreach activities, by using multiple integrated communication tools. Guided by customised and strategic communication plans, the first 18-month period saw the first developments of CS3MESH4EOSC Key Exploitable Results (KERs) and the creation of community of stakeholders interested in the project core activity. The focus for the next 18-month period is to contribute actively to the KERs' adoption by the various stakeholders and integration within the European Open Science Cloud (EOSC).

The CS3MESH4EOSC "*D5.2 Interim report on dissemination and exploitation of project results*" is an updated version of "*D5.1: Communication and stakeholder engagement plan*" released in September 2020 (M9). **This report documents the results and impact of communication efforts undertaken from September 2020** (M9 – month when Trust-IT joined the consortium and became WP5 leader) **to June 2021** (M18), which focused on creating awareness about the CS3MESH4EOSC project, its goals, its ambition and the expected KERs.

The document is divided in specific sections, listing the results achieved during this first reporting period:

- **Section 1** gives an introduction of the KERs and the engagement results achieved so far;
- **Section 2** lists the communication results from M1-M18 and indicates plans and goals for the next period;
- **Section 3** provides an overview of CS3MESH4EOSC presence at third-party events, as well events organised by the project, along with other initiatives. Plans for the next period are also detailed;
- **Section 4** describes how the project is liaising with the EOSC initiative;
- **Section 5** is dedicated to the synergies established so far or otherwise planned, with different, related initiatives and projects;
- **Section 6** provides a first overview of CS3MESH4EOSC exploitation plan;
- **Section 7** lists a quick overview of the Key Performance Indicators (KPIs) achieved by M18, along with those to be achieved by end of the project;
- **Section 8** includes a timeline of the Action Plan of activities from M18 till project end;
- **Section 9** draws some overall conclusions and provides a concise overview of the coming 18-month period.

All CS3MESH4EOSC communication and dissemination activities performed aimed to maximise the outreach, dissemination and exploitation impacts of the project during the first period, with the intent to have the same effect during the whole project lifetime and after its conclusion.

# 1. CS3MESH4EOSC offer/ target stakeholders

## 1.1 The CS3MESH4EOSC Services

The assets presented in this section are the strategic focus of this updated “D5.2 CS3MESH4EOSC Interim Report on Dissemination and exploitation of project results”. As indicated in “D5.1 Communication and stakeholder engagement plan”, an active stakeholder engagement approach is fundamental for each target group, as their involvement increases the likelihood of a broader uptake of the services developed by the Project. The goal for M19-M36 (July 2021 to December 2022) is to steadily improve the dissemination of the project’s KERs towards the key identified stakeholders, to increase the numbers of users (see Table 1).



STAKEHOLDERS				
Stakeholders	End-users & research communities	Institutional operators of services	Software developers	Policy makers & citizens
Services				
 Science Mesh	X	X	X	X
 CS <sup>3</sup> Based technologies		X	X	
Third-party technologies		X	X	

Table 1 CS3MESH4EOSC services vs Stakeholders

The following paragraphs describe the different CS3MESH4EOSC services, as well as which stakeholders and how stakeholders are addressed by the project. There are some examples provided of the engagement achieved so far. In general, the engagement goal per stakeholder is:

- End-users and research communities: increase the level of engagement from M19, to promote service adoption as soon as services are deployed. They are fundamental for the success of Science Mesh at a European level and beyond;
- Institutional operators of services: maintain the engagement among the project partners and ensure high levels of quality of service during the Project, to promote service usage after the Project’s conclusion;
- Commercial and non-commercial software developers: they are crucial for the complete deployment of the Science Mesh at European and global level. The engagement goal from now on is to expand the first list of vendors’ parts of the Science Mesh by bringing on board more institutions to be integrated in the platform;
- Policy makers and citizens: carefully follow policy priorities in the EU, namely those related to the EOSC, and promote the fact that the Science Mesh is a single contact point for European researchers and innovators for advanced data-driven research.

### 1.1.1 Science Mesh

*Stakeholders: End-users & research communities, Institutional operators of services, Non-commercial software developers, Non-commercial software developers, policy makers and citizens*

Science Mesh is the main result of CS3MESH4EOSC. The service will allow users to retain control over their remote or domestic datasets, while becoming FAIR compatible and integrated with the EOSC<sup>1</sup> at

<sup>1</sup> Link: <https://cs3mesh4eosc.eu/contribution-eosc-fair>



the same time. It is an application platform for distributed collaboration in a federated environment for research, based on both open source and open standards, implemented through a decentralised mesh of EFSS nodes. This allows users to cross-authenticate across organisations.



Figure 1 Science Mesh logo

By the time of writing this report, out of nine, the Science Mesh federated infrastructure had five nodes connected from different European countries (see Table 1) and four EFSS platforms (OwnCloud<sup>2</sup>, Seafile<sup>3</sup>, Cubbit<sup>4</sup> and NextCloud<sup>5</sup>) were being integrated.










Site	Owner & Country	Site	Owner & Country
 CERNBox	CERN, Switzerland	 SWITCHdrive	SWITCH, Switzerland
 Cubbit	Cubbit, Italy	 sciebo	WWU, Germany
 SURF DRIVE	SURF, The Netherlands	 cesnet	CESNET Czech Republic

Table 2 Connected sites in the Science Mesh

The application layer of the Science Mesh can be split in four groups (see Table 3) which are also listed on the website<sup>6</sup>.

Type of Service	Function/Description	Stakeholders
 Data Science Environments	Integrates the Science Mesh with open-data repositories. Users are able to access remote execution environments to replay (and modify) analysis algorithms without a need to setup upfront accounts in the remote system.	CERN, JRC, African Union, Ailleron, Software Mind
 Open Data Systems	Users are able to add metadata and publish datasets with persistent identifiers directly on the Science Mesh sites or to external data repositories.	PARADISEC
 Collaborative Documents	Integrates collaborative content editing applications in the Science Mesh service to enable cross-federation collaboration on content in real time: simultaneous editing of documents, commenting, versioning etc.	RiseSMA (University of Duisburg-Essen, University of Agder, Universiteit Leiden, Virtimo AG, Municipality of Kristiansand, Queensland University of Technology (QUT), The University of Sydney, Universidade do Vale do Rio dos Sinos, Universitas Padjadjaran)

<sup>2</sup> Link: <https://owncloud.com/it/>

<sup>3</sup> Link: <https://www.seafile.com/en/home/>

<sup>4</sup> Link: <https://www.cubbit.io/>

<sup>5</sup> Link: <https://nextcloud.com/>

<sup>6</sup> Link: <https://cs3mesh4eosc.eu/data-services>


Type of Service	Function/Description	Stakeholders
	Integrates data transfers of large datasets (in the TB range) within the Science Mesh, to allow efficient data-based collaboration on an "on-demand" basis. It offers high-speed transfer of information from remote locations to local sites across different countries, specifically supporting use-cases not able to extend compute capabilities to remote sites.	LOFAR

Table 3 Different Services from the Science Mesh

In order to validate the system in close connection with research groups and users (Strategic Objective N°8 of the CS3MESH4EOSC project), different use-cases with real institutions from different scientific disciplines have been established. This demonstrates how the Science Mesh is a service fit-for-purpose for multidisciplinary research. The four use-cases (from an aimed total of eight) are available on the project website. For the moment the users of this mesh are the Project partners, since the service is still in its development phase.

The Science Mesh had its first presentation on the 28th January 2021, during the "**Science Mesh Workshop - Moving Towards the Adoption Phase for Science Mesh**"<sup>7</sup>, highlighting its transition from the "Building phase" to an "Adoption phase" (more info at chapter 3.1.1 Science Mesh Workshop), with dedicated presentations focused on the different aspects of the Science Mesh.

A [first webinar](#) presenting 2 use-cases was organised along with a **podcast** (see chapter 3.1.2 Webinars and Podcasts ) focused on the general importance of the Science Mesh for open science and scientific innovation. An **article was published in the CONNECT magazine** (see chapter 2.5 Journals, publications and the press) to reach out to the research and policy community, **interviews** were made, focused on commercial and sustainability aspects of the Science Mesh and presentations were made at [third-party events organised by other initiatives](#) (see chapter 3.2 Table 15 Podcast statistics

Third-party events). The Science Mesh dissemination activities were promoted and supported with the launch of newsletters and social media post and messages (see Figure 2 Reaching stakeholders on Twitter by promoting webinars (left) and presence at third-party events (right)). Further details are available in the following chapters.

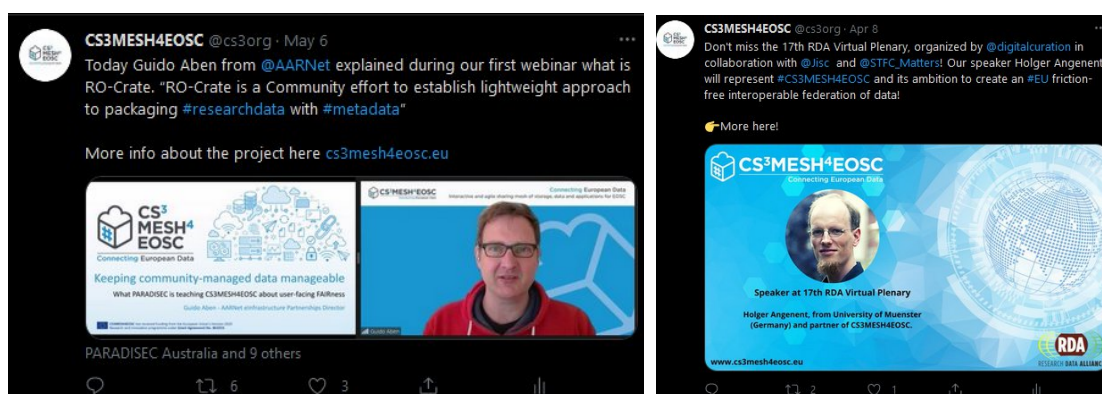


Figure 2 Reaching stakeholders on Twitter by promoting webinars (left) and presence at third-party

<sup>7</sup> Link: <https://cs3mesh4eosc.eu/news-events/events/science-mesh-workshop-moving-towards-adoption-phase-science-mesh>

events (right)

As indicated in Deliverable D5.1, from July 2021 (M19) to December 2021, the communication campaign will focus on promoting the applications which are being developed for the Science Mesh and promoting the integration of vendor software within it.

In 2022, the main focus of the **communication campaign** will be promoting the applications provided in the context of the Science Mesh and bringing on board more users and services (see Figure 3 Full Technology Deployment of the Science Mesh. The platform will be tested and improved, and **testimonials** about its benefits will be produced and distributed, like the one below.

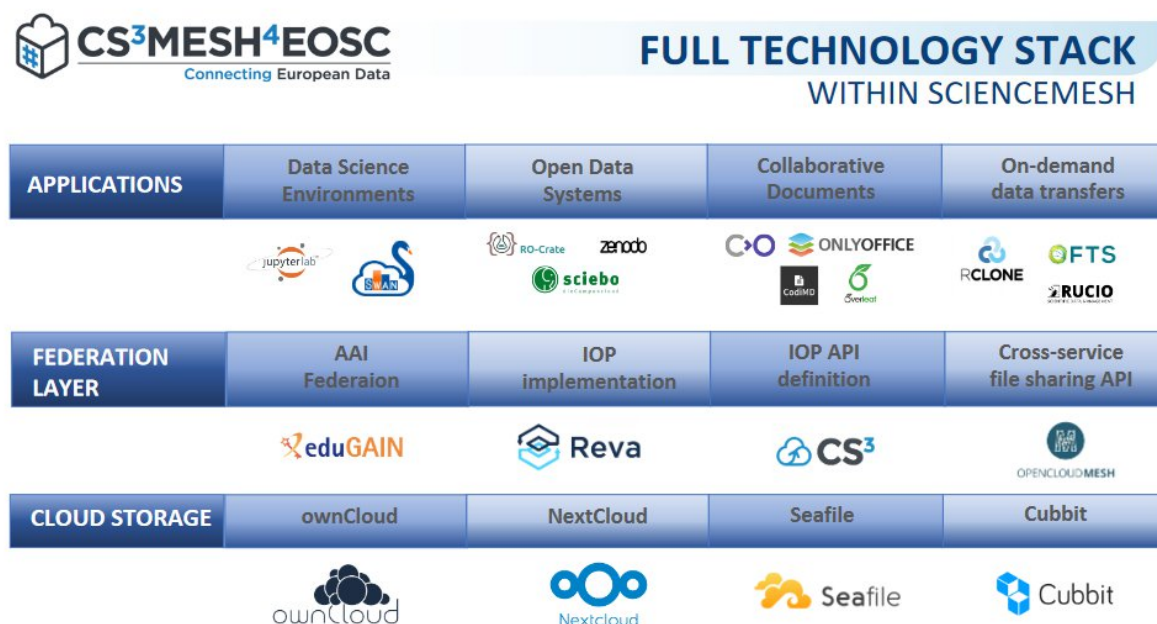


Figure 3 Full Technology Deployment of the Science Mesh

This will be complemented with short **video-pills** (that is, videos with less 30 seconds duration) with the testimonials, to be shared on social media, which will provide a more “human” touch to the Project’s activities. **Tutorial videos** showcasing how to use the different services of the Science Mesh, along with **webinars** and dedicated **podcasts** will also be arranged. **Posters and other communication materials**, such as poster and flyers will pursue the organisation of **presentations at third-party events**, as well as **organise co-located events** or **join panel discussions**. Each time a deliverable about the Science Mesh is released, or more sites are connected to the infrastructure (e.g., PSNCBox, CloudStor, ScienceData.dk, JRCBox, amongst others), **news pieces** and online visibility will be provided.

## 1.1.2 Technologies

### 1.1.2.1 CS3 base technologies

*Stakeholders: Institutional operators of services, Institutional operators of services, Non-commercial software developers*

The Open Cloud Mesh (OCM), CS3APIS and REVA are open-source technologies which provide the technical foundation for the Science Mesh, while ensuring the interoperability of applications (see Table 4 The technologies setting the boundaries of the Science Mesh). Without them, the different sites and

services would not be connected and, consequently, the Science Mesh services would not be provided for these different sites. Their integration within the Science Mesh and the development work which will be done on them is expected to have a positive effect in their Technology Readiness Level (TRL), turning them into systems that are complete and proven in an operational environment.




Technology	Function in CS3MESH4EOSC	TRL in M1	TRL in M18
 <b>CS3 APIs</b>	The CS3 APIs aim at connecting storage and application providers together, by abstracting out their inner workings and creating a common interface they can use to communicate. They effectively decrease the burden of porting applications developed for different EFSS platforms as well as the probability of vendor lock-in. The CS3 APIs will be the “glue” which will bind together nodes and applications in Science Mesh, by providing a common language which all parts will speak and allowing connectors to different services to be reused across applications.	6	9
 <b>OPENCLOUDMESH</b>	OCM aims to be a vendor-neutral open protocol which offers a common file access layer across an organisation and/or across globally interconnected organisations, regardless of the location of the data and choice of clouds. OCM is a fundamental technology for the Science Mesh, as it provides the individual nodes with a fundamental mechanism which they can use to exchange data. We expect that the various use cases and workflows which are part of the Project will result in further extensions to OCM, whose standardisation we will encourage and work on.	6	9
 <b>Reva</b>	The Reva project makes cloud storage and application providers inter-operable through a common platform. It leverages the CS3 APIs in order to offer a straightforward way to connect existing services in a simple, portable and scalable way. Reva is also the reference implementation of the CS3 APIs, providing a vendor-neutral playground which allows service providers to benefit from the economy of scale.	7	9

Table 4 The technologies setting the boundaries of the Science Mesh

The developers of such technologies will benefit from their technologies being used by a wider community of users from different countries and professional backgrounds. By the time of writing, these technologies are already integrated within the Science Mesh prototype, with many improvements on the way. Considering that some of these technologies are still being perfected and are yet to achieve full production level, the project mostly launched social media messages to promote their usage within the Science Mesh (see Figure 4 Promoting REVA, CS3 APIs and OCM on social media).

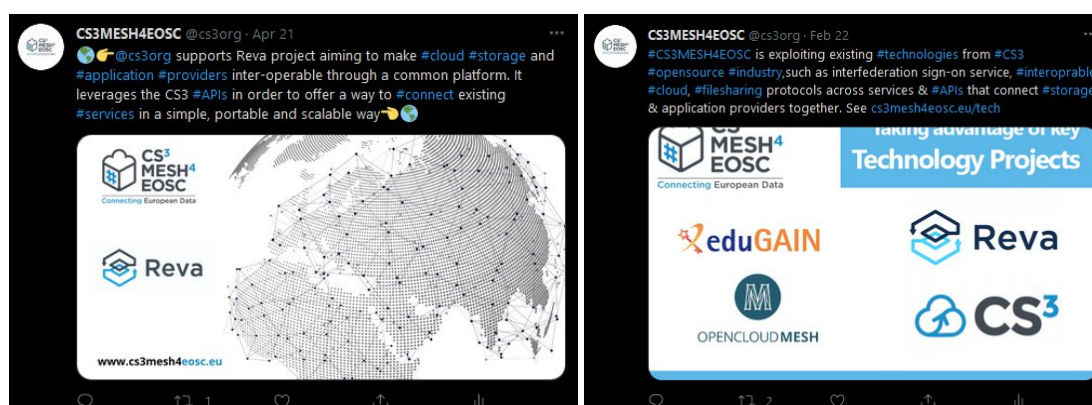


Figure 4 Promoting REVA, CS3 APIs and OCM on social media













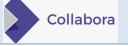
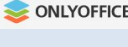

With their integration in the Science Mesh by mid-2021, a series of **interviews** with the technology providers will be prepared, along with **news pieces and press-releases** and the launch of **social media**



messages with key quotes collected from the interviews. A dedicated **webinar** (expected to take place by April 2022) will also be organised, highlighting the new novelties that these technologies received from the CS3MESH4EOSC experts (which allowed to reach higher levels of TRLs).

### 1.1.2.2 Third-party technologies

The application layer which constitutes the top tier of Science Mesh is powered almost exclusively by open-source third-party software. Some of those packages will actually benefit directly from contributions being currently developed in the context of some of the Project's Work Packages.

Application Type	3 <sup>rd</sup> party technology	Technology description	TRL M1	TRL M36
 Data Science Environments	 <b>binder</b>	<a href="#">Binder</a> , an easy place to share computing environments to everyone. It allows users to specify custom environments and share them with a single link. It builds tools that reward best-practices in reproducible data science by utilising community-developed standards for reproducibility.	6	8
	 <b>jupyter</b>	<a href="#">JupyterLab</a> is a web-based interactive development environment for Jupyter notebooks, code, and data. JupyterLab is flexible: configure and arrange the user interface to support a wide range of workflows in data science, scientific computing, and machine learning.	9	9
	 <b>SWAN</b>	<a href="#">SWAN</a> (Service for Web based ANALysis) is a platform to perform interactive data analysis in the cloud. It uses as interface Jupyter notebook and CERNBox as home directory.	9	9
	 <b>voilà</b>	<a href="#">Voilà</a> turns Jupyter notebooks into standalone applications. A very easy way to create a standalone dashboard.	8	9
 Open Data Systems	<a href="#">Describo</a>	Web-based tool that allows end users to define data collections, render them into standardised packages ("RO-Crates") and annotate them.	7	9
	 <b>zenodo</b>	<a href="#">ZENODO</a> , a general-purpose open-access repository developed under the European OpenAIRE program and operated by CERN. It allows researchers to deposit research papers, data sets, research software, reports, and any other research related digital artefacts.		
	 <b>sciebo.RDS</b>	<a href="#">ScieboRDS</a> , a web-based tool that allows end users to select RO-crates (as generated by Describo) and offer those to 3rd party systems, such as archives, repositories and publishers, including the user and quota management associated therewith.	6	9
	 <b>INVENIO RDM</b>	<a href="#">InvenioRDM</a> is an open-source software framework for large-scale digital repositories that provides the tools for management of digital assets in an institutional repository and research data management systems.	9	9
	 <b>RO-Crate</b>	<a href="#">RO-Crate</a> has been developed as a schema.org-based JSON lightweight approach to the next generation Research Object serialisation.	-	-
	 <b>OSF</b>	<a href="#">OSF</a> is a free, open-source web application that connects and supports the research workflow, enabling scientists to increase the efficiency and effectiveness of their research. Researchers use OSF to collaborate, document, archive, share, and register research projects, materials, and data. OSF is the flagship product of the non-profit <a href="#">Center for Open Science</a> .	-	-
 Collaborative Documents	 <b>Collabora</b>	<a href="#">Collabora</a> , a web-based tool for collaborative editing on office documents	9	9
	<b>CodiMD</b>	<a href="#">CodiMD</a> is the free software version of HackMD, developed and opened source by the HackMD team with reduced features (without book mode)	7	9
	 <b>ONLYOFFICE</b>	<a href="#">OnlyOffice</a> , a free software office suite that features online document editors, platform for document management, corporate communication, mail and project management tools.	6	6
	 <b>Overleaf</b>	<a href="#">Overleaf</a> , a collaborative cloud-based LaTeX editor used for writing, editing and publishing scientific documents. It partners with a wide range of scientific publishers to provide official journal LaTeX templates, and direct submission links.	6	7





Applicati on Type	3 <sup>rd</sup> party technology	Technology description	TRL M1	TRL M36
 On-demand data transfers		<a href="#">FTS</a> , a batch scheduler of data transfers. In use by the LHC experiments and numerous other communities to orchestrate data transfers around the globe. It is also used by Rucio for performing data distribution.	9	9
	GridFTP	An extension of the File Transfer Protocol (FTP) for grid computing. Its aim is to provide a more reliable and high-performance file transfer, for example to enable the transmission of very large files. GridFTP is used extensively within large science projects and by many supercomputer centres and other scientific facilities.	-	-
		<a href="#">Rclone</a> , a tool that is able to synchronise and copy data to and from cloud storage services.	9	9
		<a href="#">RUCIO</a> , an open-source software framework that provides scientific collaborations with the functionality to organise, manage, and access their data at scale. The data can be distributed across heterogeneous data centres at widely distributed locations.	9	9

Table 5 Third-party technologies being integrated in the Science Mesh

From M19 (July 2021), the CS3MESH4EOSC Communication team will organise interviews with technology providers (see chapter 2.1 Editorial Plan) to present the technologies that are part of the Science Mesh and, therefore, available to its users. These interviews will also highlight how these technologies were improved thanks to CS3MESH4EOSC Support.

## 1.2 The CS3MESH4EOSC Community

During these first 18 months of the project, CS3MESH4EOSC was able to create a community of members interested in knowing how the work developed within the Project will contribute to connecting European data. The achievement of these results (see Table 6) was possible thanks to a coordinated and continuous communication effort by CS3MESH4EOSC partners, who cooperated to support the promotion of results. Please note that the results related to the website are as of M11, when the website was revamped by Trust-IT and analytics measurements were implemented.

Type	KPI by end Project	Results by M18
<b>Community</b>		
Engaged Users	---	647 engaged users: 550 Social media followers (192 Twitter + 350 LinkedIn + 8 YouTube subscribers), 97 newsletters subscribers.
Social Media Community	2.000 (namely 1.000 Twitter and 500 LinkedIn)	550
N° members database	300	110
Newsletter subscribers	200	97
Science Mesh users	3.000	15 beta testers (service still under development)
Plugins commercial implementations	3	1 (ownCloud)
Service integrated in the EOSC	1	0
Use-cases validated in 4 different disciplines	8	0
Integration of 3 open-source, industrial EFSS technologies and 4 open-source application components into the Science Mesh.	7	Total of 5 1 open-source EFSS (ownCloud) 4 opensource application components (JupyterLab, CodiMD, Collabora, RClone)

Type	KPI by end Project	Results by M18
Services which will enter into the EOSC catalogue	3	*EOSC Catalogue is now obsolete. Replacement will be studied.
Website		
Website Sessions	60.000	29.000
Website users	5.000	2.500
Website page views	100.000	71.000
Events		
N° attendees Science Mesh Workshop	200	96
Webinar participants (average)	150	54
Podcast listeners	100	20

Table 6 CS3MESH4EOSC Community members

Figure 5 Countries of CS3MESH4EOSC community database members and Figure 6 provide an overview of where the project community members come from. The top four countries that are present in the CS3MESH4EOSC database in percentage of subscribers and participants to the events of the project are Germany (16%), Netherlands (15%), Italy (13%) and Switzerland (12%). While it is natural that the majority of members are located in Europe, it is important to highlight that the community counts with some members from overseas (e.g., 4% from USA). Most members come from Academia/Research (72%), followed by SMEs (7%).

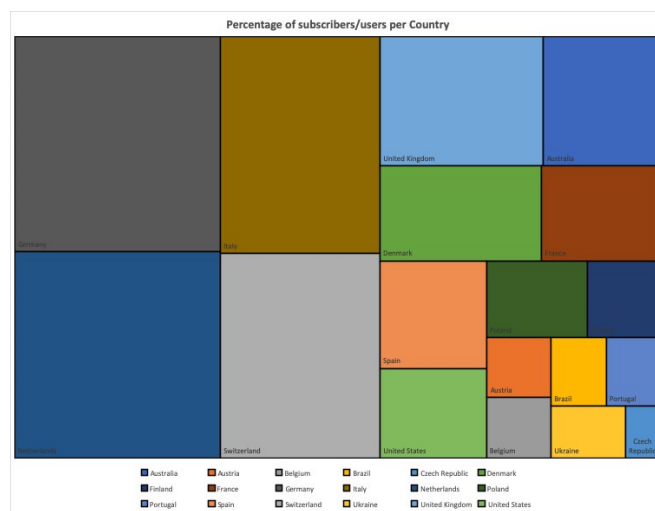


Figure 5 Countries of CS3MESH4EOSC community database members

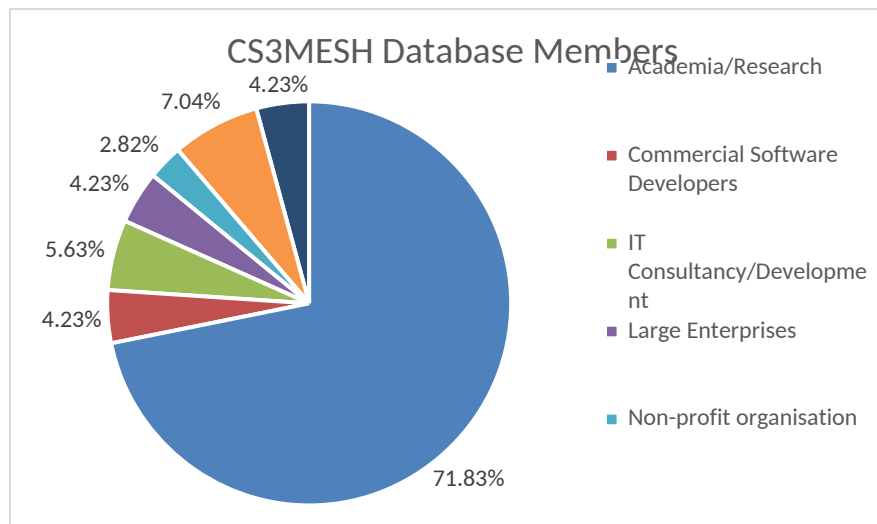


Figure 6 Stakeholders Categories part of the Science Mesh

### 1.3 Future engagement plans

At M18, CS3MESH4EOSC is in its second phase (from M12 to M24) and the two main targets of engagement are, currently, platform and application vendors and other potential early adopters. The Project's future plans are based on these two objectives, and a continuous stream of content will be produced throughout the coming months.

During the next phase (M19-M24, July 2021 – December 2021), and as the infrastructure is stabilised and made user-ready, the Project will focus on dissemination of its results to stakeholders (research and industrial), to increase the adoption of the Science Mesh. CS3MESH4EOSC will provide training and networking opportunities for the CS3 community, to also attract new user groups (Strategic Objective N° 9 of the Project). The aim is also to engage with those who are already users of the platform. In the phase right after (M24-M36, January 2022 – December 2022) the focus will be to further enlarge the community of users, while ensuring a solid impact and sustainability plan after the closure of the project.

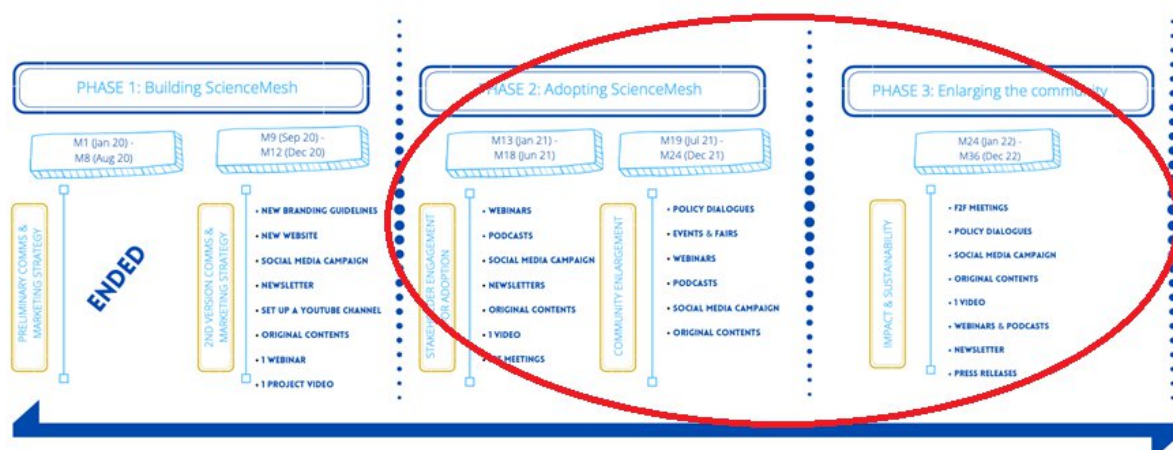


Figure 7 CS3MESH4EOSC communication roadmap and activities focus from M19.

This will be possible thanks to **several lines of action**. To increase the CS3MESH4EOSC user base and community, the project will keep **engaging with stakeholders, now more focused on technology**



**adoption**, by inviting them to use the Science Mesh or to incorporate their service in the network. This will be possible thanks to the:

- Organisation of additional webinars and Science Mesh Workshops;
- Preparation of press releases, interviews and podcasts;
- Increase of the number of newsletter subscribers and the launch of new issues;
- Increase of the number of synergies;
- Preparation of podcasts and written interviews with the Science Mesh developers, vendors and users;
- Publication of news pieces and blogposts about the direct activity made by the project partners in order to inform the community, with the continuous publication of related content on the website;
- Participation at third-party events to increase outreach and reach new audiences;
- Organisation of final event, by the end of the project, to present the Project's results and impact to be achieved in the long run.

Regarding the **copy strategy**, the next phase will be focused on collecting feedback and also performing tests with the future service users. This activity will help the project to fine tune its assets and, consequently, clearly define the value proposition and the competitive advantages of the services and promote the message to the targeted stakeholders with customised content. The main focus for communication and dissemination efforts will be aimed at increasing service adoption and long-term sustainability, after the Project's conclusion. A final video of the Project will be created to promote its results through the CS3MESH4EOSC website and social media channels.

Furthermore, the project will also focus on **expanding the international dimension** of its audience, not only on the services exploitation side, but also for collecting inputs by stabilising synergies and promoting the services with each synergy. Therefore, it will be essential to increase our collaboration not only with EU initiatives but also international ones. For more information about "Synergies", please read the chapter 5 Synergies with national and international networks.

By the end of the project, a business impact assessment and roadmap for effective management of the Science Mesh will be prepared, with the final identification of motivational drivers for the relevant research and industrial communities to be engaged in the long term within the Science Mesh (e.g., reputational drivers, rewards & incentives, financial drivers, etc). More info in chapter 6 Exploitation Plan: Making use of CS3MESH4EOSC Results.

## 2 Main Outreach and dissemination achievements from M1-M18 and future plans

### 2.1 Editorial Plan

The editorial plan is one of the main assets of the Communication and Exploitation plan of the project, and includes the regular publication of articles covering project updates, updated events calendars with their outputs, news pieces about relevant topics in the stakeholder engagement process and all the most useful information about the field, for the targeted stakeholders of the project. The content published on CS3MESH4EOSC website by June 2021 is detailed in the table below. As of June 2021, a total of **18 news pages** were published on the website, plus **26 event pages**.

Date	Type	Title
------	------	-------

Date	Type	Title
<a href="#">22 January 2020</a>	News	Meet CS3MESH4EOSC in Copenhagen
<a href="#">31 January 2020</a>	News	The project has officially started
<a href="#">24 April 2020</a>	News	FAIR data handling with CS3MESH4EOSC
<a href="#">29 April 2020</a>	News	Cloud storage tailored for researchers
<a href="#">12 June 2020</a>	News	Join the upcoming conference on data sharing
<a href="#">15 September 2020</a>	News	Join the Science Mesh journey
<a href="#">5 November 2020</a>	News	The initial definition of Science Mesh Protocols and Application Programming Interfaces is ready!
<a href="#">19 December 2020</a>	News	CS3MESH4EOSC – Making data sharing in Europe child's play: an interview with the coordinator Jakub Moscicki
<a href="#">18 January 2021</a>	News	The Science Mesh Workshop: unlocking Open Science and Digital Sovereignty in Europe
<a href="#">26 February 2021</a>	News	Science Mesh workshop – showcasing a solid foundation ready to expand data daily workflows & improve Sync&Share services
<a href="#">1 March 2021</a>	News	Science Mesh – How to commercialise science to impact European Industry? An interview with Angelo Romasanta
<a href="#">5 March 2021</a>	Blogpost	Blogpost: From endangered languages to the Science Mesh - petascale FAIR data repositories
<a href="#">1 April 2021</a>	Featured Article	CS3MESH4EOSC featured in the issue of CONNECT Magazine, on Uniting European Data Services
<a href="#">8 April 2021</a>	News	Establishing trust between users based on sites federated in the Science Mesh to share resources
<a href="#">26 April 2021</a>	Interview	Datacentre-less cloud for interoperability and no data sovereignty constraints: Cubbit in Science Mesh – An interview with Lorenzo Posani
<a href="#">24 May 2021</a>	Blogpost	Too easy and fair enough? - Blogpost from Adam Bell (AARNet) for the Digital Preservation Coalition
<a href="#">22 June 2021</a>	News	How is Science Mesh Unlocking Scientific Collaboration? – A Podcast with Guido Aben from CS3MESH4EOSC and AARNet

*Table 7 News pieces<sup>8</sup> published in the website*

The news pieces published over these months were dedicated to promote the concept of the Science Mesh, publish demos that were launched over the same time period, as well as 4 interviews from members of the project consortium (3 written interviews and 1 podcast), which gave insights about the importance of the Science Mesh in the long run for potential users.

## 2.2 Website and Social Media

### 2.2.1 Website

At M18, the CS3MESH4EOSC website<sup>9</sup> has an agile and evolving structure, useful to immediately highlight the main assets of the project and the most updated information about its evolution. Today's version is online since Autumn 2020 and its main goal is to make the different services of the Science Mesh visible, as well as the use-cases that demonstrate the value of Science Mesh for different communities (see the website homepage design in Figure 8).

The website increases the project work's visibility and promotes the Science Mesh technical developments. The home page allows the users to be linked to:

<sup>8</sup> Link of news section: <https://cs3mesh4eosc.eu/news-events/news>

<sup>9</sup> Link: <https://cs3mesh4eosc.eu>

- The [ZENODO Library section](#) of the project;
- The social media channels of the project – [LinkedIn](#), [Twitter](#), [YouTube](#);
- The contact form, to reach the team and project partners;
- The latest news and events, through an impactful slider;
- The icons of the 5 Data Services, to reach a dedicated page/section in the website;
- More information about the Science Mesh and its Mission, Impact, and Goal;
- The carousel with all the latest project & third-party events and news;
- The partners of the project;
- The form to subscribe to the newsletter of the project.

More detailed information about the web site’s overall structure is available on “D5.8 Second revamp of the project website”. The table below lists statistics for CS3MESH4EOSC website.

KPI	M18 results	M36 KPI
Users	2.5K	5K
Sessions	29K	60K
Page views	71K	100K

*Table 8 Website results and KPIs*



Figure 8 CS3MESH4EOSC Homepage as at June 2021

## 2.2.2 Social Media

The social media community of the project has increased its figures and engagement during the first 18 months of the project. The social media activity of CS3MESH4EOSC is mainly focused on the Twitter, 20

LinkedIn and YouTube channels. This frequent and engaging activity reaches out to the ‘outside community’ inviting them to join, interact and be involved in further activities of the CS3MESH4EOSC project. The table below indicates the results achieved so far on the project’s social media channels, with the overall KPI of having 2000 social media followers by the end of the project.

Social Media Channel	Result by M18
Twitter	190 + Followers
LinkedIn	350 Followers
YouTube	10 Videos 450+ total views

Table 9 Social Media Statistics

### LinkedIn<sup>10</sup>

Thanks to the coordinated effort of the entire team and the partners, the LinkedIn page started to increase in number of visitors and rate of engagement. Different LinkedIn posts were published to promote project updates and activities (see figure Figure 9), some of which gained almost 250 impressions and an impressive 8.50% engagement rate.

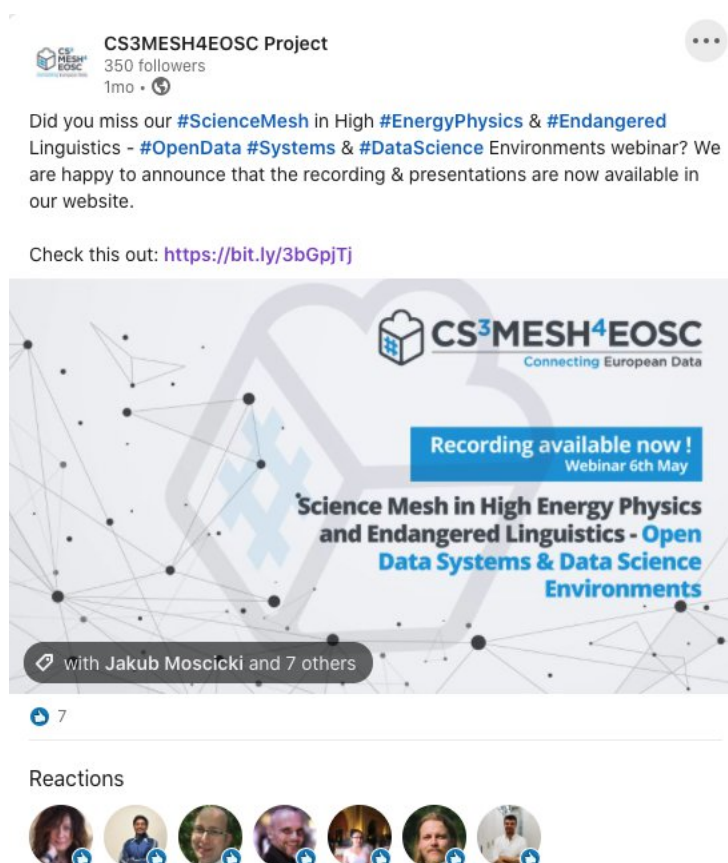


Figure 9 Example of LinkedIn post

<sup>10</sup> Link: <https://www.linkedin.com/company/cs3mesh4eosc/>

In the figure below there is a visual overview of the job functions of visitors to the CS3MESH4EOSC LinkedIn page during the last 6 months. The audience mostly consisted of people from “Information Technology” (18%) followed by Business Development (12%).

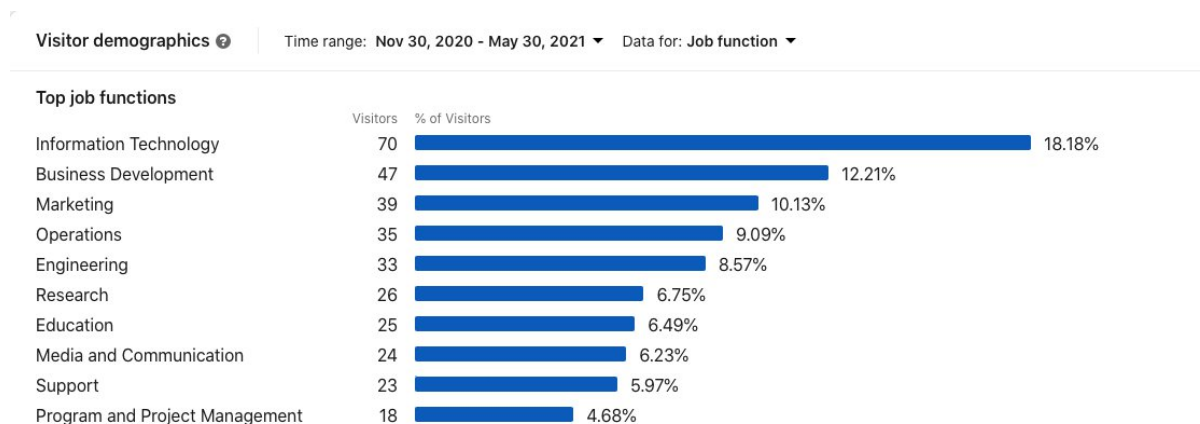


Figure 10 Job Functions of visitors to the LinkedIn page 30/11/2020-30/05/2021

## Twitter<sup>11</sup>

With the enthusiasm and interaction of relevant organisations, and the effort of the project partners, the Twitter account is now heading towards 200 followers. Dedicated messages and focused interviews, with images and interactive activities, are helping the growth of the CS3MESH4EOSC Twitter page.

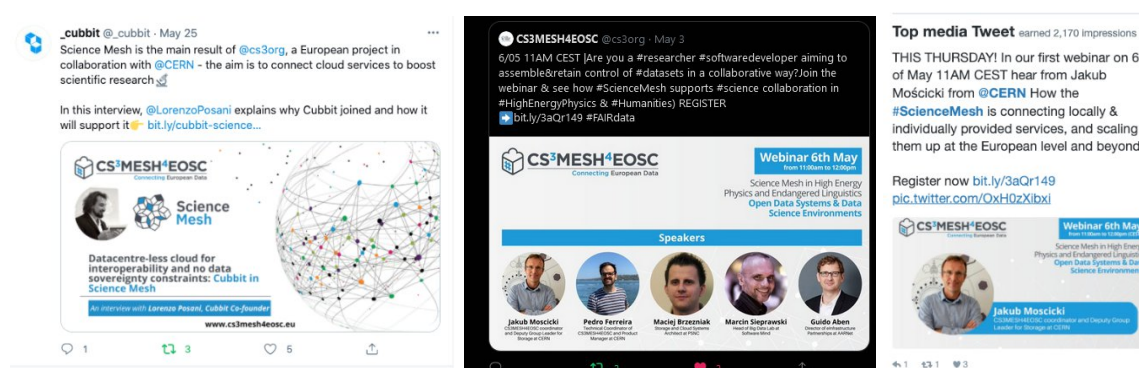


Figure 11 Example of Tweets promoting project activities

## YouTube<sup>12</sup>

CS3MESH4EOSC also uses YouTube to upload and share videos. The content shared in a video format is engaging and clear for the user. Videos are therefore considered important media to disseminate the results of the project. The figure of more than 450 views gives an idea of how important is this channel is for the communication of the achievements and promotion of Science Mesh to the project's community.

As of June 2021, the CS3MESH4EOSC channel features a total of **11 public videos**:

- 1 webinar;

<sup>11</sup> Link: <https://twitter.com/cs3org>

<sup>12</sup> Link: <https://www.youtube.com/channel/UCHKcZEkMqXjCvc3MLFjFxbw>



- 7 videos from the Science Mesh Workshop from January 2021;
- 2 demo videos;
- 1 promotional video of CS3MESH4EOSC project.



Figure 12 CS3MESH4EOSC YouTube Channel

## 2.3 Communication Materials

Besides the logo, a media kit<sup>13</sup> has been prepared and will be further developed during the project for all partners to use, in either digital or printed formats, for promoting CS3MESH4EOSC (see Table 10). The materials will be developed based on an analysis of the project's needs during its lifetime and will be used to raise awareness and understanding of the Science Mesh.

Type of material	Produced by M18
<b>Presentations</b>	<p><u>4 presentations:</u></p> <ul style="list-style-type: none"> <li>• <a href="#">Meet the CS3MESH4EOSC project</a></li> <li>• <a href="#">MESH AAI</a></li> <li>• <a href="#">IOP: Birds eyes view</a></li> <li>• <a href="#">Cubbit - a distributes use case</a></li> </ul>
<b>Flyers &amp; Posters</b>	<p>1 Flyer – (see Figure 11)</p> <p>1 Poster – (see Figure 11)</p>
<b>Branding</b>	<p>1 Vertical Logo</p> <p>1 Horizontal Logo</p> <p>1 Guideline for Graphic Design</p>
<b>Video</b>	11 <a href="#">videos</a> online on the YouTube channel

Table 10 CS3MESH4EOSC Communication materials by M18

<sup>13</sup> <https://cs3mesh4eosc.eu/media/media-kit>



Connecting European Data



### ✓ What is Science Mesh?

A federation of data and storage services integrated with a rich application ecosystem for frictionless scientific collaboration and access to research services.

### ✓ Why Science Mesh?

- Levering large existing user base and established operational services from the CS3 Sync&Share Community with nearly half a million users
- In collaboration with European industry: Open Source Software and state-of-the-art technology with OCM and CS3APIs standards

#### Join CS3MESH4EOSC

to become a Science Mesh early adopter and get privileged access to a global platform providing services for data-driven science & research collaboration

cs3mesh4osc.eu

@cs3org

company/cs3mesh4osc



CS3MESH4EOSC - Interactive and agile/responsive sharing mesh of storage, data and applications for EOSC, has received funding from the European Union's Horizon 2020 research and innovation programme under **Grant Agreement no. 863353**.

Figure 13 Flyer November 2020

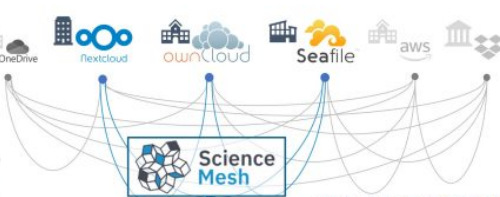
## Enabling seamless international collaborations in science Science Mesh for the European Open Science Cloud

Angelo Romasanta and Jonathan Wareham @ ESADE Business School

**SCIENCE MESH:** A digital infrastructure enabling researchers to easily collaborate

**Problem**  
Difficulty sharing and leveraging data due to fragmented cloud landscape

**Solution**  
Federated mesh layer to enable interoperability across service providers



Unlock collaborative workflows

### RESEARCH QUESTIONS:



**Infrastructure**  
How to coordinate across providers with varying incentives to support the mesh?



**Impact**  
How will the mesh impact users from the scientific and business community?



**Open Science**  
Will building tools lead users to Open Science and Fair DATA?

**PILOT:** 300,000+ users

- SURFdrive (NL)
- PSNCBox (PL)
- CloudStor (AU)
- Sciebo (NRW - DE)
- CESNET (CZ)
- SWITCHdrive (CH)
- CERNBox (CERN)
- ScienceData (DK)

If you're interested in Open Science and digital infrastructures, let's talk and find a way to collaborate:  
[angelokeneth.romasanta@esade.edu](mailto:angelokeneth.romasanta@esade.edu)



### USE CASES AND EARLY ADOPTERS:



**Frictionless sync and share**  
Easy sharing of files and documents across institutional boundaries in Social Media Analytics (RISE SMA)



**Remote data analysis**  
Collaborative Jupyter notebooks for Earth Observation (EU JRC) and High energy physics (CERN)



**Large data transfers**  
Enable easy transfer of data across instruments and analysis site for Astrophysics (LOFAR)



**Open data systems**  
Enable researchers to easily label and publish towards FAIR guidelines in Digital humanities (PARADISEC)

This project was funded by the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No. 863353 CS3MESH4EOSC

Figure 14 & Poster April 2021



## 2.4 Newsletters

Cs3MESH4EOSC Newsletters include details about upcoming and past events, as well as achievements and relevant messages about the project updates. Its content is shaped around the milestone results of the work plan, featuring comments and articles published on the CS3MESH4EOSC website.

With almost **100 subscribers** by M18, the aim of this important communication asset is to involve the community in contributing to EU activity focused on Open Science, as well as increase participation in various activities organised by the project's partners and by related initiatives in the field. Kick-started in January 2021, two issues have been sent to the audience by June of the same year.

N	Title	Date
1	The First CS3MESH4EOSC Newsletter I officially out!	<a href="#">January 2021</a>
2	THIS THURSDAY WEBINAR - 6th May 11:00 am - 12:00 pm CEST "Science Mesh in High Energy Physics and Endangered Linguistics - Open Data Systems & Data Science Environments"	<a href="#">April 2021</a>



Figure 15 Top of one of CS3MESH4EOSC Newsletters details

## 2.5 Journals, publications and the press

The content-driven approach of the Communication and Marketing activities of the project are also based on collaboration with specialised publications and magazines, which help promote the Science Mesh to the relevant audiences in this field.

A featured article was published in CONNECT<sup>14</sup> March 2021, the magazine from the GÉANT community (see Figure 16). This 2-page article refers to the main mission of the CS3MESH4EOSC project, focusing on the Science Mesh interoperable platform and how it unlocks scientific collaboration through technology.



Figure 16 Article published In the CONNECT magazine

Along with the article in CONNECT, CS3MESH4EOSC also published papers either for journals or presentation at scientific international conferences (see Table 11). The publication of papers will increase during the next reporting period.

N	Title	Journal/Conference	Submission Date	Publication Date	Authors
1	Increasing interoperability for research clouds: CS3APIs for connecting Sync&Share storage, applications and science environments	24th International Conference on Computing in High Energy and Nuclear Physics (CHEP 2019)	2020, Jan	2020, Oct	Hugo González Labrador*, Jakub T. Mościcki, Massimo Lamanna and Alberto Pace (CERN)
2	FAIR Data through a federated cloud infrastructure: exploring the Science Mesh	ECIS 2021 Research-in-Progress	2021, Feb	2021, Jun	Angelo Romasanta and Jonathan Wareham (ESADE)

Table 11 CS3MESH4EOSC Papers

## 2.6 Future Plans

The CS3MESH4EOSC **editorial plan** for the next period will include interviews with relevant bodies and partners, made in the format of podcasts or written interviews, in order to better explain the technology and business model behind the Science Mesh. The podcast format will focus on technological or practical aspects in order to involve and engage the community with representatives from the science, education, and research fields. As usual, timely updates about project achievements will be prepared.

Concerning the **Website**, the different Science Mesh data services are now being highlighted on the

<sup>14</sup> Link: <https://cs3mesh4eosc.eu/index.php/node/122>

website and each of them will be clearly explained in a proper website section. A section on user cases, published this month, highlights the benefits of using the Science Mesh. More use-cases will be published during the lifetime of the project, with details and addressed challenges. The CS3MESH4EOSC website will have frequent updates in its structure, based on the needs of the project and of the users.

Focusing on **social media**, the CS3MESH4EOSC Communication team aims to prepare and share more Twitter and LinkedIn cards, in order to give more visibility to partners and researchers involved in the project, namely to the use-cases, data services, and the podcast launched this month. This is important to further enrich and engage the community behind the project. The promotion of project activities will be increased, namely the webinars, joint events, technology, service development, along with user stories, interviews, as well as synergies. The promotion and dissemination of results and events in the field will be increased in order to enrich the communication of the project's achievements and pillars.

The **newsletter's** releases will be increased, mostly due to the launch of the podcast series and interviews, as well as the organisation of webinars and events. News pieces from key-activities from other initiatives, which CS3MESH4EOSC synergised with, may also be included. The aim is to provide the community with constantly updated information.

The project will also aim to increase the number of publications and references in **press and media channels**, they are relevant channels to expand the project's visibility to new audiences. The production of **communication materials** is expected to be produced in digital format, due to the COVID-19 Pandemic which is delaying the organisation of physical events.

## 3 Events

### 3.1 CS3MESH4EOSC events

#### 3.1.1 Science Mesh Workshop

Due to the COVID-19 pandemic, the first edition of the Science Mesh workshop was turned into a virtual event. This half-day workshop, entitled "Science Mesh Workshop - Moving Towards the Adoption Phase for Science Mesh<sup>15</sup>", counted with 95 participants and had as the main goal to promote Science Mesh and its main features. The workshop was co-located with the CS3 Conference 2021, the annual conference that brings together the CS3 community.



Figure 17 "Science Mesh Workshop - Moving Towards the Adoption Phase for Science Mesh"

<sup>15</sup> Link: <https://cs3mesh4eosc.eu/index.php/news-events/events/science-mesh-workshop-moving-towards-adoption-phase-science-mesh>

*promotional image*

The event included key presentations which highlighted the added value of the Science Mesh for adopters as well as site administrators and vendors, including how they can join the Science Mesh. The event closed with a questions and answers session to collect feedback from the Science Mesh early adopters. Table 12 shows an overview of the agenda of the workshop. The presentations are available on the website and the videos are on the project's YouTube channel.

*Table 12 Science Mesh Workshop draft agenda*

Time	Theme	Speakers
9.00-09:10	Welcome and objectives	Jakub Moscicki, from CERN, CS3MESH4EOSC Project Coordinator ( <a href="#">Presentation</a>   <a href="#">Video</a> )
9.10-09:40	Added value of the Science Mesh for adopters and vendors	Pedro Ferreira, from CERN, CS3MESH4EOSC Technical Coordinator ( <a href="#">Presentation</a>   <a href="#">Video</a> )
9.40-10.10	Science Mesh for site administrators: operation, security, trust	Ron Trompert, from SURFsara, CS3MESH4EOSC ( <a href="#">Presentation</a>   <a href="#">Video</a> )
10.10-10.40	How to join the Science Mesh?	Daniel Mueller, from WWU Münster ( <a href="#">Presentation</a>   <a href="#">Video</a> )
10.40-11.10	Science Mesh for users: applications, use cases & workflow demo	Maciej Brzezniak, from PSNC, CS3MESH4EOSC ( <a href="#">Presentation</a>   <a href="#">Video</a> )
11.10-11.30	Science Mesh for developers: how to contribute to CS3APIs and IOP	Hugo González Labrador, from CERN, CS3MESH4EOSC ( <a href="#">Presentation</a>   <a href="#">Video</a> )
11.30-11.45	Interactive Coffee break on GatherTown	
11.45-12.20	Q/A and Feedback from Science Mesh Early Adopters	
12.20-12.30	Next steps towards adopting the Science Mesh	Jakub Moscicki, from CERN, CS3MESH4EOSC Project Coordinator ( <a href="#">Video</a> )



[View](#)
[Edit](#)
[Delete](#)



28 January 2021 to 28 January 2021

#### Concept

The CS3MESH4EOSC is moving from the "Building phase" through to an "Adoption phase" in beginning of 2021. The project is organising a half-day event focused on **Science Mesh** within the larger **CS3 2021 Conference**, with a continuation of the dialogue with our stakeholders within the CS3 community towards the CS3 conference in 2022, which will be mainly focused on the real adoption & roll-out & implementation of Science Mesh within the **European Open Science Cloud (EOSC)**.

#### Purpose and main take-aways of the session

The CS3 2021 Conference is the perfect tool for Science Mesh to reach out to all our categories of main target stakeholders (namely the end users and research communities, institutional operators of services,

Figure 18 Science Mesh Workshop Official page (top part)

The workshop gathered representatives of industry, academia, research infrastructures and e-infrastructures, cloud vendors, policy makers and European bodies.

CS3MESH4EOSC used several communication channels to reach stakeholders, also considering many media and specialised channels catering to larger audiences. A sample of the formats used is provided in the table below.

Action	Description
<b>Social Media</b>	Twitter: tweets inviting potential attendees to join the workshop, private messages on Twitter and, using handles of speakers, EOSC projects and EOSC cluster projects, LinkedIn: LinkedIn posts describing the event, followed by messages posted in key groups.
<b>Newsletters</b>	Launch of newsletters with call-to-actions to join the event, with a copy strategy to immediately grab the reader's attention.
<b>Press Releases</b>	Dissemination of press releases to media, and initiatives, synergies related to the CS3 Conference, followed by follow-up actions.

Table 13 Formats to promote Science Mesh Workshop and engage with end-users

The **impact analysis** of the workshop was based on the number of:

- **Number of participants, having as KPI 100 participants:** total of 96 participants;
- **Number of new newsletters subscriptions:** 37 new subscribers;
- **Feedback collected from participants**, which will contribute to improve the Science Mesh outputs and also the next edition of the workshop. A dedicated news article<sup>16</sup> was published

<sup>16</sup> Link: <https://cs3mesh4eosc.eu/news-events/news/science-mesh-workshop-showcasing-solid-foundation->

on CS3MESH4EOSC website<sup>17</sup> focused on the main outcomes and comments collected from participants.

CS3MESH4EOSC consortium created a virtual venue for social gathering on the [Gather.Town](#) platform (see Figure 19) for both the Science Mesh workshop and the CS3 Conference. The tool was used to give a “human touch” to the coffee breaks and to the overall event, where attendees could move their virtual avatars and join other attendees to chat. Each time an attendee would approach another one, they would automatically be connected by video and audio (see Figure 20).



Figure 19 CS3 2021 Virtual Venue on Gather.Town before Its opening (lobby area)

---

[ready-expand-data-daily](#)

<sup>17</sup> <https://cs3mesh4eosc.eu/index.php/news-events/news/science-mesh-workshop-showcasing-solid-foundation-ready-expand-data-daily>

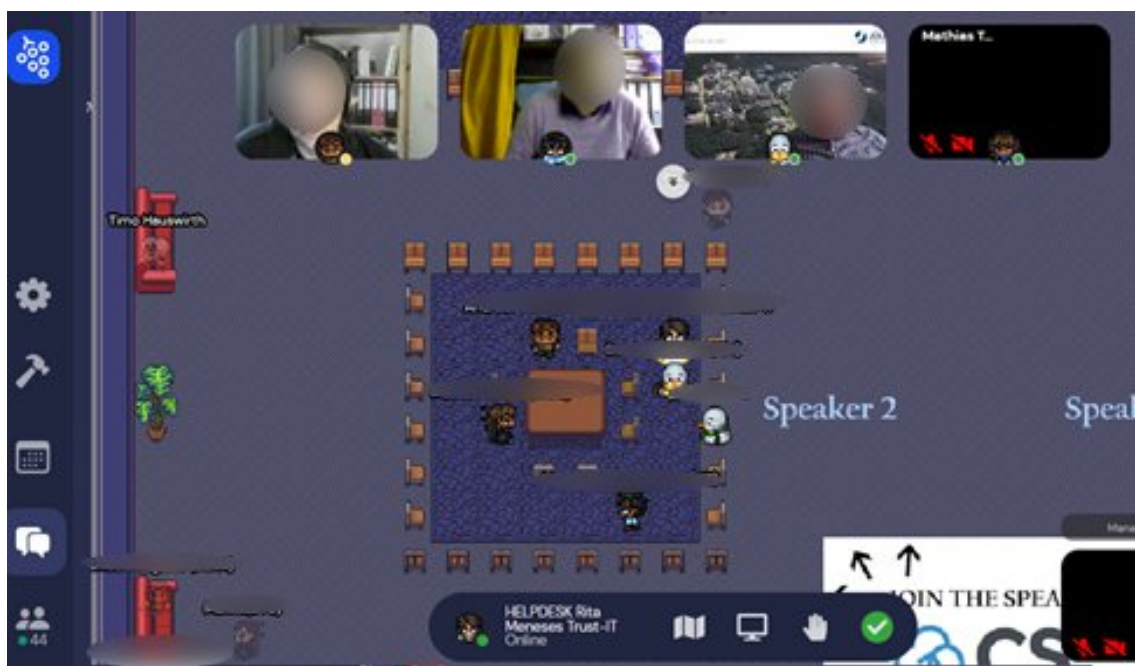


Figure 20 CS3 Conference attendees gathering together in the Speakers Room (Note: Names and Faces removed in the image due to privacy issues)

The overall layout had a lobby area, a speakers' room where attendees could liaise directly with speakers after their presentations, as well as a company room with 9 booths of commercial companies that were supporters of the CS3 2021 conference. In this room, delegates could speak directly with a representative of the company. A user manual was designed and provided to all participants, to ensure a smooth and positive experience on the Gather.Town platform (see Figure 21).

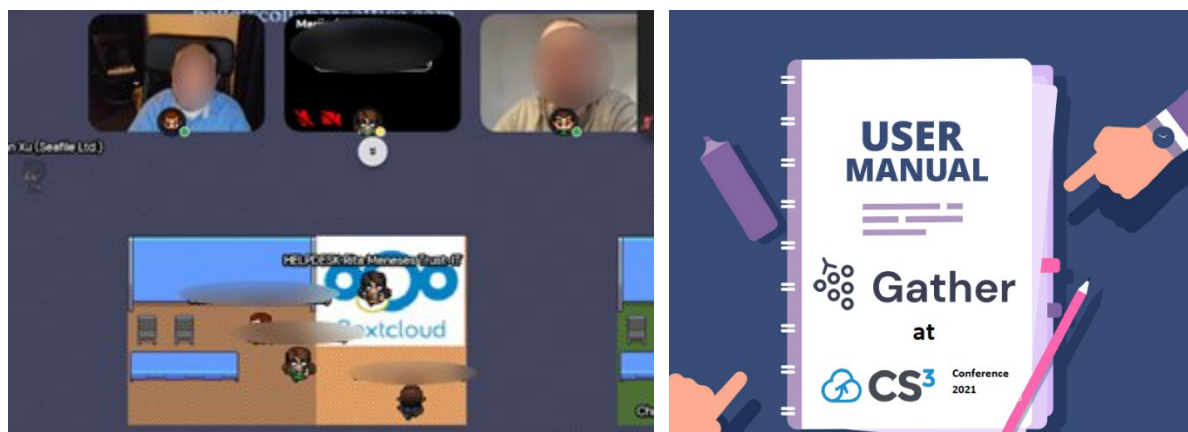


Figure 21 CS3 Conference attendees at a company booth (left - note: Names and Faces removed in the image due to privacy issues)) and User Guide (right)

### 3.1.2 Webinars and Podcasts

The projects webinars are strategically designed to promote the different use-cases and functionalities of the Science Mesh, while the podcasts are designed to address different topics related to open science as well as data connection trends and challenges.

The first webinar was organised in May 2021 (M17), entitled "Science Mesh in High Energy Physics and Endangered Linguistics - Open Data Systems & Data Science Environments"<sup>18</sup>, which had 54

<sup>18</sup> link: <https://cs3mesh4eosc.eu/index.php/news-events/webinars/science-mesh-high-energy-physics-and-endangered->

registrations (see Table 14 Webinar Statistics as of June 2021). The webinar focused on 2 use-cases from both Science Mesh services entitled “Open Data Systems” and “Data Science Environments”. All the communication materials, including the recording and presentations are available on the webinar page.

Date	Title	Registrants	Page Unique Views	YouTube Views
6 May 2021	Science Mesh in High Energy Physics and Endangered Linguistics - Open Data Systems & Data Science Environments	54	152	55

Table 14 Webinar Statistics as of June 2021

Social media posts were prepared and launched on the CS3MESH4EOSC social media channels. Personal messages were sent, not only to invite people to attend the webinar but also inviting community members to check the recording, in the case that they had not had the opportunity to register for the event.



Figure 22 Tweet promoting the 1st podcast episode

As for the Podcast, the first episode of podcast series was launched in June 2021<sup>19</sup> (M18), with Guido Aben (member of CS3MESH4EOSC project), who gave some insights about the general concept of the Science Mesh, what his role is in the project, FAIR principles, and the challenges of open science innovation that the Science Mesh will help to overcome. The podcast is available on all important podcast streaming platforms such as Spotify<sup>20</sup>, Google Podcasts<sup>21</sup>, Breaker<sup>22</sup> and Apple Podcasts (to be available soon). The episodes are uploaded and distributed to all platforms using Anchor, provided by Spotify. This is useful to make the podcast visible and accessible to all.

The podcast was only published recently, the number of views of the podcast (see Table 15) will increase in the next few days with the planned promotion to increase its visibility.

Date	Title	Views	News piece <sup>23</sup> unique page views
22 June 2021	How is Science Mesh Unlocking Scientific Collaboration?	20	59

Table 15 Podcast statistics

[linguistics-open-data-systems](#)

<sup>19</sup> Link: <https://cs3mesh4eosc.eu/Podcast>

<sup>20</sup> Link: <https://open.spotify.com/show/7rqJY8M65uZnaDlPo37bcV>

<sup>21</sup> Link: <https://podcasts.google.com/feed/aHR0cHM6Ly9hbmNob3IuZm0vcy81N2I4ZmVhMC9wb2RjYXNOL3Jzcw==>

<sup>22</sup> Link: <https://bit.ly/2Slya6l>

<sup>23</sup> Link: <https://cs3mesh4eosc.eu/news-events/news/how-science-mesh-unlocking-scientific-collaboration-podcast-guido-aben>



## 3.2 Third-party events

During the first 18 months of CS3MESH4EOSC, the project was promoted in 12 events from January 2020 (see Table 16), on-track to reach the KPI of 20 by the end of the project. Due to the advent of the COVID-19 pandemic, most of these events were online. It is expected that for now as of M19 (July 2021) this trend will remain. However, with the fact that events have been online, the project was able to reach a more global audience.

The main topic presented in these events was the Science Mesh, with some presentations focused on specific technologies that are being deployed in the platform (e.g., JupyterLab and Voilà) or else highlighting the FAIR data approach being implemented in the Science Mesh.

CS3MESH4EOSC presence at these events was done through paper submission and presentations, as well as through participation in panel sessions.

Date	Host	Event Title	Location	Stakeholder	Activity
27-29 January 2020	DeiC	CS3 Conference 2020	Copenhagen (Denmark)	End-users & research communities Software developers	Presentation
5-7 October 2020	JupyterCon	JupyterCon Conference	Online	End-users & research communities Software developers	Presentation
12 October 2020	HEPIX	HEPIX online workshop	Online	End-users & research communities Institutional operators of services	Presentation
27 October 2020	ONLYOFFICE	ONLYOFFICE Conference	Online	Institutional operators of services Software developers	Presentation
16-19 November 2020	EOSC-hub, FREYA and SSHOC	Building a FAIR research data landscape	Online	Policy makers and citizens End-users & research communities	Virtual exhibition booth
25-29 January 2021	CS3	CS3 - Workshop on Cloud Services for Synchronisation and Sharing	Online	End-users & research communities software developers	Presentation Co-located workshop
7 April 2021	LBG OIS Center	Open Innovation in Science (OIS) Research Conference 2021	Online	End-users & research communities	Paper presentation
20-23 April 2021	RDA, DCC, Jisc & UKRI	RDA Virtual Plenary 17	Online	End-users & research communities Policy makers and citizens	Presentation
14 June 2021	Association for Information Systems - ECIS 2021	European Conference on Information Systems	Online	End-users & research communities Policy makers and citizens Software Developers	Paper presentation
15-18 June 2021	EOSC Secretariat	EOSC Symposium	Online	Policy makers and citizens End-users & research communities	2 presentations
21-25 June 2021	Wave	TNC21	Online	End-users & research communities Institutional operators of services Software developers	Presentation

Table 16 CS3MESH4EOSC presence at third-party events



Figure 23 CS3MESH4EOSC Virtual Stand at the "Building a FAIR research data landscape " virtual event

### 3.3 Future plans

Different strategic plans will be applied to each of events, webinars and podcasts within CS3MESH4EOSC project. For the **organisation of events**, the project aims to organise another edition of the Science Mesh workshop, likely to be allocated with the CS3 Conference that is expected to take place in January 2022. Another idea being considered is the organisation of a final online event, with support from the EOSC community, focused on the launch of the Science Mesh in EOSC and how the tool is supporting EOSC's users. This event would bring together service adopters, vendors, and also technology providers, as well as the users who benefitted from the Science Mesh in the use-cases. Regarding **third-party events**, the project will work toward having visibility in these events, addressing different stakeholders. At the time of writing of this report, CS3MESH4EOSC has applied for presentations at the SciDataCon 2021 and is analysing opportunities related to the EGI 2021 conference. CS3MESH4EOSC's presence at third-party events will largely depend on the evolution of the COVID-19 pandemic.

The project will organise **webinars** to promote the use-cases that are being developed in the project, as well as other **webinars** showcasing the usage of the Science Mesh when its development is concluded. Early adopters will be onboarded as webinar speakers in order to give their testimonial. A joint webinar may be considering with members of EOSC on FAIR data practices.

The project has clear plans for the **podcasts**. As previously explained in the dedicated section, there will be at least 3 more episodes focused on the other Science Mesh services.

## 4 CS3MESH4EOSC and the EOSC Ecosystem

The [European Open Science Cloud \(EOSC\)](#) arises from the European Commission's stated intention to increase the circulation and exploitation of knowledge by promoting open access to the data resulting from publicly funded research under Horizon 2020. Alignment and cooperation with existing organisations, long-term projects, and other initiatives which support building the EOSC is fundamental to increase CS3MESH4EOSC success.

The Science Mesh aims to be a building block for EOSC, which integrates (open) data and (open-source) tools. CS3MESH4EOSC is following an open and bottom-up approach, where the project works closely with users' communities in order to take existing best practices, services and technologies, improve them and open up for other scientific communities. For this, building synergies and

connecting with other stakeholders is key to the success of the project.

*Bob Jones, Director of EOSC Association: “The project has the potential to deliver a collaborative cloud-based data sharing service for Europe, linking different communities and enabling cross-disciplinary research.”*

Considering the [EOSC Working Groups](#), the most relevant ones for CS3MESH4EOSC are the ones indicated in the table below. Since these working groups were already active before the start of the CS3MESH4EOSC project, we were not represented in these working groups. But a number of the CS3MESH4EOSC partners were within the context of other H2020 projects. We have followed the activities of these working groups closely and the results these groups have produced in order to stay connected with EOSC-related activities.

EOSC Working Group	Focus	Relevant Topics CS3MESH4EOSC
<a href="#">Architecture</a>	Defining the technical framework required to enable and sustain an evolving EOSC federation of systems	<ul style="list-style-type: none"> <li>• Technical interoperability (AAI amongst other things)</li> <li>• Semantic interoperability (metadata schema's)</li> <li>• Organisational interoperability (rules of participation)</li> <li>• Legal interoperability</li> </ul>
<a href="#">Rules of Participation</a>	Designing the Rules of Participation that shall define the rights, obligations governing EOSC transactions between EOSC users, providers and operators	EOSC principles of openness, architecture & interoperability guidelines, namely FAIR practice, PID policy, EOSC interoperability framework, AAI (AARC Blueprint).
<a href="#">Sustainability</a>	Providing a set of recommendations concerning the implementation of an operational, scalable and sustainable EOSC federation after 2020	Funding of EOSC Core and EOSC Exchange business models

*Table 17 EOSC Working Groups relevant for CS3MESH4EOSC*

Focusing on the EOSC high-level architecture (see Figure 24), the CS3MESH4EOSC aims to contribute to both EOSC-Exchange and EOSC-Core by:

- **EOSC-Core:** Contributing FAIR data services to EOSC that are fully integrated with Sync-and-share services.
- **EOSC-Exchange:** Enriching EOSC-Exchange with services allowing users to easily share data, interactively analyse data, collaboratively work on documents, archive data, creating and use FAIR data. In addition, it will bring several hundreds and thousands of users already using sync-and-share services to EOSC. Sync-and-share services already interface with different types of services, meaning that they are likely to interacted with other EOSC-core services as well.

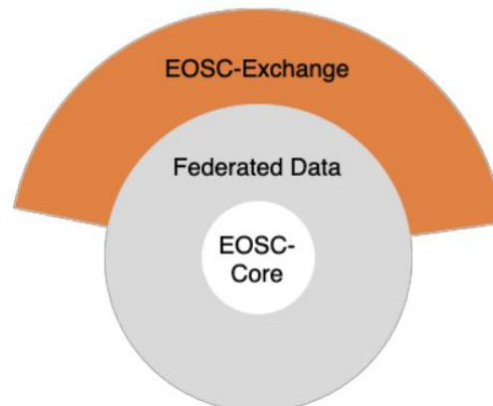


Figure 24 EOSC High-level architecture

In order to build a pan-European storage and application Service Mesh, one of the key objectives to be achieved **is the integration of the Science Mesh into the EOSC catalogue**. Science Mesh will complement the EOSC services with interactive and agile collaboration sharing capabilities for the EOSC users. This also allows the connection of existing services in EOSC (e.g., B2DROP) in the mesh, generating more added value for all services in the EOSC catalogue. One concrete example of this is the collaboration we have at the moment with the CERN FTS/Rucio teams in the context of the ESCAPE project. In this collaboration, related to task 4.4, we aim to link big science use-cases like LOFAR with sync-and-share services.

Along with EOSC, there is the **GAIA-X<sup>24</sup>** project, a federated data infrastructure for Europe, which brings together **business, science and politics, where an open, transparent digital ecosystem, can make available, collated and shareable both data and services, in an environment of trust**. CS3MESH4EOSC will closely follow connections and alignments that may arise between both initiatives in terms of technical infrastructure requirements and data-sharing.

Concerning data-sharing, topics like metadata and FAIR Digital Objects are relevant. In this regard, CS3MESH4EOSC is working on a paper focused on FAIR Data Objects (FDOs) and FAIR data standards, related to the use-case “PARADISEC”, where the Australian AARNET is involved. Furthermore, the CS3MESH4EOSC is considering the creation of a use-case focused on enabling discovery and interoperability of federated research objects across scientific communities, involving different initiatives from different fields.







In order to streamline activities and create win-win activities, some first contacts were made with FAIRsFAIR project, whose members are also involved in key working groups from the EOSC landscape or FAIR digital objects (e.g., FAIR Digital Objects Forum).

## 5 Synergies with national and international networks

CS3MESH4EOSC is working on the identification of relevant EU and international initiatives connected to the data sharing and open science, to promote a structured dialogue to align and cluster common opportunities and goals. The established synergies will aim to enhance the scientific and economic potential and exploitation opportunities of the CS3MESH4EOSC services.

<sup>24</sup> Webpage: <https://www.data-infrastructure.eu/GAIA-X/Navigation/EN/Home/home.html>

By June 2021 (M18), there are a total of 15 projects, initiatives and organisations interested in cooperating with CS3MESH4EOSC. The list of the current established synergies can be found in the table below. The synergies are mostly related to technology integration into the Science Mesh, from both commercial and non-commercial software developers.

Who	Synergy area	Stakeholder Category	Activities
	Dissemination on Technology Integration	Non-commercial software developers	<p>The CS3 APIs are the “glue” which will bind together nodes and applications in Science Mesh, by providing a common language which all parts will speak and allowing connectors to different services to be reused across applications.</p> <p>Co-location of the Science Mesh workshop at the CS3 2021 Conference and organisations support of the “coffee break area” of the general CS3 2021 Conference in Gather.Town platform.</p> <p>Joint-engagement with stakeholders. CS3 Community involved both by engaging its developers for the development of the Science Mesh, and as an end-user to validate the Science Mesh service offering, namely the involvement with NRENs and e-Infrastructure to join the Science Mesh as early adopters</p>
	Technology integration	Non-commercial software developers	<p>It transpired that one of the CS3MESH4EOSC partners, specifically WWU, are related to several other eScience projects run in the state of North-Rhine Westphalia (NRW). Their SCIEBO platform is a capability funded through NRW eScience, and a similar project is the NRW research data management project. Part of this NRW, there is the RDM project, an initiative to roll out an electronic lab notebook at scale, and their tech choice has landed on <a href="#">eLabFTW</a> (from Deltablot), a popular FLOSS ELN platform that is seeing excellent uptake. As Université Libre de Bruxelles, a valued observer of the CS3MESH4EOSC project, had earlier indicated their interest in seeing eLabFTW more closely integrated with the Science Mesh, we have begun a joint undertaking to investigate integration options with the developers of eLabFTW, NRW.FDM, ULB and CS3MESH4EOSC.</p>
	Technology integration	Non-commercial software developers	<p>FAIMS3 is a project to build a digital platform for data collection in the field and offline – targeted at geology, archaeology, crop science etc. A central requirement in the FAIMS3 system is to be able to opportunistically synchronise data from the field to a secure store whenever networking is available, and to be able to schedule compute jobs on the same data from the field units. CS3MESH4EOSC provides platforms for the synch as well as the compute part. To fund the development work needed to join FAIMS3 frontend with the CS3MESH4EOSC backend, both projects put in a joint bid for the <a href="#">NelC open call</a>. A decision is expected by July, 2021.</p>
	Dissemination	Other	<p>The project has been interviewed as one of the five structured interviews with operators of FAIR-enabling services, FAIRsFAIR task 2.4 <a href="https://zenodo.org/record/4293788">https://zenodo.org/record/4293788</a></p> <p>CS3MESH4EOSC have also made available as a test repository for future data seal / data quality best practices.</p>
	Technology integration	Institutional operators of services Technology Integration	<p>Usage of eduGAIN to connect the different sites in the Science Mesh. While the technology stack underlying Science Mesh will be service-agnostic and thus reusable across authentication backends and federations, eduGAIN's worldwide reach and the fact that all the founding mesh nodes are already on it make it a perfect fit for gateway to Science Mesh.</p> <p>Plus, OCM is a fundamental technology for CS3MESH4EOSC and its flagship service the Science Mesh, as it provides the individual nodes with a fundamental mechanism they can use to exchange data. Various use cases and workflows which are part of the Project will result in further extensions to OCM, whose standardisation we will encourage and work on. OCM is a joint international initiative originally under the umbrella of the GÉANT.</p>
	Technology integration	Non-commercial	<p>The federated cloud compute IT capability of the Helmholtz society. HIFIS currently builds a federation of EFSS sites in many ways similar to</p>

Who	Synergy area	Stakeholder Category	Activities
		software developers	ScienceMesh (decentralized federation of independently operated sites). Several productive discussions took place on synergies and interoperability between HIFIS Federation and Science Mesh. Joint development work between HIFIS, CS3MESH4EOSC and GEANT has been proposed and will be pursued Q3/Q4 2021intends to implement group-aware sharing functionality and integration with REVA interoperability layer.
<a href="#">InvenioRDM</a> 	Technology integration	Non-commercial software developers	InvenioRDM is a turn-key research data management (RDM) repository platform based on Invenio Framework and Zenodo developed by CERN. InvenioRDM is also a growing community of research institutions, private companies and individuals to pursuing the development of the platform and interoperation in a larger research landscape. CS3MESH4EOSC closely collaborates with the InvenioRDM project on integrating the InvenioRDM technology in ScienceMesh ("Open Data Systems" application task) and fostering further synergies with European network of digital repositories.
<a href="#">LOFAR</a> 	Service adoption	End-users & research communities	Involved in one of the Science Mesh use-cases. Currently LOFAR lacks the ability to easily share data with its participants and the Science Mesh is going to deliver that capability to them.
<a href="#">PARADISEC</a> 	Service adoption	End-users & research communities	Involved in one of the Science Mesh use-cases. CS3MESH4EOSC project will help on maintaining high quality metadata descriptors in a distributed archive with many researchers depositing data, while keeping costs down and reusing existing scalable infrastructure as much as possible. Provision of a blogpost for the CS3MESH4EOSC website
<a href="#">Observatoire du Sahara et du Sahel</a> 	Service adoption	End-users & research communities	Involved in one of the Science Mesh use-cases. They need support decision-making in the field of sustainable management of natural resources and water through the provision of products and services based on Earth Observation (EO) data analysis. CS3MESH4EOSC will support them on sharing processing algorithms directly inside the environments and thus limit the possibility of collaboration between users.
<a href="#">Open Science Framework (OSF)</a> 	Technology integration and dissemination	Non-commercial software developers	Drafted a blueprint for how to better connect the OSF portal with the CS3MESH4EOSC data holdings. Based on this blueprint, the project is looking for sources of funding; particularly the NGI Atlantic fund has been studied as this one has provision to simultaneously fund a US and an EU counterpart. This is necessary as there's work to be done both on the OSF and CS3MESH4EOSC side. A full work schedule at OSF means we will revisit funding opportunities in Q3, 2021.
<a href="#">Rclone Open Source Community</a> 	Technology integration	Non-commercial software developers	Joint development with rClone community a joint set of requirements ( <a href="https://github.com/rclone/rclone/issues/4996">https://github.com/rclone/rclone/issues/4996</a> ), instead of developing code in-house. Project funds are being redirect to pay for the rClone lead developer to include our changes. This has resulted in the "connection strings" feature, for which the project is indeed attributed in the rClone changelogs.
<a href="#">RiseSMA Project</a> 	Service adoption	Other	Involved in one of the Science Mesh use-cases. Synchronous editing, collaborative citations, using software like Gephy online, most people use the web version of applications leading to sync problems. Continuous switching across online and offline analysis leading to inconvenient uploading and downloading. CS3MESH4EOSC will support them in this matter
<a href="#">RO-Crate Community</a> 	Technology integration	Non-commercial software developers	Technology integrated in the Science Mesh, under "Open Data Systems" category of service
<a href="#">University of Technology Sydney</a> 	Technology integration	End-users & research communities	Integration of "Describo" technology in the Science Mesh, under "Open Data Systems" category of service. Describo is a tool to help researchers turn their folders of content into Research Object Crates suitable for sharing, reuse, and long-term preservation in archival systems. Describo is open-source software.

Table 18 CS3MESH4EOSC synergies by M18

## 5.1 Future Plans

In the second half of the project, CS3MESH4EOSC will continue looking for new relevant initiatives, not only related to technology integration in the Science Mesh, but also the organisation of joint event with key initiatives also involved in the EOSC and potential new use-cases to be created with institutions from distinct business areas. To expand stakeholder engagement, the consortium will explore the organisation of joint-workshops at key events showcasing the benefits of the Science Mesh, as soon as the tool development is finalised. Dedicated pages for each synergy established will be available on the CS3MESH4EOSC website.

## 6 Exploitation Plan: Making use of CS3MESH4EOSC Results

The Science Mesh would be the primary output of the CS3MESH4EOSC project. The mesh enables researchers to easily share and collaborate on data across institutional and geographical boundaries.

### 6.1 Overview

Cloud computing has revolutionised the conduct of science, enabling new forms of collaboration across the research community. Despite its advances, the cloud still has not fully realised its impact due to the fragmentation of the cloud storage ecosystem. Different cloud storage services do not interoperate with one another. This means that researchers cannot easily exchange or share information and use functionalities across different services easily. This has led to problems including vendor lock-in, storage costs, missed interdisciplinary research and lost potential economic growth. Realising its importance, various stakeholders have called for measures to improve the interoperability across cloud storage services. The Science Mesh is a federated mesh infrastructure that aims to make it easier for researchers to easily collaborate and share data with one another. This overview of the mesh has been presented at the European Conference on Information Systems (Romasanta and Wareham 2021).

#### 6.1.1 The cloud storage landscape

The primary players in cloud storage are large American companies such as Amazon, Dropbox, Google and Microsoft. Services such as Microsoft OneDrive, Dropbox and Google Drive have become ubiquitous to consumers of cloud storage through a pay-as-you-go model. However, as these became widespread for consumers, the research community has become increasingly concerned about whether these services adequately address issues like data control, governance and data ownership. As an alternative to these services, research institutes have set up on-premise cloud services through vendors like NextCloud, OwnCloud and Seafile. These vendors are based on the open-source model and can easily be deployed by research organisations.



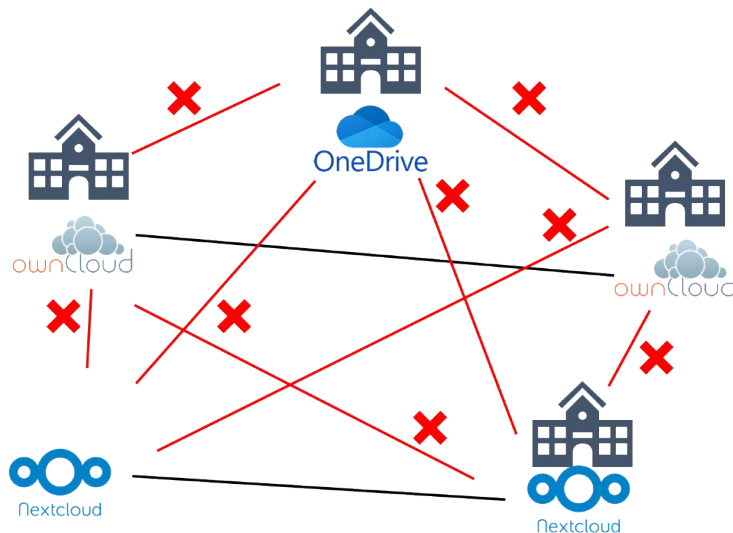


Figure 25 The fragmented cloud storage landscape

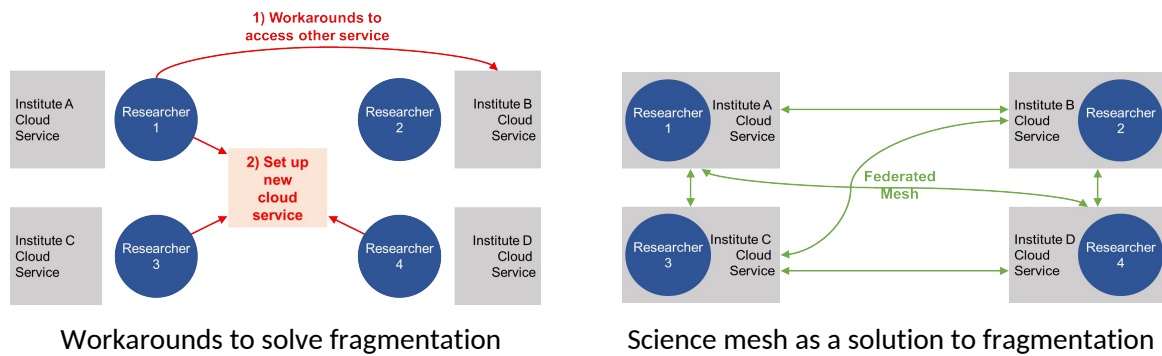
While the proliferation of both private and public cloud storage services has enabled research organisations to address their individual needs, this however has also caused fragmentation in the ecosystem due to the lack of interoperability across these different options. Cloud interoperability is defined as the ability to seamlessly deploy, migrate and manage application workloads across different hardware and software resources from cloud providers (Ranjan 2014). Without interoperability, organisations cannot easily exchange or share information and use functionalities across them easily. When organisations depend too much on an individual provider, they are prone to vendor lock-in where they cannot easily move to another provider due to high switching costs. This is aggravated by network effects. When a certain research institute chooses to host their data on one of these cloud services, they implicitly force users who will interact with their data to use that public cloud service. These cloud providers then can use these data to improve their service. With users' data attracting more users, it becomes difficult for other companies with smaller user bases to compete. In sum, cloud providers are incentivised to put up a walled garden to attract more users and leverage natural monopoly effects.

### 6.1.2 Science Mesh as a solution

The Science Mesh is a digital infrastructure aiming to enable interoperability across different cloud service providers. In its pilot phase, it will enable frictionless sharing of data across researchers under the following existing services: SURFdrive (Netherlands), CERNBox (Global - CERN), PSNCBox (Poland), CloudStor (Australia), Sciebo (North Rhine-Westphalia, Germany), CESNET (Czech Republic), SWITCHdrive (Switzerland) and ScienceData (Denmark). These services currently host 300,000+ user accounts with over 8.7 PB of storage, equivalent to 2.47 billion files and directories.

The Science Mesh aims to directly address the fragmentation challenge by enabling interoperability across cloud providers (see Figure 1). Through this federated approach, users can readily access resources from other cloud providers, without moving outside of their own provider. Users can share their data conveniently with peers without requiring additional steps. From the users' perspective, they do not even need to know that they are working with other cloud providers. By removing various barriers, the mesh promotes research collaborations and data sharing among researchers located across geographic and institutional barriers.





*Figure 26 Approaches to solving fragmentation.*

### 6.1.3 Alternate solutions

Before the mesh, researchers had to use various workarounds to collaborate and share data with other researchers. For individual researchers, the common workaround to collaborating across different providers is to move data in and out of the cloud on their own effort. It is not unusual for researchers to send datasets or documents through email. More tech-savvy researchers may even use tools such as container and virtualisation technologies to assist with these processes. As seen, researchers have to go through various inconvenient procedures just to exchange data with their collaborators. This added barrier can then lead to researchers not sharing their data at all.

On a larger scale, another common solution is to create a new, standalone infrastructure where researchers' data and analysis tools are collocated to be readily accessible. This approach is especially deployed in international research collaborations, where a new cloud service is set up to enable remote project teams to store, pool and analyse data. However, one downside to this approach is that adding new services can aggravate further the already fragmented landscape. It might be difficult also for researchers who are not part of the consortium to access data generated by the researchers who belong to the consortium.

Other Initiatives take this idea to a wider scale, aiming to serve the scientific community at large. The Open Science Data Cloud ([opensciencedatacloud.org](https://opensciencedatacloud.org)) is described as "is a data science ecosystem in which researchers can house and share their own scientific data, access complementary public datasets, build and share customised virtual machines with whatever tools necessary to analyse their data and perform the analysis to answer their research questions. It is a one-stop-shop for making scientific research faster and easier." In the EU, EUDAT Collaborative Data Infrastructure ([eudat.eu](https://eudat.eu)) is a consortium made up of 25 research organisations, data and computing centres, that aims to provide data services to researchers.

The success of new data commons like these two relies on attracting a critical mass of researchers who would then be able to share data with other users of the service. Compared to the mesh, the challenge with these approaches is that they require researchers to move to these new services and learn how to use them. The mesh, however, is not a competition to these services, although they all try to improve collaborations across researchers. These services can be added as nodes to the mesh, enabling easier access to those who are not already part of these services.

#### Go-to-market strategy

In general, gaining adoption for the mesh is straightforward as we are merely building on top of existing cloud services already used by 300,000+ users across Europe and beyond. Unlike the previous services that lean on attracting users at the researcher level, the mesh works at the level of the cloud provider. By federating the first eight cloud services (SURFdrive, CERN, PSNCBox, CloudStor, Sciebo, CESNET, SWITCHdrive and ScienceData), the mesh team will gain crucial insights on the various

challenges and potential in its usage. This initial implementation would provide additional feedback to fuel further adoption from other researchers.

One important issue to note however is that even when the cloud storage provider is already plugged into the mesh, users might not actually use the functionalities offered by the mesh if they are not informed of its various capabilities. As such, we need to interface well with the institutional providers to ensure that they effectively disseminate about the mesh. Quick tutorials about the mesh should be easily accessible through their providers. Moreover, workshops should also be given by the team to further educate potential users about the possible applications of the mesh. Video tutorials should easily be accessible through the Science Mesh website and also the site of the institutional provider.

To further attract researchers to join the mesh, the team should be active in disseminating news about the mesh. New research studies that were facilitated through the mesh should be highlighted through the website. Case studies of the mesh's usage should be publicised through different avenues including conferences, journal articles, practitioner articles and popular mainstream media.

As for the providers that are still not under the mesh, a quick route towards joining the mesh should be provided by the team. A website that contains details, explaining all the technical, legal and institutional aspects related to being part of the mesh should be disseminated. Once a provider decides to be part of the mesh, a convenient procedure should be put into place to enable their integration, lowering barriers to adoption.

For users who do not belong to any institutional provider, a path to joining the mesh should be opened. Information on how to join should be published through the Science Mesh website.

## 6.2 Functionalities

To attract researchers to use the mesh, it will offer new functionalities that are not served well in the present systems. For each of these functionalities, we have a specific scientific community that will test it and give early feedback to further improve the service. By gaining adoption from these lead users, we can demonstrate to other researchers much more concretely the value that the mesh provides. In the following, we describe these functionalities:

Application	Problem addressed	Description	User Community	Use Case
<b>Frictionless Sync and Share</b>	Sharing files across different providers is difficult and not user friendly	Easily share and transfer data across institutional and geographical boundaries	Low-Frequency Array (LOFAR) – Astrophysics	User-friendly transfer of data from the storage site to compute site
<b>Remote data analysis</b>	Difficulty of transferring large files for analysis	Analyse large datasets located at a remote site through collaborative Jupyter notebooks	EU Joint Research Center (EU JRC) - Earth Observation	Enable local partners to analyse satellite images without transferring data
	No access to compute capability		European Organization for Nuclear Research (CERN) –Particle physics	Enable researchers to use CERN's compute facilities to analyse data remotely
<b>Collaborative applications</b>	Unsecure collaborative editing	Edit documents collaboratively	Social Media Analytics for Society and Crisis Communication (RISE SMA) – Social Sciences	Collaboratively write articles across groups in a secure manner

Application	Problem addressed	Description	User Community	Use Case
<b>Open data systems</b>	Inconvenient process in preparing and publishing datasets		Pacific Regional Archive for Digital Sources in Endangered Cultures (PARADISEC) - Humanities	Conveniently label and package data for publishing in repositories

*Table 19 Applications of the mesh and early adopters*

## 6.2.1 Frictionless sync and share

At a basic level, the mesh would enable teams to easily share and transfer data between different research sites. This sharing functionality allows collaborators to browse and synchronise files and folders of their peers (like Dropbox). When it is necessary to transfer large datasets, the mesh would facilitate efficient, high-speed transfers.

An early adopter for this use case is in astrophysics. We are partnering with the Low-Frequency Array (LOFAR) in the Netherlands which needs to manage data from multiple antennas scattered over a large geographic area. Since this data needs to be moved from the storage site to the compute site, The Science Mesh will facilitate the transfer of such large amounts of data through the user-friendly interface of researchers' sync and storage providers. We have already initiated contact with the team. Early adopter studies are being conducted.

## 6.2.2 Remote data analysis

Through the mesh, researchers would be able to interactively analyse large datasets located at a remote site. Researchers would not have to transfer data but instead, carry out all the analysis through the web via access to the data science environment. The key enabling technology are Jupyter notebooks that allow researchers to write and run code and create interactive visualisations - all in the same web-based computational environment.

An early adopter of this is the Earth Observation community. At the EU Joint Research Center (JRC), researchers process satellite images to gain insights into the trends and changes happening to the environment. This requires the collaboration of local partners who can edit and process the input images. Transferring large amounts of data may not be the most appropriate nor efficient for all applications. Notebooks can then be shared with local partners, enabling them to process the data without requiring data transfer. These research teams can then collaboratively prototype and further develop the code in the notebook. We have conducted an initial interview with the project member from EU JRC. Further work is needed to highlight the adoption challenges.

This capability will also be tested by the high-energy physics community. At the Large Hadron Collider at the European Organization for Nuclear Research (CERN), researchers process the large amounts of data from their experiments by reducing the dataset through elaborate filtering algorithms, then later performing the analysis on this reduced dataset on their local computers. Instead of working on the reduced dataset, researchers can be gain remote access to perform data analysis on CERN's robust computing platforms. With CERN being central to the Science Mesh, we foresee that gaining adoption from this organisation would be straightforward. Nonetheless, we are conducting early adopter studies to understand various opportunities in the mesh.

### 6.2.3 Collaborative editing

The mesh will enable collaborators to edit documents in a federated manner. They would be able to comment and track revisions, like existing services such as Google Docs. In this case, however, the federated mesh allows the files to not be in a centralised repository, giving scientists more control of their data. Moreover, the mesh helps decouple data storage from the applications, enabling scientists much more flexibility on their preferred software to analyse their data.

The early adopter here would be the Rise Social Media Analytics (Rise SMA) project, which explores how social media is used for disasters and propaganda. The project team would use the mesh to work on their articles collaboratively. We have interviewed a representative from the team who highlighted the need for easier collaborative editing across research teams. We will conduct further studies with the team.

### 6.2.4 Open Data Systems

Finally, the mesh would enable researchers to collaboratively label and add metadata to datasets and publish them with persistent identifiers through the Science Mesh. The Mesh will allow researchers to publish their data into open repositories from the convenience of the interface of their cloud provider.

This functionality will be especially useful in managing archival collections. For instance, the Pacific Regional Archive for Digital Sources in Endangered Cultures (PARADISEC) is a digital archive, containing records of many small cultures and languages around the world. The mesh will enable researchers to collaborate on labelling and processing such files in their catalogue. Once processed and published, these files can then be accessed by other researchers for further analysis through the mesh. The PARADISEC team is closely engaged with the WP4 on open data systems. We will work closely with them to understand further how PARADISEC can benefit from the mesh.

## 6.3 Stakeholder analysis

To ensure that the project's results are exploited and used to their full use, we need to ensure that key stakeholders are aligned: researchers, universities, institutional providers, cloud vendors and industry. In the following, we discuss the exploitation plan for each stakeholder.

Stakeholder	Pain point	Value Proposition	Outreach	Next steps
<b>End-users and research communities</b>	Difficulty in sharing and collaborating on data across researchers with different providers	The mesh enables sharing and data collaborations with ease	-Workshops -Video tutorials -Manuals posted on the website -Conference presentations -Scientific publications	Conduct user engagement studies
<b>Institutional operators of services</b>	Vendor lock-in due to lack of interoperability across cloud vendors	Interoperability enables providers to choose flexibly the vendor that serve best their needs	-Workshops -Video tutorials -Manuals posted on the website	Conduct adoption studies to understand the challenges with joining the mesh
<b>Cloud vendors</b>	Difficulty to compete and attract customers due to natural	Create a more competitive cloud storage landscape where companies do not lead just due to	-Close relationship building	Conduct studies to understand their hesitations towards interoperability and explore how they can benefit from

Stakeholder	Pain point	Value Proposition	Outreach	Next steps
	monopolies	high switching costs		joining the mesh
<b>Non-commercial software developers</b>	Difficulty in developing software across different software systems	Enable ecosystem for the development of innovative apps for research	-Workshops -Video tutorials -Manuals posted on the website	Exploratory study on potential research apps that can be developed through the mesh
<b>Policymakers and citizens</b>	Inefficiencies caused by research output not being reused	Foster reuse of data to solve societal challenges	-Conference presentations -Scientific publications	Conduct cost-benefit analysis of the mesh

Table 20 Key stakeholders for CS3MESH4EOSC

### 6.3.1 End-users & research communities

The primary audience of the Science Mesh are the researchers, who could use the mesh to enable interdisciplinary collaborations and promote Open Science and FAIR data. To ensure that the mesh would be used effectively by researchers, we are currently conducting user adoption studies. Through interviews with researchers from different domains, we are understanding the various challenges and opportunities in cloud storage and what particular role the mesh would play to improve these aspects. Currently, we have conducted 15 interviews with different stakeholders from the research community and also various members of the project. Moreover, we have presented the mesh in research conferences where we can get feedback from the scientific community. Examples include the Open Innovation in Science Conference ([ois.lbg.ac.at/en/research/ois-conference-2021](https://ois.lbg.ac.at/en/research/ois-conference-2021)) and the European Conference for Information Systems ([ecis2021.ma/](https://ecis2021.ma/)).

For the majority of the research community, the biggest challenge is that cloud storage tends to not be a big priority in their workflow. They tend to just store their files depending on what they already use for their personal storage (such as Dropbox) or use the service provided through their institution. When they need to collaborate in document editing, for instance, they tend to send files via email or just use Google Docs due to its ease. Thus, to ensure that the mesh would be used by researchers, the most important is to ensure that it is user-friendly and that it is intuitive so that it can easily be used by researchers.

The advantage of the mesh is that it runs in the background of the current cloud storage services, and thus can be used by researchers without necessarily having to know that the mesh exists. As such, getting adoption from the researchers would be straightforward. Nonetheless, establishing good relations with institutional providers would be key to ensuring that it gets properly integrated into their cloud storage service.

### 6.3.2 Institutional operators of services

Universities and the organisations providing cloud services to researchers are also important components of the mesh. In the current phase of the mesh, it would integrate the following services: SURFdrive (Netherlands), CERNBox (Global - CERN), PSNCBox (Poland), CloudStor (Australia), Sciebo (North Rhine-Westphalia, Germany), CESNET (Czech Republic), SWITCHdrive (Switzerland) and ScienceData (Denmark). A study with this original cohort should be conducted to already anticipate the challenges when it comes to joining the mesh.

Beyond this original group, other cloud providers who would like to join should be able to easily be part of the mesh. To make this possible, the CS3MESH4EOSC team needs to provide well-documented technical manuals and easily accessible governance agreements to make this process efficient. To

help with this onboarding, the mesh team should also provide workshops so that IT teams can be oriented on the various benefits and costs associated with the mesh.

### 6.3.3 Cloud Vendors

To implement the Science Mesh, cloud vendors upstream would have to open their service sufficiently such that they can plug into the mesh and be interoperable with other vendors. In the first phase of the project, three vendors OwnCloud, NextCloud and Seafile, which serve the eight previously mentioned cloud services, would be included in the mesh. To gain their continued support, the team should continuously engage with key personnel in these organisations. Helping cloud vendors meet their business objectives while also ensuring that researchers are adequately served is an activity that would need more research.

Nonetheless, by starting with this group of three vendors, we hope to gain crucial insight on the business case for joining the mesh. With a successful first phase, the long-term goal is to convince other providers such as Dropbox, Amazon, Microsoft and Google to also be part of the mesh in the future. More research is necessary to make the business case for cloud vendors to connect to the mesh. Engagements with these players would be necessary through workshops and individual consultations.

### 6.3.4 Software developers

Generally, we have focused on the role of the mesh in the academic community. However, the mesh can also be exploited by industry in two ways. More directly, industry partners can develop apps for the mesh. In the previous section on researchers, we already outlined various functionalities that that initial implementation of the mesh enables. Beyond this, however, there are endless options of what can be achieved by enabling interoperability. The mesh opens new ways of collaborating across different organisations. Start-ups and other industry players can take advantage of this new ecosystem and introduce innovative workflows towards collaborations.

In the CS3MESH4EOSC team, we have two industry partners who would already benefit from the mesh. First is Cubbit, a start-up creating a "datacentre-less" cloud as an alternative to traditional commercial cloud storage solutions. By being part of the mesh, Cubbit users will be able to share data and collaborate with colleagues that use a different, centralised storage solution. This capability would enable Cubbit to have a wider reach and expand their customer base easily. With their academic clients becoming increasingly concerned about interoperability, being part of the mesh would lower the adoption barriers for Cubbit as they expand.

Second is Software Mind, a part of the Ailleron group, which is a global IT service provider based in Poland. The mesh is collaborating closely with the Big Data Lab to make collaborative data analysis possible for researchers. Software Mind benefits by working closely with researchers who are at the cutting-edge of data science. They can use this as input to develop new software to serve the research community. Moreover, they can then leverage this know-how to create new offerings for their business clients in the area of big data and analytics.

Indirectly, the mesh can also enable industry actors to be part of the mesh and thus, promote inter-organisational collaborations. Enabling these collaborations can help indirectly in the creation of new products and the improvement of various processes. To ensure that the mesh can cater to these needs, dialogue with industry partners would be useful. Moreover, establishing relationship with projects like GAIA-X, which aim to serve industry, would also be a fruitful endeavour.

### 6.3.5 Policy makers and citizens

The Science Mesh would be a crucial part of the European Open Science Cloud, which has been a



grand initiative by the EU. Dialogue is already started to ensure that the mesh is integrated in the EOSC hub.

It has been estimated that the European Union loses a total of 26 billion EUR each year due to the lack of FAIR data (European Commission 2019). FAIR refers to the principles espoused by the research community and policy makers to ensure that the data and the tools to analyse them are findable, accessible, interoperable and reusable (Wilkinson et al. 2016). With the increasing volume and complexity of data generated by the scientific community, these principles are necessary to improve the findability of existing data, ease the access to data at scale and allow reuse of data (Wise et al. 2019). The most promising impact of FAIR is enabling computational systems to take existing data and find new uses with minimal human intervention. Despite its ambitious promises, transitioning to FAIR data is not straightforward. Thus, by providing the infrastructure to enable FAIR data, it would be easier for scientists to produce research that would address grand societal challenges.

Principle	Description	Current setting	Federated mesh
Findable	Metadata and data are easy to find for both humans and computers.	Data may not be properly labelled for easy search	Also subject to existing barriers of data not being properly labelled
Accessible	Once data is found, they can be accessed with authorisation and authentication	Data may be stored in silos that are difficult to access	Data can be accessed through existing authentication systems
Interoperable	Data can be readily used by applications for analysis, storage, and processing.	Workarounds to use data and apps outside their original service	Data and apps can be used across systems through interoperability layer
Reusable	Metadata and data are well-described for replication and integration	Data is stored or archived without considering reusability	Tools towards reusability are integrated into the workflow

*Table 21 Difficulties of FAIR data with the fragmented ecosystem*

## 6.4 Next Steps

This exploitation plan highlights the various challenges and opportunities potential of FAIR data. We showed that it solves the fragmentation of the cloud storage ecosystem by interoperating various cloud service providers. In its first phase, the mesh will link eight cloud providers serving 300,000 researchers. From this initial implementation, it hopes to build a critical mass to then compel other cloud providers to open their walled gardens and plug into the mesh. This initial implementation would then be crucial in informing the future challenges as the mesh expands. More studies are needed on the specific revenue models for the future continued existence of the Science Mesh. Fortunately, we have similar initiatives that can inspire this such as EUDAT, which has done extensive studies for their business model.

Beyond the initial go-to market plan, each partner would play a crucial role in the continued operation of the mesh. We highlight these roles in the following table.

Role	Partners	Proposed tasks for long-term sustainability
<b>Coordinator</b>	CERN	Strategies for long-term sustainability Coordinate between different stakeholders
<b>Institutional Cloud storage providers</b>	Aarnet, CESNET, WWU Munster, PSNC, SURFsara	Gain adoption of mesh to users Explain to other cloud providers the benefit of joining the mesh
<b>Research organizations</b>	CERN, WWU Muenster, EU JRC	Demonstrate research application of the mesh

<b>Industry partners</b>	Cubbit, Ailleron,	Demonstrate business case for the mesh
<b>Dissemination</b>	Trust IT	Maintenance of website and constant dissemination of new functionalities
<b>Business support</b>	ESADE	Long-term studies on socioeconomic impacts

*Table 22 Roles of partners for the mesh's exploitation*

The mesh aims to make it convenient for researchers to make their data FAIR by federating their existing cloud provider and attracting them through advanced functionalities such as frictionless sync and share, remote data analysis and collaborative applications. We provided examples of the potential of FAIR data by enabling novel research workflows in fields including astronomy, high energy physics, earth science and the humanities. Moving forward, further empirical studies will be conducted to explore the challenges of FAIR data in these lead user communities. Case studies will also be conducted to explore how these advanced functionalities can fuel novel ways of conducting science.

We also applied and received the service of the EU Horizon Results Booster programme ([horizonresultsbooster.eu](https://horizonresultsbooster.eu)). Here, we are getting help from experts in project exploitation in crafting the Key Exploitable Results with the project. We are holding various workshops with important project members and leaders from the scientific community to explore how to improve adoption from the mesh.

As the volume of data generated by the research community accelerates, reducing the inconveniences in data sharing will be crucial to ensure that no data goes to waste and that data is used effectively to inform important research questions. An important step to FAIRness is ensuring that data and the tools used to analyse them can operate across different cloud providers. If successful, the Science Mesh will play an important role in enabling collaborative research towards solving the increasingly complex problems facing society.

## 7 Key Performance Indicators Achieved

The table below summarises the status of communication and engagement KPIs to date as compared with targets.

Type	Results by M18	Results by M36
<b>Community</b>		
<b>Social Media Community</b>	550 Social media followers (192 Twitter + 350 LinkedIn + 8 YouTube subscribers)	2.000
<b>N° members database</b>	110	300
<b>Newsletter subscribers</b>	97	200
<b>Science Mesh users</b>	0 (service still under development)	
<b>Website</b>		
<b>Website Sessions</b>	29.000	60.000
<b>Website users</b>	2.500	5.000
<b>Website page views</b>	71.000	100.000
<b>Communication Materials</b>		

Type	Results by M18	Results by M36
<b>Communication Materials</b>	<ul style="list-style-type: none"> <li>• 1 flyer</li> <li>• 1 poster</li> </ul>	<ul style="list-style-type: none"> <li>• 3 flyers</li> <li>• 1 roll-up</li> <li>• 200 branded post-its</li> <li>• 1 e-book</li> </ul>
Videos produced	1	3
N° videos on YouTube	11	300
Publications in peer reviewed journals	2	3
Press Releases	2	3
Publications and articles	4	6
Public reports on Zenodo/OpenAIRE	4	10
<b>Events</b>		
Science Mesh Workshop	1	2
N° attendees Science Mesh Workshops	96	200
Webinar participants	54	150
Webinars organised	1	3
Presence at 3 <sup>rd</sup> party events	12	+20
Podcasts organised	1	3
Podcast listeners	20	100
<b>Others</b>		
Synergies Stablished	15	30

Table 23 KPIs achieved by M18 and KPIs for M36

As a note, the number related to the website traffic are only from M11 till M18. The observation of website traffic and engagement have been made possible with the implementation of analytics tools, when Trust-IT was in charge of the new website launch and maintenance.

During the first 18 months of activity, the CS3MESH4EOSC communication team has established and upgraded tools and systems which are assisting the project partners in tracking performances, measuring the impact of the activities and planning for the future activities of the project. To monitor the digital presence of CS3MESH4EOSC, a dashboard has been set up. The first version of the dashboard is available<sup>25</sup> (see Figure 27). Updates and adjustments will be made during the project. Alerts will keep partners informed on the content of the CS3MESH4EOSC website and social media.

<sup>25</sup> Link: <https://datastudio.google.com/u/0/reporting/608c064a-c7fb-42cf-aae1-2f31367f3e77/page/4mju>

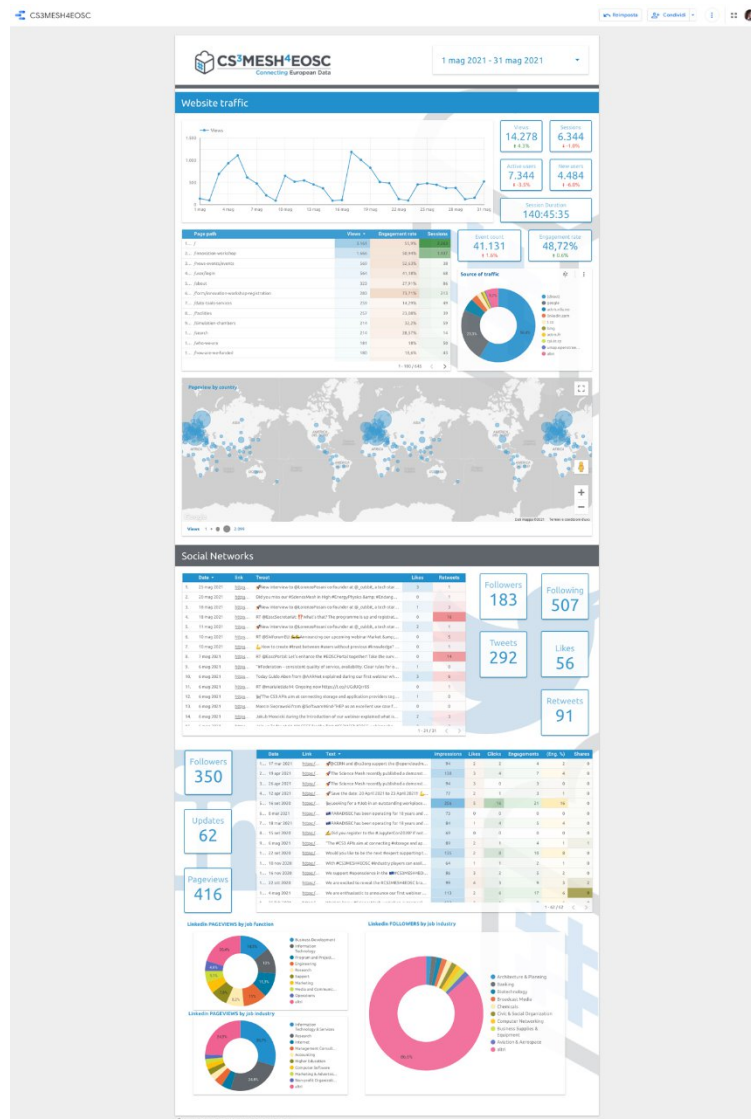


Figure 27 Website and Social Media Dashboard

The continuous communication effort made by the communication team and all the CS3MES4EOSC partners is making possible to support the promotion of the results and the engagement of the stakeholders and the community at large.

CS3MESH4EOSC deliverables will be available on the project website and ZENODO after they are approved by the European Commission. Furthermore, the project will also exploit the new Horizon Results Platform, launched in 2019 by the European Commission, an online space to showcase project results in view of future exploitation in research, business and politics, to desired audiences and key stakeholders.

## 8 Timeline of Action Plan of activities from M19 till end project

The timelines presented in Figure 28 outline the main CS3MESH4EOSC communications, dissemination and engagement milestones from M19 to the end of the project (note that the timeline only includes the most relevant activities). This timing is subject to change, particularly as regards events, and outputs and activities performed by other WPs.

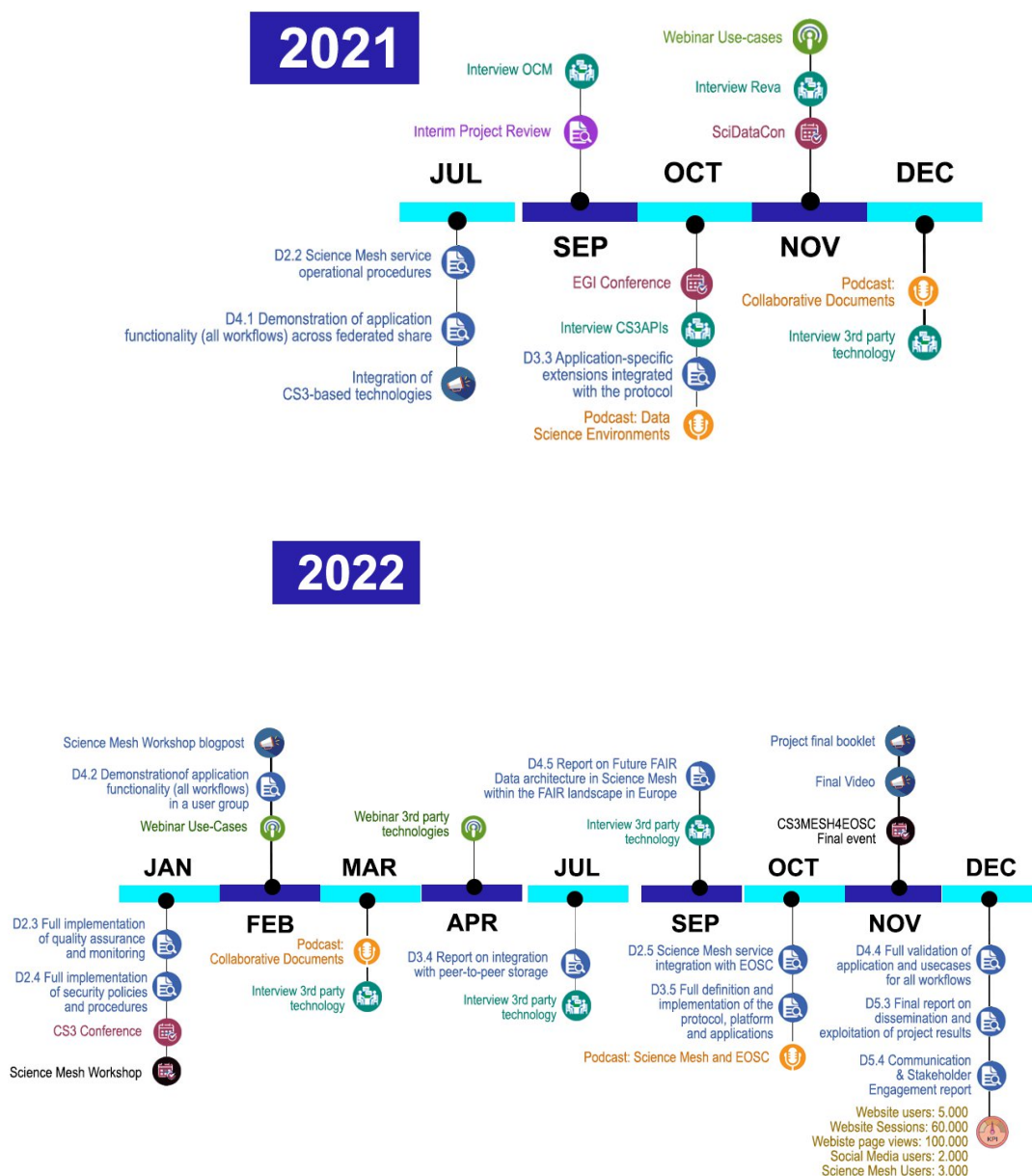


Figure 28 CS3MESH4EOSC Draft Plan of Activities from M19 (July 2021) till M36 (December 2022)

## 9 Conclusion

This document is the revised version of the “D5.1 Communication and stakeholder engagement plan”, which presents the main outreach and the dissemination achievements for the whole project time frame. This report paves the way to the future set of activities to be set and executed in the upcoming months, keeping a bright vision of the KPIs in order to monitor the results and achievements reached.

The goal for the next period is to broaden the community and support the uptake of Science Mesh. This will be done through a rich mix of actions, including the organisation of webinars, release of podcasts and interviews, organisation of the Science Mesh workshop and, especially, the exploitation of synergies that will be consolidated in the following months, jointly addressing different stakeholder categories. The future onboarding of the Science Mesh into the EOSC Portal will also represent a key-achievement of the project, which will be supported by a communication campaign.

A special effort will be placed on engaging with end-users, operators of services and software developers, without losing focus on the EOSC community. The CS3MESH4EOSC WP5 team will also focus on establishing synergies with key initiatives to ensure a solid service adoption after the project closure.

The dissemination activities of CS3MESH4EOSC will be organised and constantly communicated through the project website and the social media accounts of the project, with the aim to reach more potential stakeholders, and targeted users in research, scientific and policy field.

This deliverable will be followed by “D5.3 Final report on dissemination and exploitation of project results”, by end of the project (M36, December 2022), which will report on the marketing, communication & dissemination activities carried out by the CS3MESH4EOSC project. Regarding the exploitation plan, it will be available in the “D5.5 Business impact assessment and roadmap for effective management”, to be submitted in the same month.



## 10 References

- European Commission. 2019. "Cost-Benefit Analysis for FAIR Research Data."
- Ranjan, Rajiv. 2014. "The Cloud Interoperability Challenge." *IEEE Cloud Computing* 1 (2): 20–24.
- Romasanta, Angelo, and Jonathan Wareham. 2021. "FAIR DATA THROUGH A FEDERATED CLOUD INFRASTRUCTURE: EXPLORING THE SCIENCE MESH." In *European Conference on Information System*.
- Wilkinson, Mark D., Michel Dumontier, IJsbrand Jan Aalbersberg, Gabrielle Appleton, Myles Axton, Arie Baak, Niklas Blomberg, et al. 2016. "The FAIR Guiding Principles for Scientific Data Management and Stewardship." *Scientific Data* 3 (1): 160018.
- Wise, John, Alexandra Grebe de Barron, Andrea Splendiani, Beeta Balali-Mood, Drashti Vasant, Eric Little, Gaspare Mellino, et al. 2019. "Implementation and Relevance of FAIR Data Principles in Biopharmaceutical R&D." *Drug Discovery Today* 24 (4): 933–38.