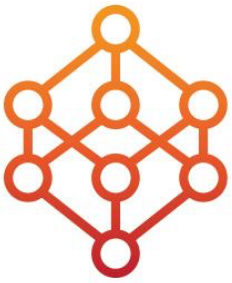

PHYSICS

oPTIMIZED HYBRID SPACE-TIME SERVICE CONTINUUM IN FAAS

D.7.4 –COMMUNICATION, DISSEMINATION AND STANDARDIZATION PLAN AND ACTIVITIES

Lead Beneficiary	INNOV
Work Package Ref.	WP7 – Exploitation, Dissemination and Impact Creation
Task Ref.	T7.1 – Exploitation, Dissemination and Impact Creation T7.3 - Standardization & Open Source Activities
Deliverable Title	D.7.4 Communication, Dissemination and Standardization Plan and Activities V3
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EC Project Officer	Mr. Stefano Foglietta

H2020 ICT 40 2020 Research and Innovation Action

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0.8	2023-12-20	DFKI	QA
0.9	2023-12-22	INNOV	Final Deliverable Version

[1] Lead Beneficiary, Contributor, Internal Reviewer, Quality Assurance
[2] Can be left void

LIST OF ABBREVIATIONS

FaaS	Function as a Service
KPI	Key performance indicator
k8s	Kubernetes

EXECUTIVE SUMMARY

The purpose of this deliverable is to provide an updated report on the progress of the PHYSICS H2020 project's communication, dissemination, and standardization activities throughout the duration of the project. The dissemination and communication activities are of critical importance, ensuring that the project's objectives and results are adequately promoted and maximized for future exploitation. This report follows the deliverables "D.7.2 Communication, Dissemination, and Standardization Plan and Activities V1" and "D.7.3 Communication, Dissemination, and Standardization Plan and Activities V2" submitted in December 2022 and 2023 respectively.
The deliverable's primary objective is to demonstrate the communication, dissemination, and standardization as achievements in Year 3 of the project defined by the project's dissemination and communication strategy. In addition, it summarizes the project's communication, dissemination, and standardization across the PHYSICS project lifecycle, demonstrating how the project has achieved specific KPIs with regards to communication, dissemination, and standardization plans.

During the last year of the project, the communication and dissemination focused its efforts on promoting a deeper understanding of the assets developed by the pilots and new technologies, engaging with both internal and external stakeholders through a range of communication channels. The primary channel for communicating project-related information has been the project website, while social media has been instrumental in driving traffic and reaching a diverse audience. Additionally, aiming to further disseminate and promote the project results to different audiences, PHYSICS has organized several community engagement events and has participated in various externally organized event, whereas the project has produced several academic publications.

Along the same lines, regarding standardization & open-source activities, the main target of PHYSICS has been to contribute to standardization mainly through contributions to relevant upstream open-source projects and their communities, which represent de-facto software standards. This was achieved mainly through more synergies with upstream projects which have been intensified during the second half of the project.

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1. INTRODUCTION

This deliverable represents the final report within the series of three deliverables focused on the Communication, Dissemination, and Standardization Plan and Activities. Its purpose is to provide a comprehensive overview of the activities carried out in Tasks 7.1 and 7.3 of WP7, while also summarizing the key achievement of the project with regards to specific KPIs throughout the project's three-year duration. The report details the updated dissemination, communication, and standardization activities implemented over the course of the project, including any challenges encountered and additional actions taken.

The deliverable reports on the progress of the dissemination and communication activities. It begins by presenting the upgrades on the project website which serves as a comprehensive repository of all relevant project information. It then reports on the notable publications of the project achieved in Year 3, boosting up the project's outreach to the research community. It also reports on the events organized by the project including hackathons. As social media platforms and newsletters effectively distribute project information by uploading updates and, at the same time, serving "reminders" by reposting significant posts for stakeholders, social media campaigns have also been at the core of the project's dissemination and communication strategy.

A significant addition to this deliverable is Section 7, which summarizes the dissemination strategy implemented by the PHYSICS project throughout its duration. It elaborates on the KPIs and objectives set for the project and provides an analysis of the results achieved across the three-year project lifecycle. Furthermore, the chapter highlights any additional materials created to meet the dissemination and communication needs of the project.

Section 8 provides an overview of the project's efforts to contribute to standardization by actively engaging with upstream open-source projects. Over the project's three-year span, the PHYSICS project has aimed at identifying and collaborating with relevant standardization bodies and projects. This deliverable reports on the final year standardization activities including synergies with upstream projects, particularly with Knative and Kepler.

The rest of this deliverable is structured as follows:

- **Section 2** has a well-structured analysis for the website analytics during the three years of the project and comparisons when this is possible. Also, it describes the website's improvements in the context. A detailed RAMP analysis is also included with screenshots.
- **Section 3** includes tables and screenshots of the PHYSICS publications. Also, this section includes the press releases of the project which appear both on PHYSICSH2020 website and/or on the partner's website and/or external websites. The last issue in this chapter is the visual material that was created during the last year of the project.
- **Section 4** includes the hackathons of the project, and the community engagement events that occurred during the last year of the project.
- **Section 5** describes the newsletters and includes print screens of all the newsletters that have been sent in the third year of the project, picking up where the previous deliverable left off.
- **Section 6** includes all the Social Media actions, the present followers on social media, analytics of each medium for year three, and screenshots of posts and comparisons when possible.
- **Section 7** provides information about the dissemination and communication strategy, the objectives and the KPIs that the project should achieve and the results of them.
- **Section 8** includes the Standardization & Open-Source Activities.

2. WEBSITE

2.1 Website Analytics

Google Analytics is a tool that can measure valuable data on websites. Google Analytics was set up on the PHYSICS H2020 website from the early beginning of the project. The analytics information extracted from the website and social media platforms reflects data collected between 1st January and 21st December 2023 and from the whole duration of the project.
Figure 1 depicts the comparison of the statistical data during the three years of the project. This includes information on the project's third year recorded 705 users on the website with an average engagement time of 1 minute 13 seconds and 500 page views.

Figure 1 - Statistical data during the three years of the project.

Based on the data obtained from Google Analytics, the following Figure 2 illustrates the overall project metrics for the website physics-faas.eu. The website recorded a total of 2.3K users, with an average engagement time of approximately 1 minute and 25 seconds per user. Moreover, the website received a total of 12K page views.

The average engagement time for each user is a crucial metric that provides insights into the level of interest and involvement of visitors on the website. It indicates how long users are actively engaging with the

content and exploring various pages. A longer average engagement time suggests that visitors are finding the website valuable and absorbing the provided information.

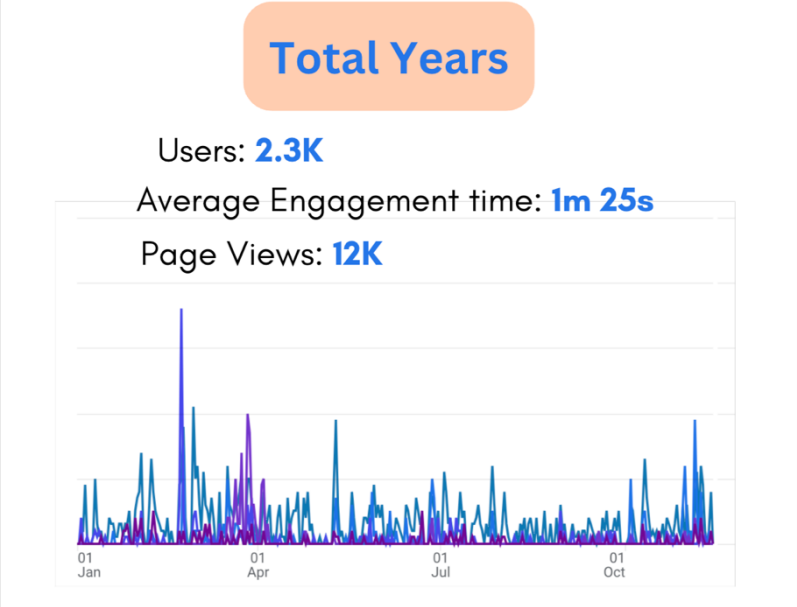


Figure 2 - Overall project's metrics.

Demographics

Figure 3 illustrates the countries of origin for each visit over the project's three-year duration. Greece records the highest number of active users, with 544. The United States follows, with 198 active users. Spain ranks third with 190 active users, Italy with 187, and Germany with 143 active users.

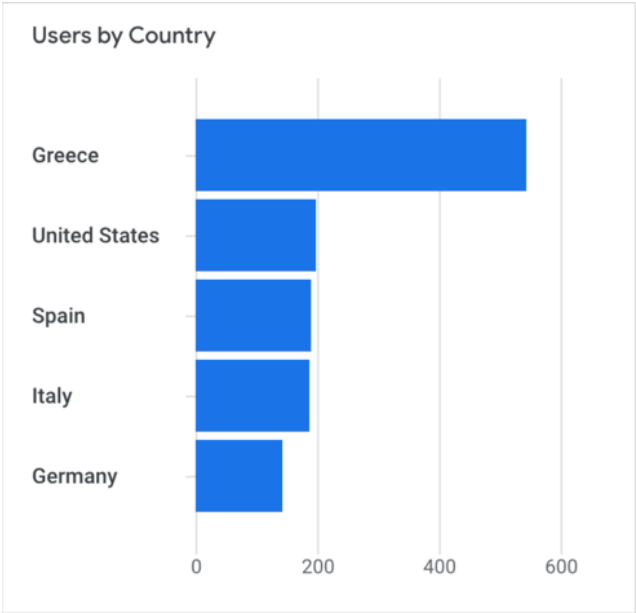


Figure 3 - Countries of origin for each visit over the project's three-year duration.

2.2 Website Improvements

Significant improvements have been implemented on the website over the past three years, focusing on enhancing user-friendliness and the overall browsing experience, as highlighted in the previous deliverable.

Notably, including pictures and minimizing text has contributed to this objective. Below, we include the website changes recorded in the third year of the project.

2.2.1 Calendar

A calendar that includes upcoming and previous events has been created on the website, enabling users to access it in a concise manner conveniently (see Figure 4).

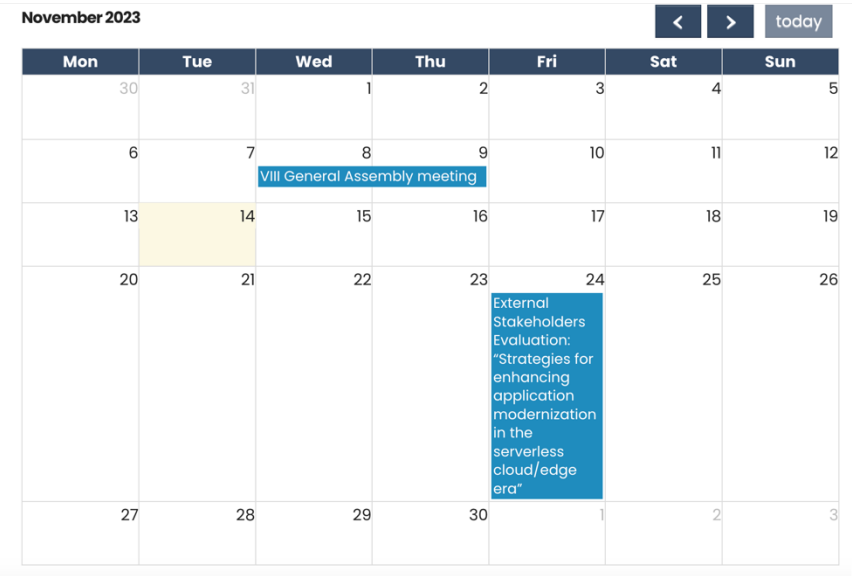


Figure 4 - Event calendar on the homepage of the site.

2.2.2 Hackathons

As the project developed, there were specific parts that should be included on the website. For that reason, in the "Events" section, a new tab named "Hackathon" was added. This addition is two-fold, as it provides the user with all the necessary information about the PHYSICS' hackathons in this specific place and increases their awareness, as they are an essential part of the project's dissemination (see Figure 5)

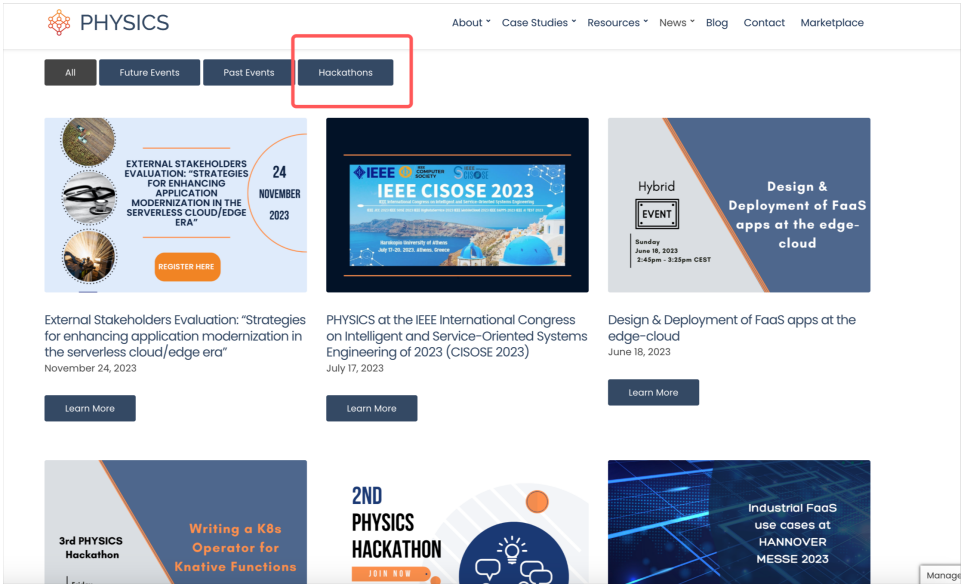


Figure 5 - Hackathon section added on the Events category.

2.2.3 Calendar View

Meanwhile, in the same category as the Figure 6 depicted, an orange button entitled “Calendar View” has been added that drives users to a new landing page with the same calendar provided on the homepage. All the upcoming and past events are presented (see Figure 7).

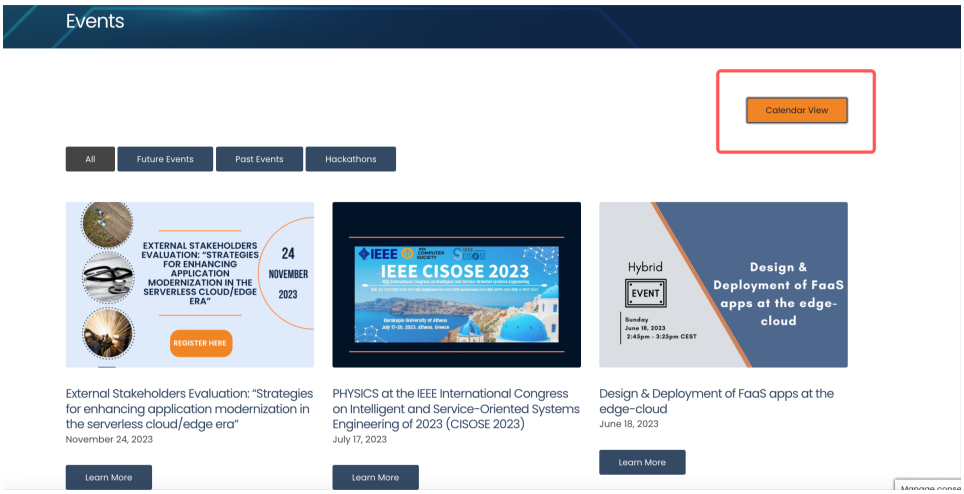


Figure 6 - New button entitled “Calendar View.”

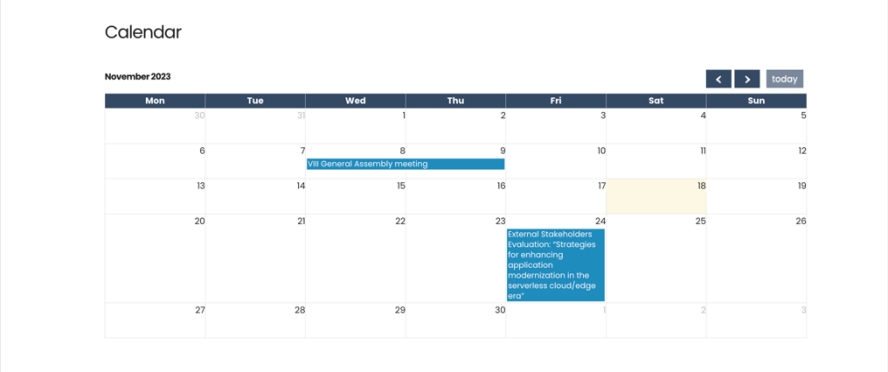


Figure 7 - Calendar’s landing page.

2.2.4 Videos

Furthermore, there were improvements to the PHYSICS website regarding the “Videos” subcategory (see Figure 8), which is under the “Resources” category. In this subcategory, all the videos of the project are included. For a better user experience, there was a segmentation of five different categories: “All,” “General,” “Hackathon,” “Training,” and “Webinars.” each category includes relevant videos according to the category that belongs.

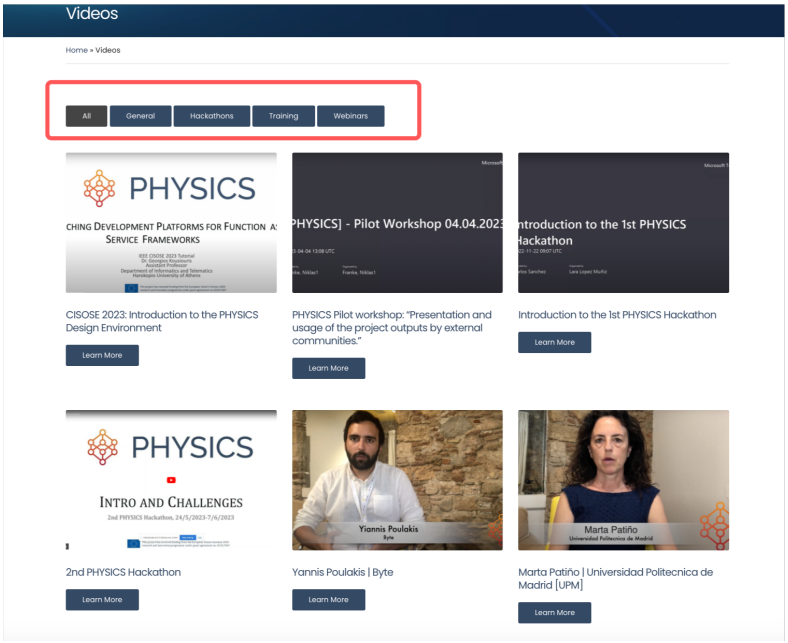


Figure 8 - PHYSICS website - Video category.

2.3 Marketplace

For the project's needs, a Marketplace was created, this is a new website linked to the project's main website (see Figure 9) but includes specific categories that will be analyzed below. The Marketplace of PHYSICS website contains Reusable Artefacts of the H2020 PHYSICS project.

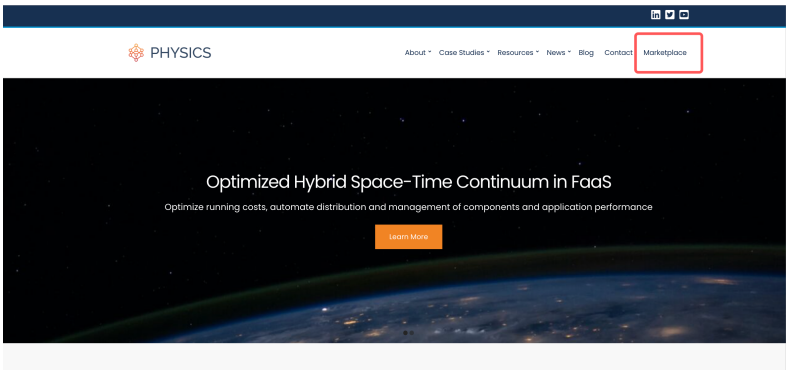


Figure 9 - The PHYSICS' Marketplace is linked to the official website.

Notably, as Figure 10 depicted, the menu of the Marketplace's website consists of eight main categories:

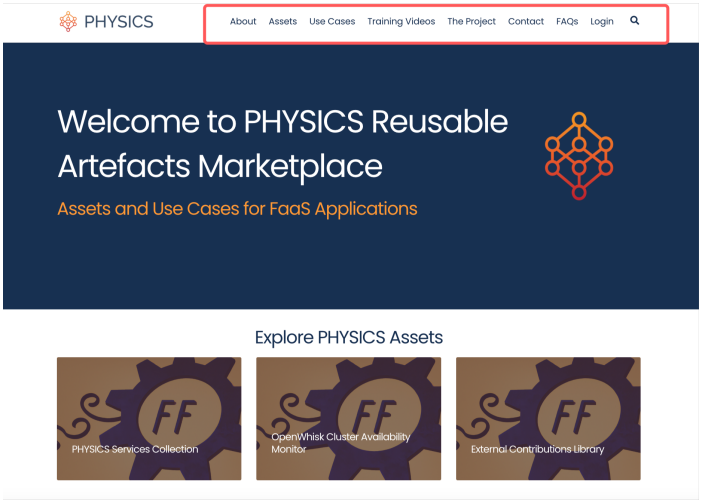


Figure 10 - The homepage of Marketplace.

- About: provides information about the PHYSICS H2020 project, the PHYSICS Marketplace (Reusable Artefacts Marketplace Platform (RAMP), and the main goal of the RAMP (see Figure 11).
- Assets: this category includes all the assets categorized according to their use ("All," "Dataset," "External," "Flow," "Function," "NodeRed Flow," "Pattern," "Semantics," and "Services.") Each asset is clickable and has its own landing page that provides information about the asset's characteristics, such as owner, release date, license, field of use, and a detailed explanation of each specific asset. Notably, there are three significant buttons: the "Add New Asset" button, the "Request Asset" button, and the "View Tutorial" button that leads to a well-explained video (see Figure 12).
- Use cases: in the Use case's category, there are four main categories ('All," "eHealth," Smart Agriculture," and "Smart Manufacturing." The usability of the use case is underlined in each specific category, as well as its benefits. Details of the owner are also included (see Figure 13)
- Training Videos: this landing page (see Figure 14) includes all the necessary training videos, which are categorized into three categories: "All," "Demo," and "Webinar."
- The Project: pushing the category "The Project" on the Menu drives the user to the main PHYSICS website, as it is essential to point out the link between the project and the Marketplace.
- Contact: selecting the "Contact" category appeared a form that the user could complete to contact the PHYSICS team (see Figure 15).
- FAQs: this category includes the most frequently asked questions to provide users with direct answers when it is needed (see Figure 16).
- Login: To access the Marketplace the user should log in as Figure 17 presents.

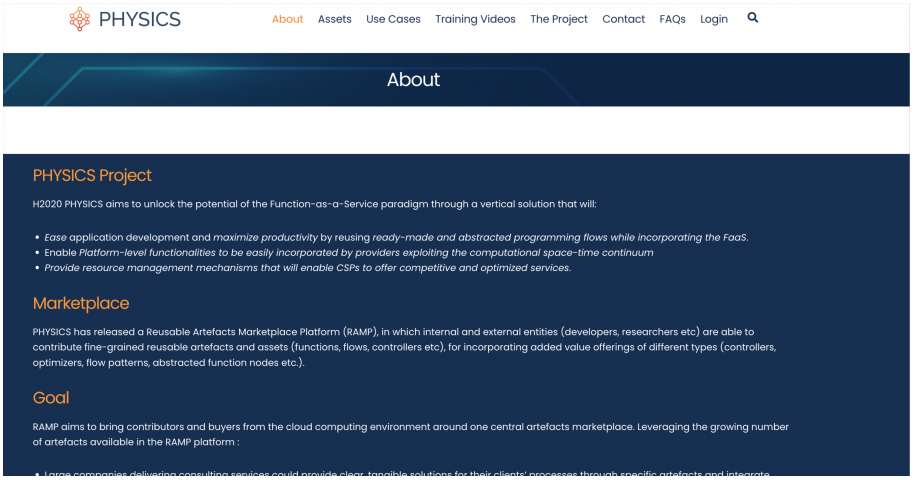


Figure 11 - About landing page | PHYSICS Marketplace.

Figure 12 - Assets landing page | PHYSICS Marketplace.

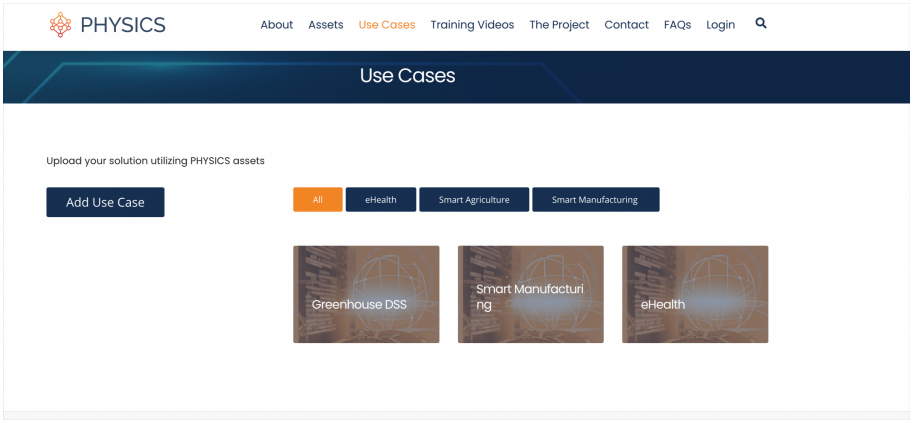


Figure 13 - Use cases landing page | PHYSICS Marketplace.

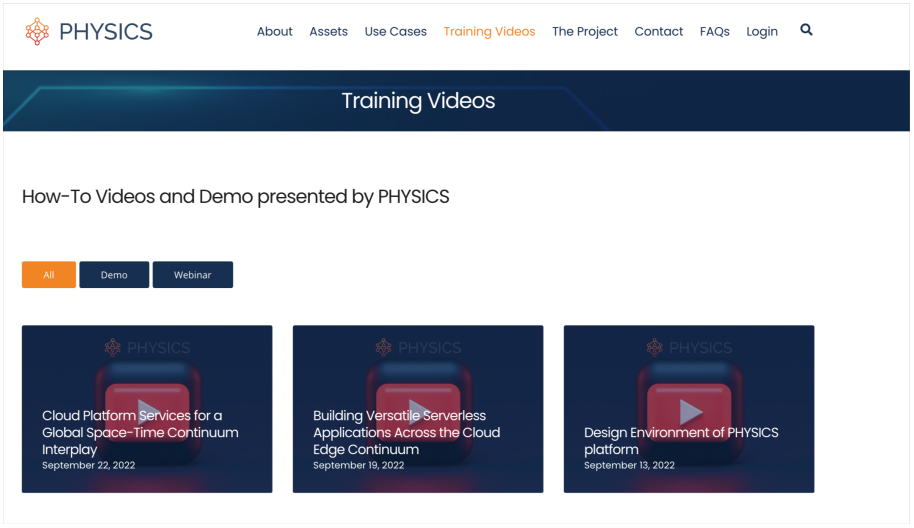


Figure 14 - Training Videos landing page | PHYSICS Marketplace.

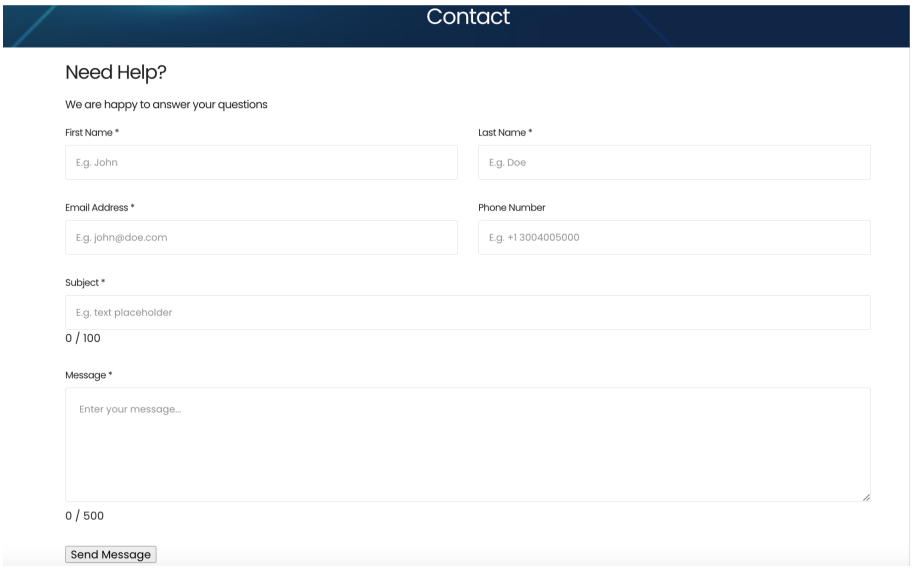


Figure 15 - Contact landing page | PHYSICS Marketplace.

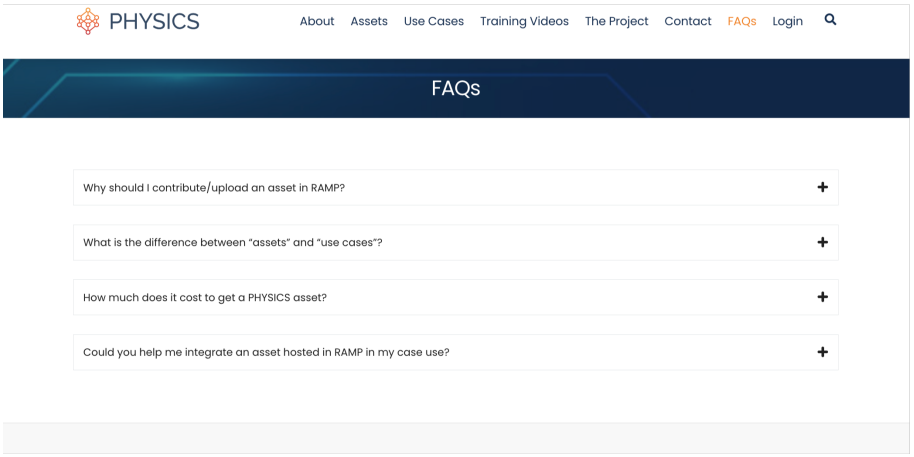


Figure 16 - FAQs landing page | PHYSICS Marketplace.

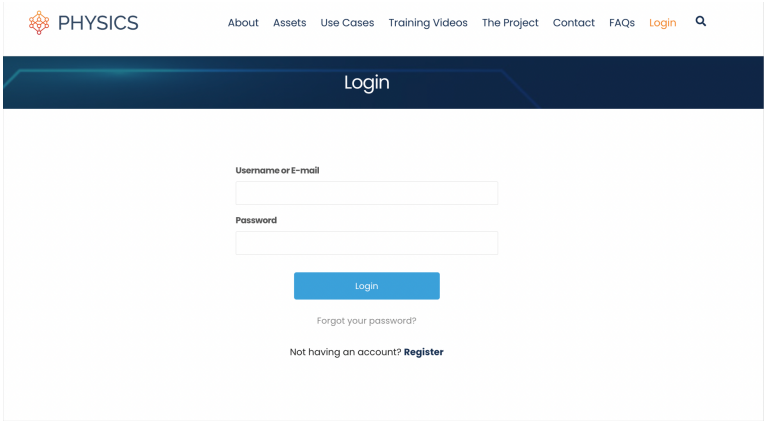


Figure 17 - Login landing page | PHYSICS Marketplace.

3. Dissemination Material Publications and press releases

3.1 Publications

The publications of PHYSICS' partners regarding the project are constantly updated during the 3 years on the project's website. This aims to disseminate the publication internally and externally as every user could have access to it. (see **Error! Reference source not found.**)

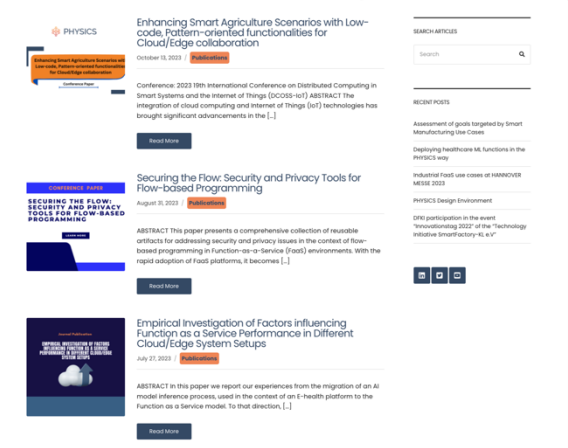


Figure 18 - Sample of publications on website

Table 1 below presents publications that PHYSICS H2020 partners have been published across the project's lifecycle.

Table 1 - PHYSICS H2020 Publications of PHYSICS project.

Research Publications in Y1, 2021 (M1-M12)
1 Kousiouris, G. and Kyriazis, D., 2021. Functionalities, Challenges and Enablers for a Generalized FaaS based Architecture as the Realizer of Cloud/Edge Continuum Interplay. In CLOSER (pp. 199-206) Green OA: https://zenodo.org/records/7034728
2 Kousiouris, G., 2021. A self-adaptive batch request aggregation pattern for improving resource management, response time and costs in microservice and serverless environments. In 40th IEEE International Performance Computing and Communications Conference. Green OA: https://zenodo.org/records/7034799
3 Volkan Gezer, Achim Wagner.,2021 Real-Time Edge Framework (RTEF): Decentralized Decision Making for Offloading 7th International Conference on Engineering and Emerging Technologies (ICEET 2021). Green OA: https://zenodo.org/records/10391344
Research Publications in Y2, 2022 (M13-M24)
4 Franke, N., Mohr, F. and Hennecke, A., (2022). Entwicklung und Auswahl geeigneter Use Cases und KPIs zur erfolgreichen Einführung neuer Hochtechnologie am Beispiel von "Function-as-a-Service", Mensch und Computer 2022-Workshopband . Gold OA: https://zenodo.org/records/10391381

5 Kousiouris, G., Giannakos, C., Tserpes, K. and Stamati, T., (2022). Measuring Baseline Overheads in Different Orchestration Mechanisms for Large FaaS Workflows. In Companion of the 2022 ACM/SPEC International Conference on Performance Engineering (pp. 61-68). Green OA: https://zenodo.org/records/10391407
6 Poulakis, Y., Fatouros, G., Kousiouris, G. and Kyriazis, D., 2022, September. Hocc: an ontology for holistic description of cluster settings. In International Conference on the Economics of Grids, Clouds, Systems, and Services (pp. 41-49). Cham: Springer Nature Switzerland. Green OA: https://zenodo.org/records/10401131
7 Kousiouris, G., Ambroziak, S., Costantino, D., Tsarsitalidis, S., Boutas, E., Mamelli, A. and Stamati, T. (2022). Combining Node-RED and Openwhisk for Pattern-based Development and Execution of Complex FaaS Workflows. arXiv preprint arXiv:2202.09683. Gold OA: https://zenodo.org/records/7034825
8 Volkan Gezer, et al. (2022): Industrial Edge Cloud für die Smart Factory. In: atp magazin Bd. 63 Nr. 4 (2022): atp magazin 4/2022 – Hauptbeitrag. Green OA: https://zenodo.org/records/10391489
9 Jimenez-Peris, R., Burgos-Sancho, D., Ballesteros, F., Patiño-Martinez, M. and Valduriez, P. (2022). Elastic scalable transaction processing in LeanXcale. Information Systems, 108, p.102043. Gold OA: https://zenodo.org/records/10391508
10 Fatouros,G., Poulakis,Y., Polyviou, A. Tsarsitalidis,S., Makridis,G., Soldatos,J., Kousiouris, G, Filippakis,M., Kyriazis, D. (2022). Knowledge Graphs and interoperability techniques for hybrid-cloud deployment of FaaS applications. In Proceedings of CloudCom 2022. Green OA: https://zenodo.org/records/10391541
Research Publications in Y3, 2023 (M24-M36)
11 Gkoulis, D., Bardaki, C., Kousiouris, G. and Nikolaidou, M., 2023. Transforming IoT Events to Meaningful Business Events on the Edge: Implementation for Smart Farming Application. Future Internet, 15(4), p.135. Gold OA: https://zenodo.org/records/10401520
12 Kousiouris, G., Ambroziak, S., Zarzycki, B., Costantino, D., Tsarsitalidis, S., Katevas, V., Mamelli, A. and Stamati, T., 2023, April. A Pattern-based Function and Workflow Visual Environment for FaaS Development across the Continuum. In Companion of the 2023 ACM/SPEC International Conference on Performance Engineering (pp. 165-172). Gold OA: https://zenodo.org/records/10401548
13 Kousiouris, G. and Pnevmatikakis, A., 2023, April. Performance experiences from running an e-health inference process as Faas across diverse clusters. In Companion of the 2023 ACM/SPEC International Conference on Performance Engineering (pp. 289-295). Gold OA: https://zenodo.org/records/10401597

14 Lipitakis, A.D., Kousiouris, G., Nikolaidou, M., Bardaki, C. and Anagnostopoulos, D., 2023. Empirical investigation of factors influencing function as a service performance in different cloud/edge system setups. Simulation Modelling Practice and Theory, 128, p.102808. Green OA: https://zenodo.org/records/10401751
15 Ioannidis, T., Bolgouras, V., Xenakis, C. and Politis, I., 2023, August. Securing the Flow: Security and Privacy Tools for Flow-based Programming. In Proceedings of the 18th International Conference on Availability, Reliability and Security (pp. 1-6). Green OA: https://zenodo.org/records/10401770
16 Fatouros, G., Kousiouris, G., Lohier, T., Makridis, G., Polyviou, A., Soldatos, J. and Kyriazis, D., 2023, June. Enhancing Smart Agriculture Scenarios with Low-code, Pattern-oriented functionalities for Cloud/Edge collaboration. In 2023 19th International Conference on Distributed Computing in Smart Systems and the Internet of Things (DCOSS-IoT) (pp. 285-292). IEEE. Green OA: https://zenodo.org/records/10401446
17 Fatouros G., Kousiouris G., Makridis G., Soldatos J., Filippakis M., Kyriazis D., 2023, December. Enhanced Routing for Serverless Functions: A Performance-based Approach with Runtime Adaptation. In 2023 The 14th IEEE International Conference On Cloud Computing Technology And Science. Green OA: https://zenodo.org/records/10303901

The minimum of 15 publications is the KPI for the 36-month PHYSICS project.
As presented in the above Table 1, **17 publications** have been published by PHYSICS partners during the years. All these publications have followed an open-access publication policy, whereas in cases where this was not possible green open access approach was followed.

3.2 Press Releases

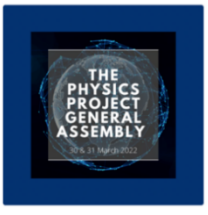
The dissemination of press releases serves as a crucial KPI for the PHYSICS H2020 project, as it plays a vital role in enhancing the project's visibility among stakeholders and keeping them informed about the latest news and achievements. To achieve this objective, PHYSICS H2020 has uploaded press releases on the project website and social media platforms. The list provided serves as an indication of the press releases that have been prepared and shared during the third year of the project (see Table 2).

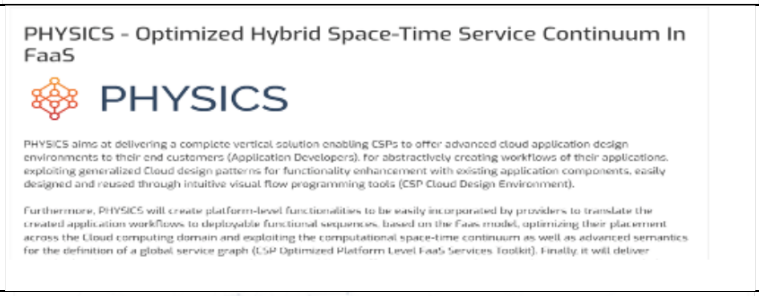
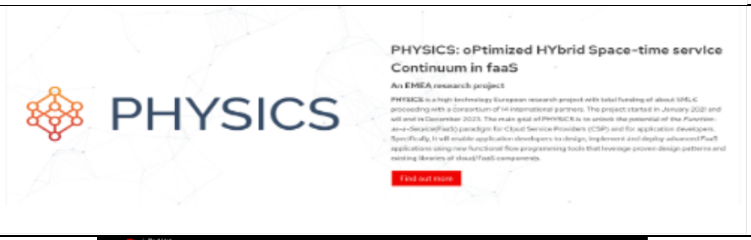
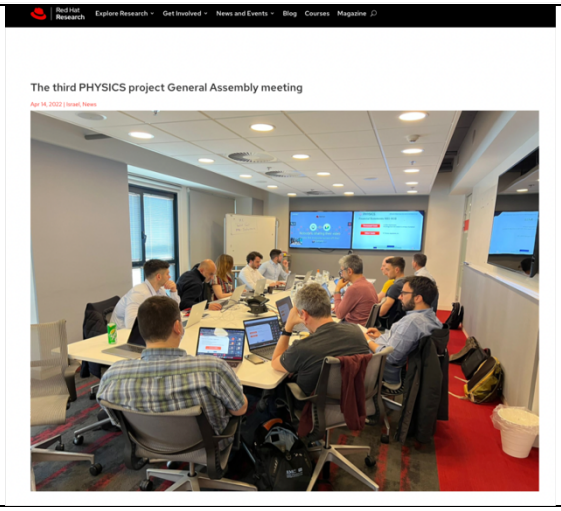
In addition, PHYSICS H2020 dissemination team distributed some of press releases to the project partners, enabling them to further share the news and updates with their respective audiences through their established communication channels. Furthermore, the partners have created their own press releases highlighting the achievements of the project, and they have disseminated these releases through their channels or shared them on relevant websites.

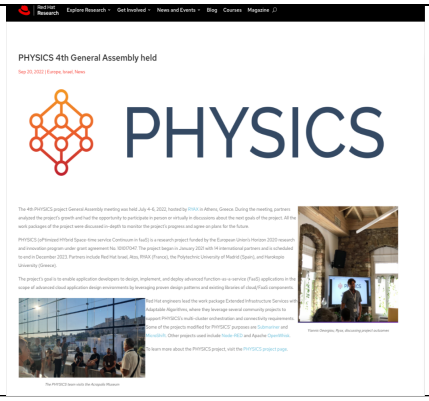
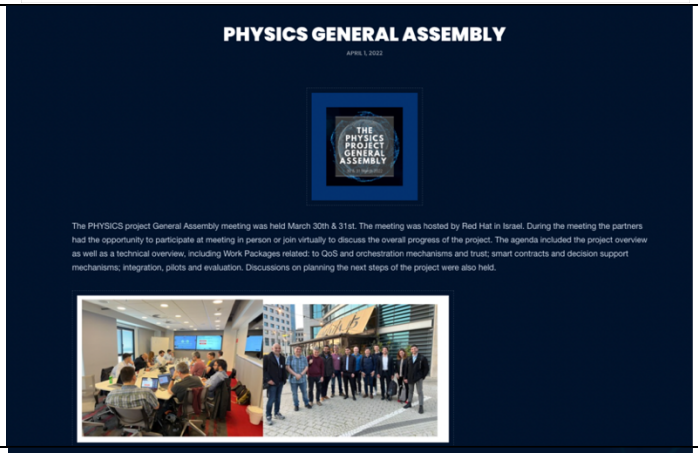
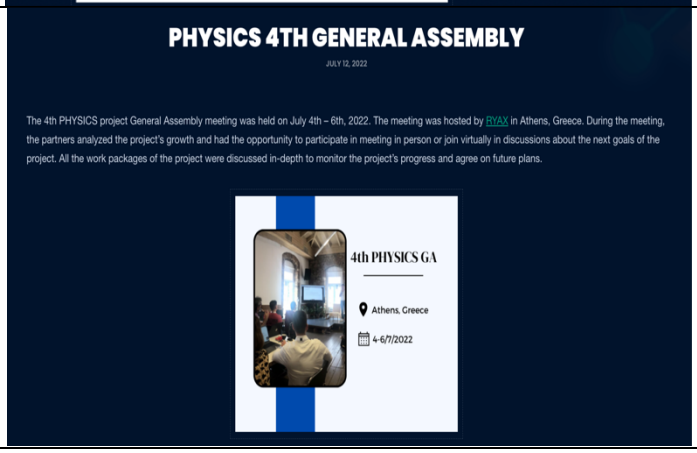
By leveraging the power of press releases and engaging project partners PHYSICS H2020 successfully increased the project's reach and awareness among key stakeholders. This proactive approach toward sharing project milestones and outcomes has been well received, ensuring that the project's progress is communicated effectively and reaches a wide range of audiences.

Table 2 - Press Releases during 3 years of the project.

Placement	Quotation

PHYSICS website	 Press Release: PHYSICS 8th General Assembly November 13, 2023 / News, Press Release The PHYSICS project, held its 8th General Assembly meeting on November 8th – 9th, 2023, in Florence, Italy. Hosted by GFT, the meeting provided an opportunity for partners to present updates on task progress and […] Read More
PHYSICS website	 Press Release: PHYSICS 7th General Assembly July 7, 2023 / News, Press Release The PHYSICS project's 7th General Assembly meeting was held on July 4th – 5th, 2023, in Pafos, Cyprus. The meeting was hosted by Innov-Acts LTD. During the GA the consortium partners presented their updates on […] Read More
PHYSICS website	 Press Release: PHYSICS 6th General Assembly March 8, 2023 / News, Press Release The 6th General Assembly meeting of the PHYSICS project took place on March 6th – 7th, 2023, in Munich, Germany, and was hosted by Fujitsu TDS GmbH.The event provided a platform for the consortium partners […] Read More
PHYSICS website	 Press Release: PHYSICS 5th General Assembly November 18, 2022 / News, Press Release The 5th PHYSICS project General Assembly meeting was held on November 15th – 16th, 2022 in Madrid, Spain and was hosted by ATOS.Partners had the opportunity to update the consortium on the progress of different tasks and deliverables, […] Read More
PHYSICS website	 Press Release: PHYSICS 4th General Assembly July 8, 2022 / News, Press Release The 4th PHYSICS project General Assembly meeting was held on July 4th – 6th, 2022. The meeting was hosted by RYAX in Athens, Greece. During the meeting, the partners analyzed the project's growth and had […] Read More
PHYSICS website	 Press Release: PHYSICS General Assembly April 1, 2022 / News, Press Release The PHYSICS project General Assembly meeting was held on March 30th & 31st. The meeting was hosted by Red Hat in Israel. During the meeting the partners had the opportunity to participate at meeting in […] Read More

PHYSICS website & ellak.gr	 Press Release: Google Summer of Code 2022 – PHYSICS representatives will be mentoring on FaaS March 18, 2022 / Events, News, Press Release Application period is about to start! Google Summer of Code (GSoC) is a program designed to bring new, excited contributors into open source communities, with the hope that they will continue to contribute to open […] Read More
PHYSICS website & Horizon Cloud website	 Press Release: PHYSICS project at Horizon Cloud Technical Community Event March 4, 2022 / News, Press Release On March 3rd, 2022 the PHYSICS project had the opportunity to present the recent project outcoming in the frame to the technical community at an event organized by Horizon Cloud. During the event, the motivation […] Read More
Charity project	
Red-Hat Partner	
Red-Hat Partner	

Red-Hat Partner	
Innovation Sprint	
Innov-Acts	
Innov-Acts	

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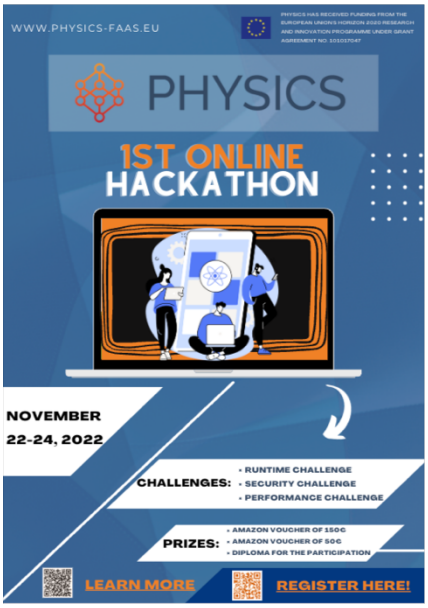
3.3 Visual Materials

According to the dissemination and communication KPIs, one of the key components of dissemination planning and execution is to create and establish some common material to identify and show an image for the project. Some materials that have been made are the general roll-up banner and leaflet of the project. However, there was a need to create one more roll-up banner for "PHYSICS participation in Concertation and Consultation on Computing Continuum: From Cloud to Edge to IoT" (see Figure 19) and leaflets for the first two hackathons (see Figure 20).

Figure 19 - Roll up banner.



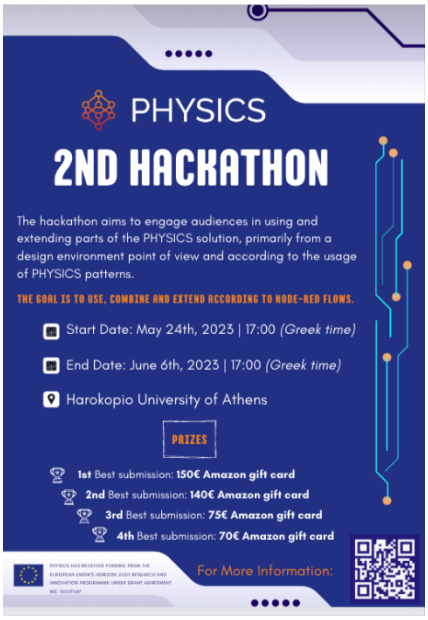


Figure 20 - Hackathons' Flyers.

Additionally, new PHYSICS H2020 banners have been designed for the YouTube channel (https://www.youtube.com/channel/UC1otUEHDmUGNmsdcBw6QFsA) as an additional social media channel of the project, as the **Error! Reference source not found.** displays.

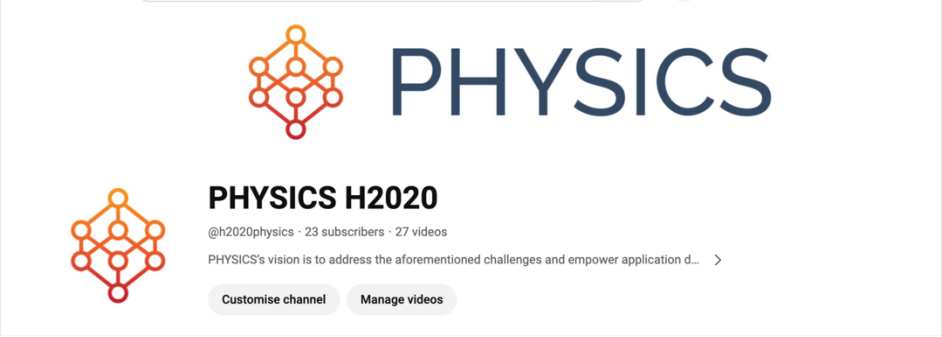


Figure 21 - YouTube Banner

In addition to the materials presented above and more detailed in the first deliverable, it has been created a general video of the project (three minutes duration), which has both a marketing and dissemination scope, thus aiming at demonstrating PHYSICS H2020 vision, scope, measurable targets, use cases and to create an additional value for the consortium and for third parties. The video is uploaded in the official YouTube channel of the project.

The scenario of this video is considered with the following steps:

- Presenting the PHYSICS' vision
- Explaining PHYSICS' goals
- Explaining PHYSICS' measurable targets
- Demonstrating PHYSICS' use case scenarios
- Presenting PHYSICS' architecture

- Summarizing PHYSICS' offer
- Presenting PHYSICS' consortium
- Ending with a call to action for visiting the website and following the official accounts of the project on social media

It should be mentioned that the visual presentation of the project contains a few texts with graphical visuals, and during the video, there was a voice-over that explained in more detail each visual presented at this time (see Figure 22).

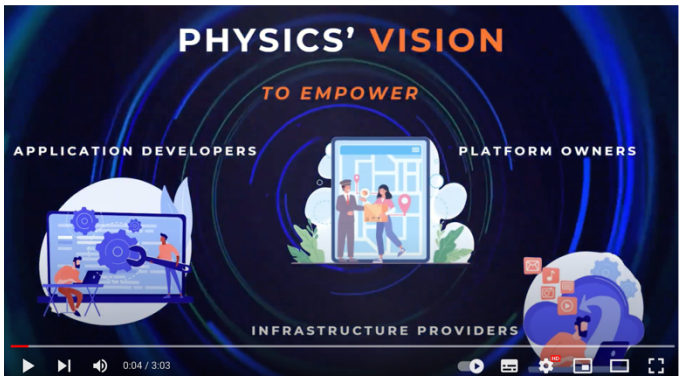


Figure 22 - Screenshots from PHYSICS video.

4. EVENTS

During its final phase, the mature stage, the PHYSICS H2020 project actively participated in and organized several events. These events were conducted either independently or in collaboration with other project initiatives. The significance of effective dissemination and communication cannot be understated, as it serves multiple purposes. Firstly, it expands awareness among stakeholders, ensuring that the project's objectives and outcomes reach a wider audience. Secondly, these events foster an educational environment, often incorporating activities such as hackathons and workshops, which contribute to knowledge sharing and skill development. Lastly, these events facilitate valuable dialogues and exchanges, which not only aid in the project's development but also enhance its market growth.

The project purposively utilizes various communication channels, such as the official website, social media platforms including LinkedIn, Twitter, and YouTube, as well as newsletters, to inform the community about these events. Whenever possible, recordings of the events are made available on the project's YouTube channel. Additionally, relevant follow-up press releases and posts are created to ensure comprehensive dissemination and keep the community well-informed (Figure 23).

Figure 23 - Screenshots from PHYSICS video.

4.1 Hackathons

The **1st hackathon** aimed to develop solutions for FaaS runtime orchestration, load generators and performance monitors, as well as assess platform security. It took place **online** over a three-day event from **November 22nd to 24th, 2022**. The hackathon began with a workshop, where participants were introduced to the challenges and provided with guidelines for the expected outcomes. The workshop recording was subsequently uploaded to the project's YouTube channel. Throughout the hackathon, participants had access to a dedicated Slack platform for mentor support. At the conclusion of the event, participants submitted their code and a concise presentation showcasing their innovative ideas.

Additionally, the introduction of the hackathon was recorded and made available on the **PHYSICS YouTube channel and website**.

The **2nd PHYSICS hackathon** was held on **May 24th, 2023, at Harokopio University of Athens**. The event featured **a two-hour presentation on the challenges and two hands-on tutorials.** The presentation was conducted both **physically and via live streaming**, with the recording made available for future reference. The video was uploaded to the official **PHYSICS YouTube channel** and mentioned on the website.

Taking place on **June 16th, 2023, the 3rd PHYSICS hackathon** centered around writing **k8s operators for knative functions**. With the participation of twenty individuals, the event was held in the **Czech Republic**. During the hackathon, participants utilized the operatorsdk framework to create a K8s Operator that offered similar functionality to the Knative CLI, simplifying the creation and deployment of functions with Knative. This allowed participants to gain practical experience and a deeper understanding of K8s Operators in real-world scenarios.

These hackathons have made **significant contributions to the PHYSICS project** as they enhance the **awareness of the PHYSICS** project in an **amount of 55 participants**. During these hackathons, participants successfully engaged active external communities and received validation for the Gaming Server approach and/or were involved in the implementation of a K8s Operator, using the operatorsdk framework, to provide the functionality of the Knative CLI. The hackathon also resulted in a significant expansion of external contributions, totaling 26 outcomes/flows that can be executed with Openwhisk functions. The provided artefacts extended the functionality of PHYSICS functions, including enrichment of the clustering function with normalization features and additional algorithms for classification and regression. Based on audience feedback, various improvements were made, such as extending tutorials to cover more PHYSICS flows, enabling the Gaming Server to store scores and act as a continuous gamification server, and creating a specific JSON logic node for easier testing. More information on the structure of each hackathon is included below.

4.1.1 1st Hackathon

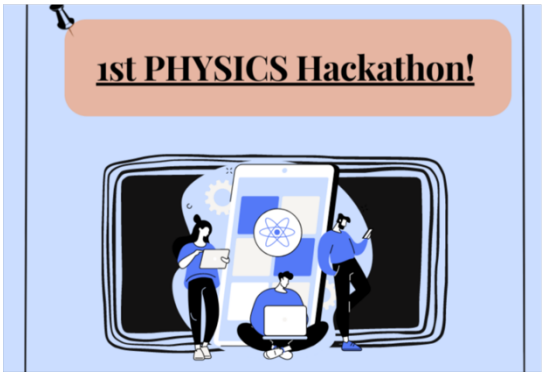


Figure 24- Visual of the 1st PHYSICS Hackathon.

The aim of the 1st hackathon was to create solutions for FaaS runtime orchestration, load generators and performance monitors or assess platform security. The hackathon took place online at the 3-day event (22-24 November 2022) organized by ATOS. The hackathon commenced with a workshop wherein the three challenges were introduced, and participants were briefed on the expected deliverables for each challenge. The workshop recording was subsequently made available on the project's YouTube channel. Throughout the hackathon, participants had access to a dedicated Slack platform through which they could seek guidance and support from mentors. At the conclusion of the event, participants submitted their code for the runtime and performance challenges via Drive, along with a concise presentation outlining their

innovative concepts. The introduction of the hackathon was uploaded as a recording video on PHYSICS' YouTube channel and has been mentioned on the website (see Figure 25).

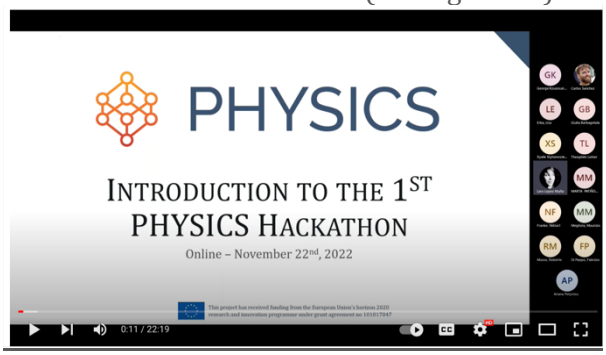


Figure 25 - Introduction of the 1st hackathon.

4.1.2 2nd PHYSICS Hackathon

Figure 26 - Visual of the 2nd PHYSICS Hackathon.

HUA, together with INQ, organized the **2nd PHYSICS Hackathon on May 2023 at HUA** premises. The purpose of the event was to attract further external contributions, enhance the usage of the PHYSICS artefacts, extend them from external audiences and evaluate their characteristics. DevPost was used to organize the participants of the Hackathon. Two hands-on tutorials were performed during the kickstart event. Initially, the Openwhisk Node-RED function skeleton template and process of generating a working Openwhisk image from a Node-RED flow was presented. Following, a demo of the deployment and usage of the Gaming Server was performed in parallel to the participants. This was deemed necessary in order to enable a quick start by the participants into the main entry points of the PHYSICS processes.

The presentation was performed in both a physical and streaming manner while it was recorded and made available for future reference of the participants. The video is uploaded on the official PHYSICS YouTube channel and it is mentioned on the website (see Figure 27).

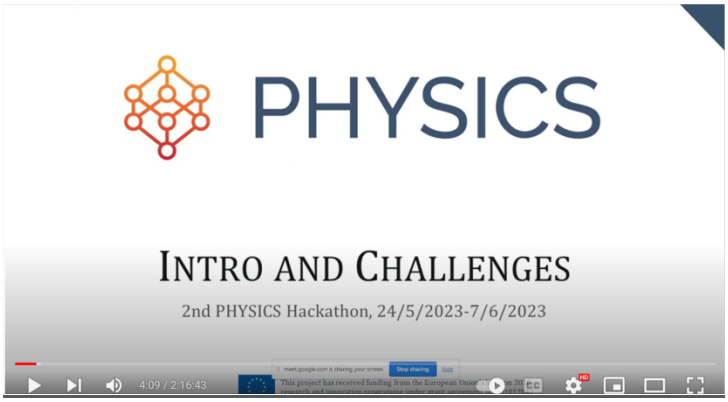


Figure 27 - Introduction of the 2nd hackathon.

4.1.3 3rd Hackathon: "Writing a K8s Operator for Knative Functions"

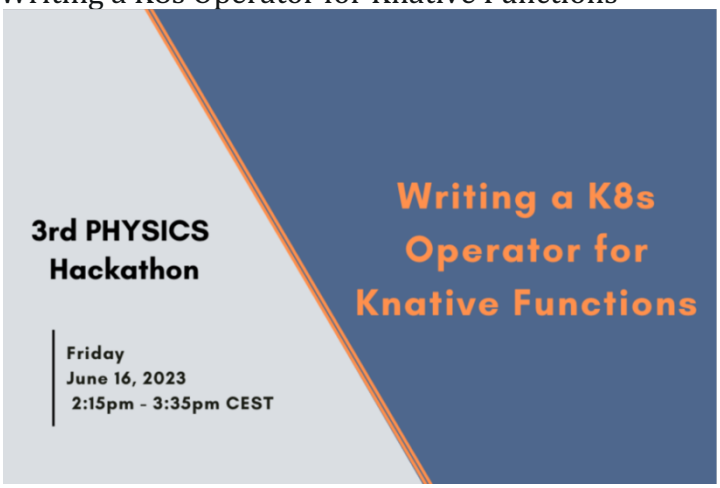


Figure 28 - Visual of the 3rd PHYSICS Hackathon.

The 3rd PHYSICS hackathon was held on the 16th of June, 2023 and was organised by RedHat. The hackathon was about writing k8s operators for knative functions. At the hackathon, the participants utilized the operatorsdk framework to create a K8s Operator that offers the same functionality as the Knative CLI. This allowed the participants to create Kubernetes (CR) objects easily, making it simpler to build and deploy functions with Knative. It also helped them gain a deeper understanding of how K8s Operators work in a real-world scenario.

4.2 Community Engagement Events

Following presenting the events that were held in the third and the last year of the project.
The events in which PHYSICS participated or organized the second year of the project were analyzed in detail in the previous deliverable.

4.2.1 External Stakeholders Evaluation: "Strategies for enhancing application modernization in the serverless cloud/edge era."

Figure 29 - Visual for the event "External Stakeholders Evaluation: "Strategies for enhancing application modernization in the serverless cloud/edge era."

The event took place on the 24th of November 2023, and aimed to showcase the three pilot applications of the PHYSICS project, during the event 18 attendees participated.

The external stakeholders' evaluation workshop aimed to present the project's outputs to external communities and demonstrate how they can be utilized. Participants have the opportunity to witness the implementation of the FaaS model in each pilot application and clarify open questions and give feedback afterward. The agenda of the event included an overview of the PHYSICS project and platform, the presentation of use cases of the project: eHealth, smart Manufacturing, and smart Agriculture, and at the end was a wrap-up of the workshop.

4.2.2 Pilot workshop: "Presentation and usage of the project outputs by external communities."

Figure 30 - Pilot workshop: "Presentation and usage of the project outputs by external communities."

The PHYSICS consortium cordially organized the pilot workshop with the topic "Presentation and usage of the project outputs by external communities," which is aimed at showcasing the three pilot applications of the PHYSICS project. The PHYSICS project has also identified three pilot partners from key industries: Healthcare, Agriculture, and Manufacturing.

These sectors have increasing needs for flexibility, scalability, efficiency, and better resource allocation, making them critical for FaaS deployment.
The pilot workshop aimed to present the project's outputs to external communities and demonstrate how they can be utilized. Attendees had the opportunity to witness the implementation of the FaaS model in each pilot application and to learn about the project's methodology, outcomes, and future plans.
The workshop held on April 4, 2023, at 3:00 PM – 4:30 PM CET covered the topics of PHYSICS introduction, a demonstration of how to use different domains and a conclusion with a Q&A session.

The engaging Q&A session that was conducted, allowed the 18th participants (PHYSICS H2020 partners) to participate and contribute actively. The audience posed interesting and significant questions, which were thoughtfully addressed and answered by experts. This interactive session fostered a productive exchange of ideas and ensured that the concerns and inquiries of the participants were acknowledged and resolved.

The recorded video is uploaded to the YouTube channel, as the Figure 31 illustrates:

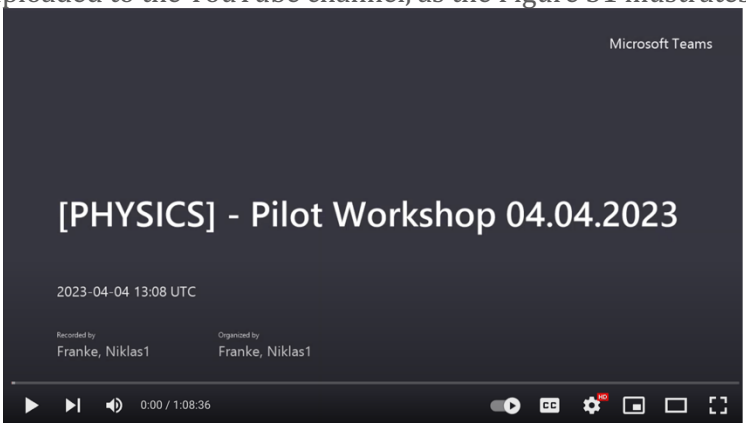


Figure 31 - Recorded video from the Pilot workshop: "Presentation and usage of the project outputs by external communities."

4.3 Participation and presentation of the project in external events

4.3.1 Industrial FaaS use cases at HANNOVER MESSE 2023

Figure 32 - Visual for the event entitled "Industrial FaaS use cases at HANNOVER MESSE 2023."

More than 4.000 exhibitors, over 1.900 trade show premieres, almost 70.000 on-site attendees from around the whole world, including famous politicians such as the chancellor of Germany or Indonesian president, caused that the spirit of excitement and optimism permeate the halls at HANNOVER MESSE. The DFKI team was present for the entire event, which ran from April 17 to April 21, 2023. The DFKI partner gave a 15-minute PHYSICS presentation on April 20, 2023, at 11.30 am. The presentation covered the

advantages of using the PHYSICS platform and followed a question-and-answer period. Fifty to one hundred people with expertise in engineering, manufacturing, and industry 4.0 attended this presentation.

One of the biggest topics of HANNOVER MESSE 2023 were among others Industry 4.0, Smart Manufacturing, Artificial Intelligence, Energy Management, and CO2 neutral production. Therefore, the German Research Centre for Artificial Intelligence (DFKI) was keen to present the PHYSICS H2020 Project, and smart manufacturing use cases: - Deployment of substitute service in the Cloud, - High Confidence Quality Control

Since the presentation was carried out at SmartFactory-KL booth which was visited by an estimated 4.000 visitors within 5 days of the fair, it was the great opportunity to introduce the project to a wide audience interested in innovation solutions for production and show that smart manufacturing sector can significantly benefit from the use of the Function as a Service (FaaS) paradigm. Moreover, the DFKI showed the advantage of using the PHYSICS platform, which can offer a manufacturer-independent solution for the FaaS and thus simplify the development and scalability of the plant in the future. In addition to the live presentation, the PHYSICS logo was displayed throughout the fair at the SmartFactory-KL stand and passively promoted the project. Furthermore, it was demonstrated that thanks to PHYSICS platform, which can offer redundancy of services provided by physical modules, it is possible to decrease the unplanned downtimes, and increase the reliability and stability of the production line. Overall, the concept of the PHYSICS platform using FaaS paradigm was received with interest by both industrial and research visitors.

4.3.2 Design & Deployment of FaaS apps at the edge-cloud

Figure 33 - Visual of the event "Design & Deployment of FaaS apps at the edge-cloud."

The hybrid event talk entitled" Design & Deployment of FaaS apps at the edge-cloud", held in Czech Republic in 18th of June 2023 and focused on the project's design and development environment that aims to ease application evolution to the new FaaS model. It used the Node-RED open-source tool as the primary function and workflow runtime. The goal of the environment is to enable a more user-friendly and abstract function and workflow creation process for complex FaaS applications.
To this end, it provides an extendable, pattern-enriched palette of ready-made, reusable functionalities such as workload parallelization, data collection at the edge, and function orchestration creation among others. The environment embeds seamless DevOps processes for generating the deployable artefacts of the FaaS platform (Openwhisk). Annotation mechanisms are also available for the developer to dictate diverse execution options towards the deployment stacks, including sizing and locality considerations, as well as abilities for dynamic FaaS applications to continuously leverage the edge-cloud continuum.

4.3.3 PHYSICS results presented at the IEEE International Congress on Intelligent and Service-Oriented Systems Engineering of 2023 (CISOSE 2023)

Figure 34 - Visual for the event "PHYSICS at the IEEE International Congress on Intelligent and Service-Oriented Systems Engineering of 2023 (CISOSE 2023)."

The event "IEEE CISOSE2023, IEEE International Congress on Intelligent and Service-Oriented Systems Engineering of 2023" took place on 17th of July, 2023 at, Harokopio University of Athens.

In this talk we introduced the H2020 PHYSICS FaaS Design Environment and presented various issues around function and workflow development, link to internal DevOps processes as well as aspects of workflow and function concurrency overheads that appear. The use of visual flow-based programming techniques was presented as a mean to enhance the process of FaaS application creation. Pattern-based development was discussed, along with a set of indicative pattern prototypes for the FaaS domain and beyond. Challenges that appear from the use of asynchronous APIs and an even more distributed function execution in combination with FaaS limitations were identified. Performance issues investigation was highlighted as well as means to annotate functions for easier cloud/edge tradeoffs and placement considerations, as well as embed other needs for semantics and annotations for a given function. Different function orchestration means as well as their benefits and drawbacks were analyzed. Finally, applications of the specific process in various scenarios such as smart agriculture and ehealth cases were presented and discussed.
Around 40-50 participants were spotted during the presentation session. At the end was an engaging Q&A in which contact info with other projects and participants was shared to forward more project-related documents.

4.3.4 PHYSICS presented the scientific paper entitled "Enhancing Smart Agriculture Scenarios with Low-code, Pattern-oriented Functionalities for Cloud/Edge Collaboration" on DCOSS-IoT 2023.

The 19th Annual International Conference on Distributed Computing in Smart Systems and the Internet of Things 2023 (DCOSS-IoT 2023) Conference took place in Pafos, Cyprus from June 19-21, 2023. DCOSS-IoT has always been technically co-sponsored by the IEEE Computer Society and the IEEE Technical Committee on Parallel Processing (TCPP).
A new publication from the PHYSICS H2020 project titled "Enhancing Smart Agriculture Scenarios with Low-code, Pattern-oriented Functionalities for Cloud/Edge Collaboration" was presented at the workshop. The scientific paper presenting a low-code approach to enhance smart agriculture scenarios with pattern-oriented functionality blocks for cloud/edge collaboration.
The presentation generated valuable discussions and contributed to the conference's discussions on the latest advancements in IoT applications and industry 5.0.

Figure 35 - Visual for the presentation of the publication "Enhancing Smart Agriculture Scenarios with Low-code, Pattern-oriented Functionalities for Cloud/Edge Collaboration."

4.4 Internal Events of Year 3

4.4.1 PHYSICS 6th General Assembly

Figure 36 - Visual for PHYSICS 6th General Assembly meeting.

The **6th General Assembly meeting** of the PHYSICS project took place on March 6th – 7th, 2023, in Munich, Germany, and was hosted by Fujitsu TDS GmbH.

The event provided a platform for the consortium partners to report on the status of various tasks and deliverables. The coordinator and work package (WP) leaders led discussions on any outstanding matters, fostering engagement and collaboration. The meeting was conducted using a hybrid format, blending in-person and virtual participation.

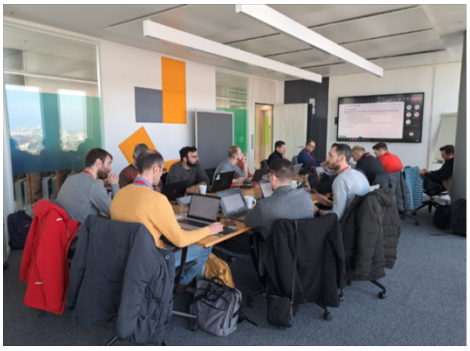


Figure 37 - Partners during the PHYSICS 6th General Assembly meeting.

4.4.2 PHYSICS 7th General Assembly

Figure 38 - Partners during the PHYSICS 7th General Assembly meeting.

The PHYSICS project's 7th General Assembly meeting was held on July 4th – 5th, 2023, in Pafos, Cyprus. The meeting was hosted by Innov-Acts LTD. During the GA, the consortium partners presented their updates on the progress of different tasks and deliverables and discussed current and upcoming project results. The coordinator and leaders of the work packages (WP) facilitated discussions on any remaining issues, promoting active participation and constructive feedback. To accommodate both in-person and remote attendees, the meeting was conducted using a hybrid format.

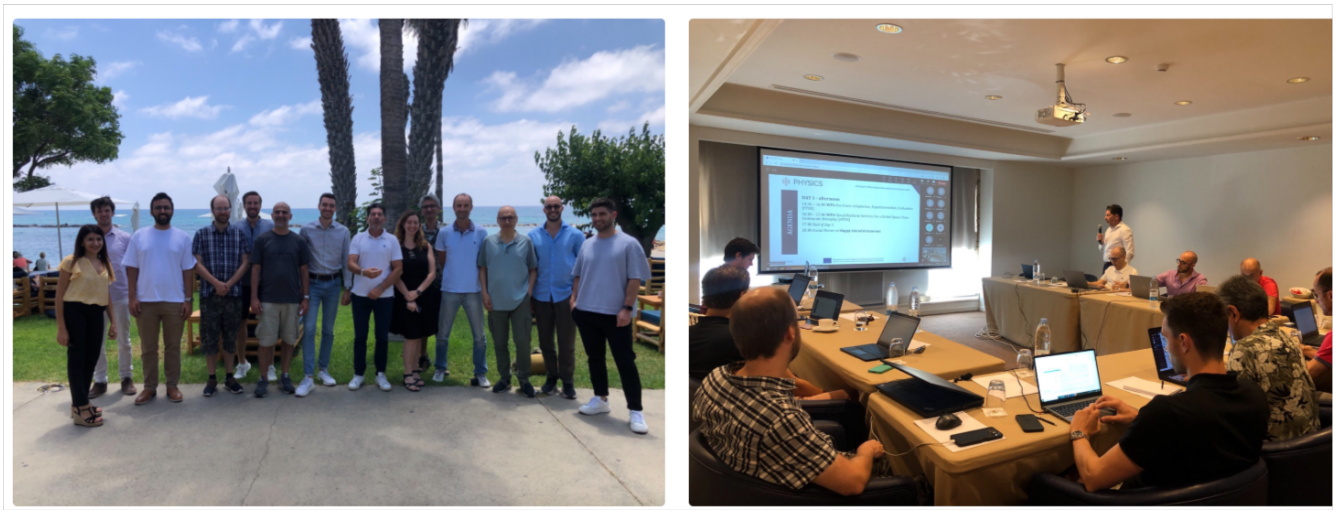


Figure 39 - PHYSICS partners during the 7th General Assembly meeting.

4.4.3 PHYSICS 8th General Assembly

Figure 40 - Visual for PHYSICS 8th General Assembly meeting.

The PHYSICS H2020 project, held its 8th General Assembly meeting on November 8th – 9th, 2023, in Florence, Italy. Hosted by GFT, the meeting provided an opportunity for partners to present updates on task progress and deliverables, as well as discuss upcoming project results. The coordinator and leaders of the work packages (WP) led discussions on any outstanding issues, fostering active participation and constructive feedback.
The meeting was conducted using a hybrid format, accommodating both in-person and remote attendees. Among the meeting's key objectives were the status of PHYSICS' 2nd Iteration Pilot Implementation, the finalization of the Final Review demo, and the definition of the Final Review agenda and logistics.

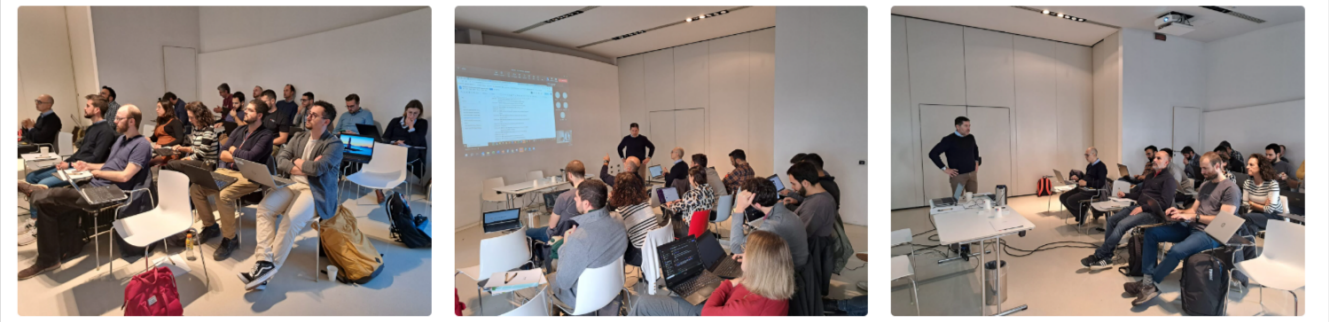


Figure 41 - PHYSICS partners during the 8th and last General Assembly meeting.

4.4.4 PHYSICS multipurpose workshop

On June 9th, 2023 The session began with an introduction and purpose overview by Giulia Barbagelata (GFT), followed by a presentation of the HandBook activities by Lara Lopez (ATOS). Luis Tomas Bolivar (RH) then provided an update on the latest activities related to open access. Next, Elina Papadopoulou (BYTE) led an innovation session. Following that, Giulia Barbagelata (GFT) conducted an exploitation seminar from 11.00-12.00. The session concluded with a question and answer session, along with discussions on conclusions and next steps towards the general assembly. It was important that at least one representative from each partner attended the session.

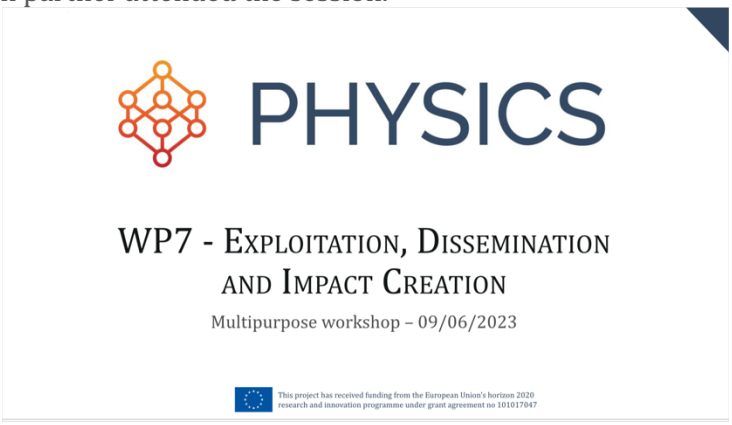


Figure 42 - Multipurpose workshop.

5. NEWSLETTERS

During the three-year period, the PHYSICS project has sent 26 Newsletters (see **Error! Reference source not found.**, Table 3) to a valuable mailing list. The mailing list of the PHYSICS project has almost 170 members who are relevant and interested in the project. The Figure below presents the KPIs of Newsletters per year. According to the KPI for newsletters, the goal was set to send at least 6 newsletters in the first year, 8 newsletters in the second year, and 10 newsletters in the last year. The goal has been achieved as the total Newsletters that the project has circulated was 26.

Table 3 - Newsletters' KPIs.

	KPIs	Achievements
In house Newsletters	YR1: min. 6; YR2: min. 8; YR3: min. 10	Total NL: 26

The average open rate for the Newsletters sent during the three years is 34.9%.

Figure 43-All the Newsletters

In the last two deliverables, there have been presented in detail the Newsletters that have been sent to the mailing list. Following a detailed analysis of the last year of the project.

5.1 20th Newsletter

Figure 44-20th Newsletter.

The 20th Newsletter was sent on 27th March 2023 and included an invitation of the PHYSICS consortium to the pilot workshop with the topic "Presentation and usage of the project outputs by external communities.

Table 4-Statistics for 20th Newsletter

Statistics	20th Newsletter: Pilot workshop! 👉 Register now! 👈
Successful Deliveries	170
Total Opens	97

Clicks per Unique Opens	10.3%

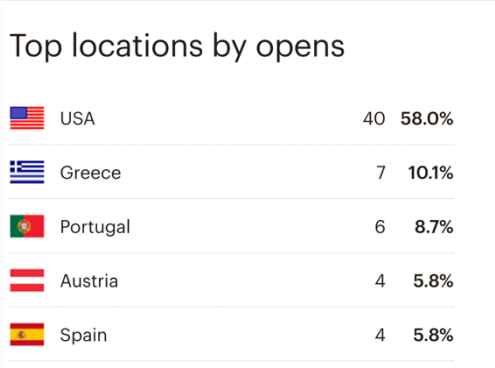


Figure 45-Top Locations | 20 Newsletter for 2023.

5.2 21st Newsletter

Figure 46-21st Newsletter.

In the 21st Newsletter, which was sent on the 18th of May 2023, the second PHYSICS Hackathon was presented with a visual which included the goal of the hackathon, as well as the prizes. It should be underlined that the use of emojis in the newsletter's subject enhance the user to open the Newsletter.

Table 5-Statistics of the 21st Newsletter

Statistics	21th Newsletter: 👉 2nd PHYSICS' Hackathon 👈
Successful Deliveries	165
Total Opens	94
Clicks per Unique Opens	10.2%

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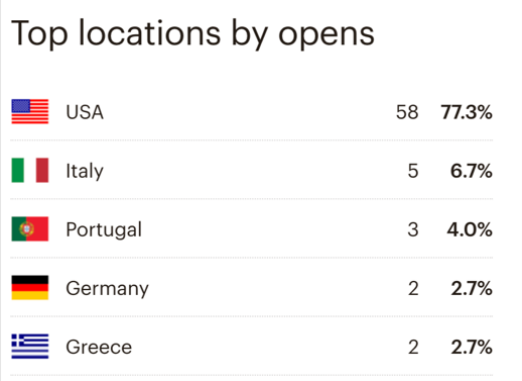

Figure 47-Top Locations | 21 Newsletter.

5.3 22nd - 23th Newsletter

Figure 48-22nd Newsletter.

The 22nd Newsletter was similar with the 23rd. The 23rd is the correction of the 22nd.
The 23rd Newsletter was sent on the 14th of May 2023 and it was presented two significal events of the PHYSICS project. The first one was the presentation of the 3rd PHYSICS Hackathon: "Writing a K8s Operator for Knative Functions." The second one was the announcement of the talk "Design & Deployment of FaaS apps at the edge-cloud" that took place during the DevConf.CZ.

Table 6-Statistics of the 22nd – 23rd Newsletter.

Statistics	22th - 23rd Newsletter: 👉3rd PHYSICS' Hackathon & Talk 👈
Successful Deliveries	165
Total Opens	84
Clicks per Unique Opens	7.4%

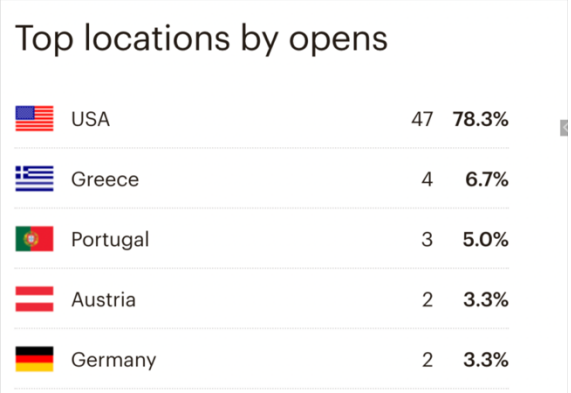

Figure 49-Top Locations 22nd – 23rd Newsletter.

5.4 24th Newsletter

Figure 50-24th Newsletter.

The 24th Newsletter was of high importance since it included three major assets. The first one was a call to action to subscribe to PHYSICS' YouTube channel; the second one was about the tutorial in the frame of the IEEE International Congress on Intelligent and Service-Oriented Systems Engineering of 2023 (CISOSE 2023) held in Athens, Greece, between July 17-20. The last asset of this Newsletter was the announcement of a New journal publication entitled "Empirical Investigation of Factors Influencing Function As A Service Performance in Different Cloud/ Edge System Setups." This email was sent on the 28th of July, 2023.

Table 7-Statistics of 24th Newsletter

Statistics	24th Newsletter: PHYSICS on YouTube! See the latest news!
Successful Deliveries	162
Total Opens	98
Clicks per Unique Opens	15.8%

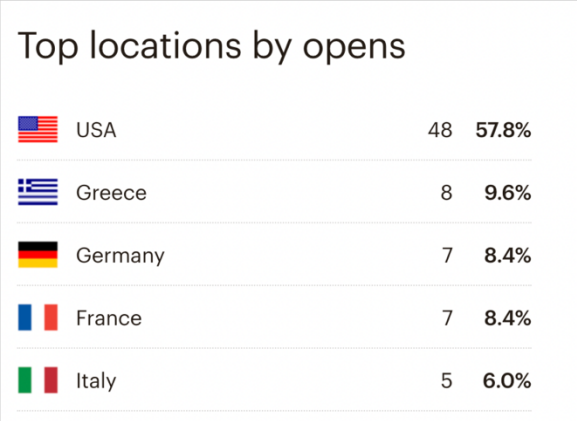

Figure 51-Top Locations 24th Newsletter

5.5 25th Newsletter

Figure 52-25th Newsletter.

The [25th Newsletter] was a brief update about crucial points of the project, such as the RAM presentation, the YouTube channel, and the presentation of a new Conference paper entitled "Securing the Flow: Security and Privacy Tools for Flow-based Programming." This email was sent on the 11th of October 2023.

Table 8-Statistics for 25th Newsletter.

Statistics	25th Newsletter: Marketplace - 🟧 New Publications & PHYSICS YouTube!
Successful Deliveries	159
Total Opens	86
Clicks per Unique Opens	9.8%

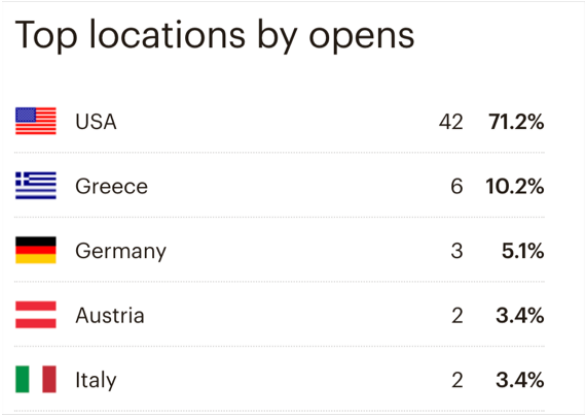

Figure 53-Top – Locations 25th Newsletter

5.6 26th Newsletter

Figure 54-26th Newsletter.

This newsletter was sent on 16th November 2023. It reported about the General Assembly meeting held in Italy and the invitation of External Stakeholders Evaluation on "Strategies for enhancing application modernization in the serverless cloud/edge era." Finally, the call to action to subscribe to the YouTube channel is included.

Table 9-Statistics for 26th Newsletter.

Statistics	26th Newsletter: External Stakeholders Workshop - 👬 VIII GA Meeting!
Successful Deliveries	151
Total Opens	51
Clicks per Unique Opens	10%

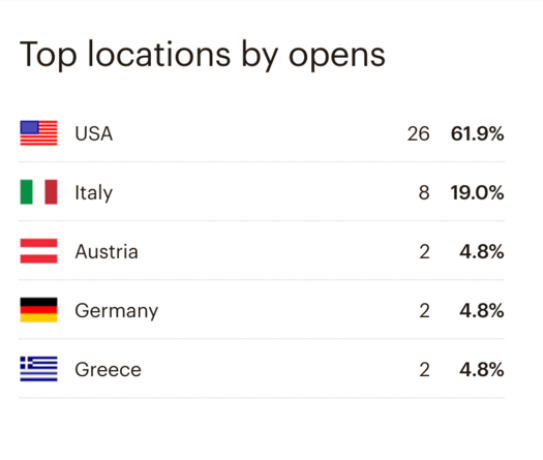

Figure 55-Total Locations 26th Newsletter.

6. SOCIAL MEDIA

The PHYSICS H2020 Social Media strategy is multichannel as the project has presence in different channels. As identified at the Grant Agreement stage, the core social media platforms used by the project are Twitter and LinkedIn. In addition to these, the consortium has also decided to add an additional channel on YouTube (added in July 2022), aiming to serve as a library for the videos produced by the project.

Through the utilization of key platforms – Twitter and LinkedIn- a thriving community has been established around our esteemed project. It's remarkable to mention the engagement of PHYSICS' followers, particularly on Twitter, where they not only mention the project but also share the posts that capture their interest. The content created on these channels is curated to resonate with the target audience. This focus on relevance ensures that the message truly resonates and connects with the established community.

In the first year, has been created some relevant hashtags as it was mentioned in the previous deliverable. The digital footprint of the PHYSICS project has been established during these three years. This strategy with hashtags aimed to increase the discoverability of the posts.
The content pillars of social media focus on events / workshops/meetings / conferences of the project, publications, relevant blog posts, videos, newsletters, and any other updates that are relevant to PHYSICS H2020.

The hashtags which were used, are the following:
#cloudcomputing, #faas, #physicsh2020, #edge_computing, #Function_as_a_Service, #H2020PHYSICS, #cloudcomputingservices

As depicted Table 10, there was an increment in the number of followers in the past year concerning the two core social media channels of the Physics project.

Table 10 - Statistics from social media.

Medium	Followers 2023
Twitter	174
LinkedIn	141

6.1 Twitter

The Twitter channel: https://twitter.com/H2020Physics gained 31 followers during the third year of the project. Regarding the online strategy of the Twitter account, the PHYSICS account retweets every working day a tweet that is related to the content of the project, such as cloud computing and FaaS. This technique is crucial as the project appears almost every day on the homepage of the followers.

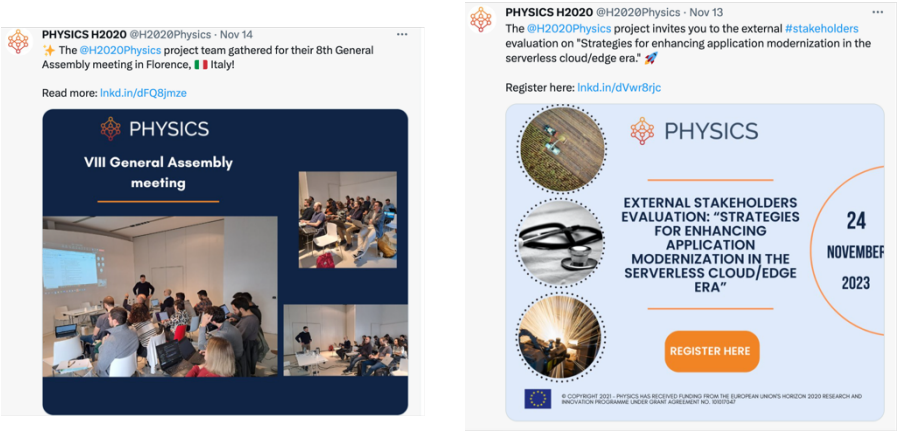

Figure 56 - Samples of Twitter Posts.

Table 11 reports on the project's top tweets during the last year of the product as reflected through the number of impressions, engagement, and engagement rate. Compared the results with these in previous years, it can be noticed a small drop in the Impressions.

Table 11 - PHYSICS Top Tweets.

Top Tweets sort by Impressions	Impressions	Engagements	Engagement rate
PHYSICS H2020 @H2020Physics · Mar 22 Did you book your seat in the **#pilotworkshop "Presentation and usage of the project outputs by external communities"**? Register now: lnkd.in/gAxWrp9C physics-faas.eu/event/pilot-wo… View Tweet activity	209	5	2.4%
PHYSICS H2020 @H2020Physics · Jul 27 🚀The PHYSICS H2020 project organized a tutorial in the frame of the IEEE International Congress on Intelligent and Service-Oriented Systems Engineering (CISOSE 2023). 🤖🌐 Held in Athens, Greece, from July 17-20 Read more: lnkd.in/dEquc7VN pic.twitter.com/0S9qM5J93A View Tweet activity	65	1	1.5%

PHYSICS H2020 @H2020Physics · Jul 7 On July 4th - 5th, 2023, the 7th General Assembly meeting of the **@H2020Physics** project occurred in Pafos, Cyprus. **@InnovActsLtd** served as the host for the meeting. Read more: shorturl.at/oCPS8 pic.twitter.com/3gME6nncGP View Tweet activity	59	7	11.9%
PHYSICS H2020 @H2020Physics · Jun 21 publication of the PHYSICS entitled "Enhancing Smart Agriculture Scenarios with Low-code, Pattern-oriented functionalities for Cloud/Edge collaboration" was presented at the 5th International Workshop on IoT Applications and Industry 5.0 of the IEEE DCOSS-IoT 2023 Conference pic.twitter.com/OZd3Kwevl5 View Tweet activity	43	2	4.7%

6.2 LinkedIn

LinkedIn is one of the most important channels regarding the dissemination and communication of the project. The project's LinkedIn channel: https://www.linkedin.com/company/physicsh2020/ aimed at informing the project's community of it's the latest updates and achievements.

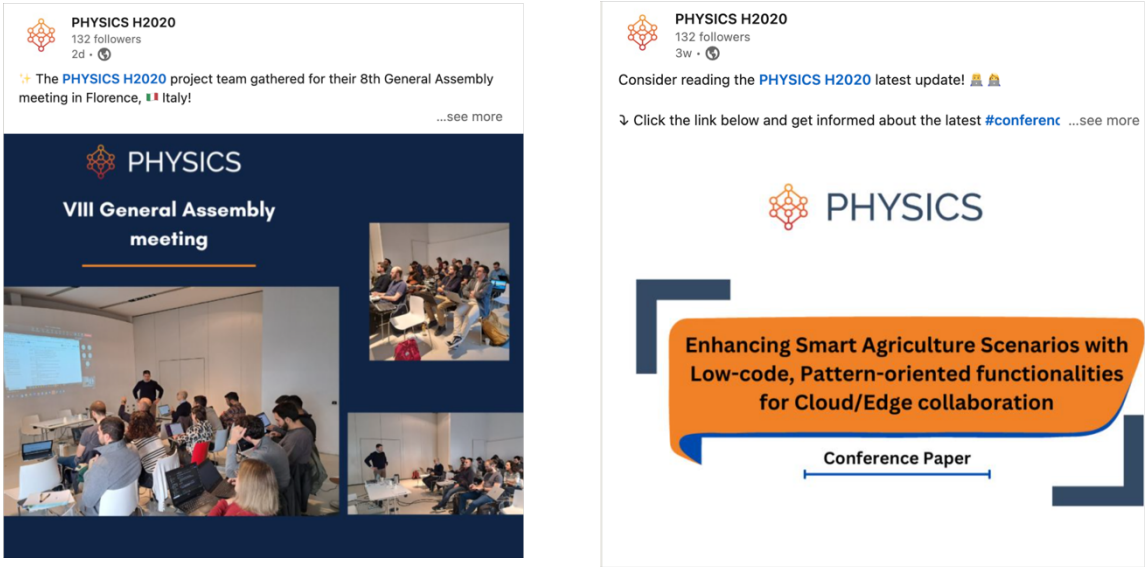

Figure 57 - Samples of LinkedIn Posts.

The demographics of the LinkedIn followers remain almost the same as the Figure 58 illustrates. Particularly, the project has attracted the target audience from different locations worldwide. The first country remains Greece, with a 2.3% increase, and in the second place is Italy, Milan, with a 1.8% decrease. Can observe a change in the third position as during the second year, was Genoa (5.1%), but in 2023, Greater Madrid Metropolitan Area, Spain (4.5%) has this position.

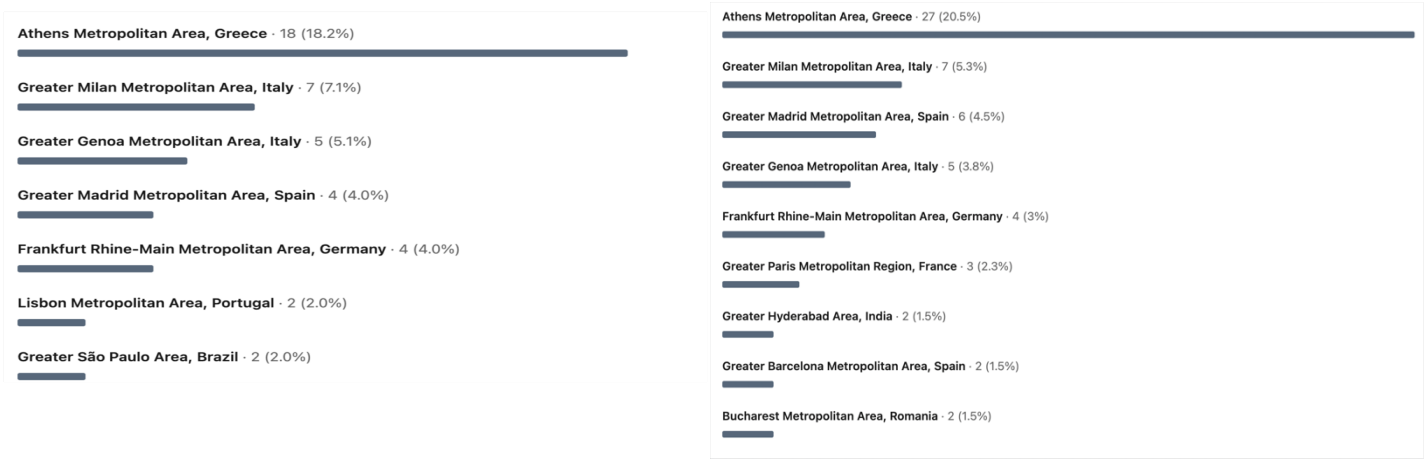

Figure 58 - Followers' Demographics/ 2022 VS 2023.

In analyzing the followers of the PHYSICS LinkedIn page, it is evident that there have been minimal fluctuations in terms of the followers' business fields compared to the previous year. Notably, engineers continue to hold the top position, with a modest increase of 2%. Following closely behind are researchers, showing a slight growth of 3%. Remarkably, the third position has undergone a change, with education professionals occupying this spot, accounting for 7.6% of the follower base.

Throughout the duration of the project, there have been no significant shifts in the occupations of the followers. This can be attributed to the specific nature of the project, as it caters to a distinct audience.

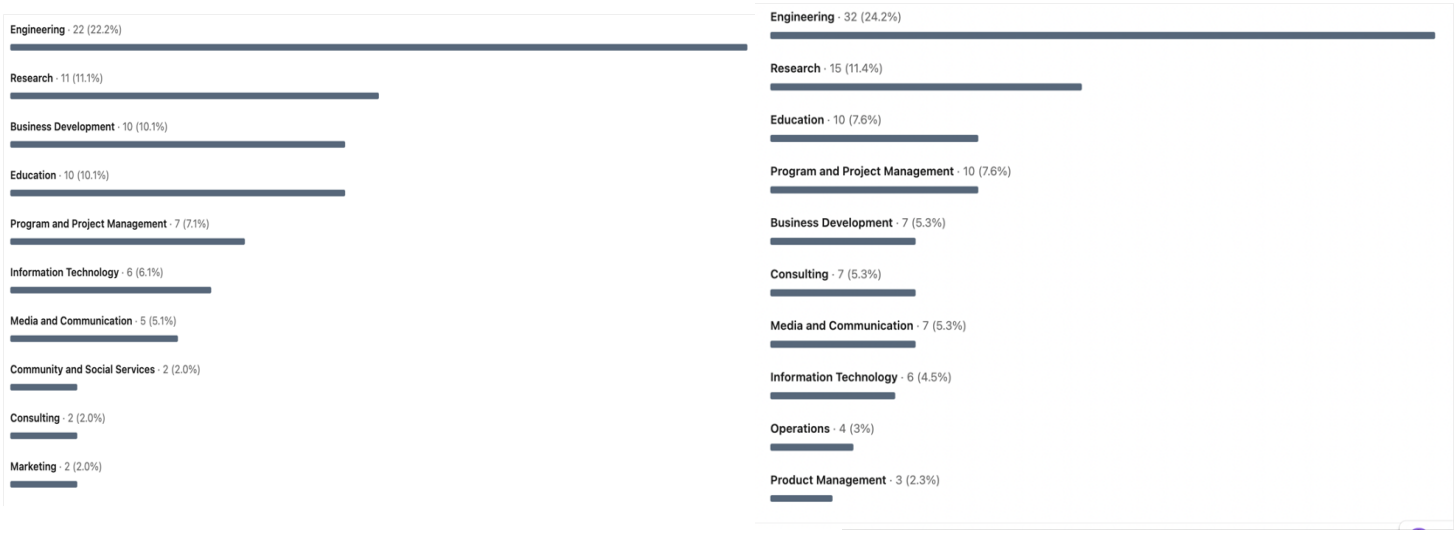

Figure 59 - Job Functions 2022 VS 2023.

6.3 YouTube

In Year 2, the YouTube channel was created:
https://www.youtube.com/channel/UC1otUEHDmUGNmsdcBw6QFsA

aiming at sharing video content with the community of the project (see Figure 60).

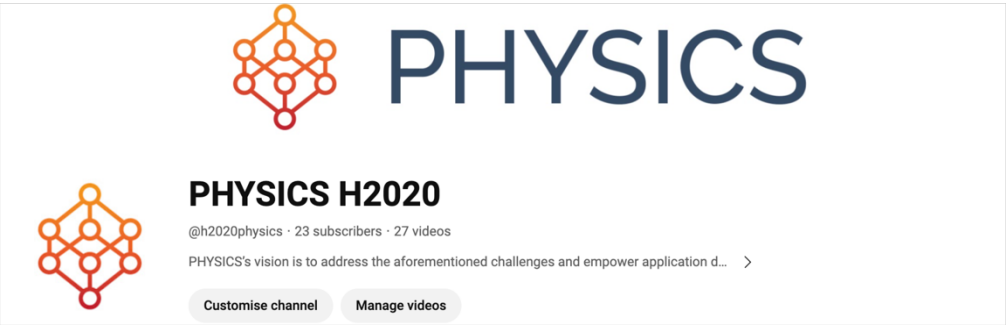

Figure 60 - PHYSICS YouTube's banner.

PHYSICS' YouTube channel includes 27 videos as the Table 12, Table 13, Table 14, Table 15 below present, 27 videos.

For the purposes of this deliverable the videos are organized in clusters based on their purpose:

- The general category general videos produced for promoting the project, such as partners' interviews.
- The hackathon category contains videos of 2 of the 3 hackathons which occurred online or in hybrid format.
- The webinar category consists of some webinars organized by PHYSICS for which recording consent was provided by the participants.
- The training/demo category videos include videos that aim to train users (such as how-to videos, RAMP explanation etc.)

Table 12 - General category of YouTube videos.

Title of the Video
Interview | Yannis Poulakis | Byte
Interview | Marta Patiño | Universidad Politecnica de Madrid [UPM]
Interview | Yiannis Georgiou | RYAX
Interview | Thodoris Ioannidis | InQbit
Interview | Jose Castillo Lema | Red Hat Israel Ltd
Interview | Aristodemos Pnevmatikakis | Innovation Sprint
Interview | George Fatouros | Innov-Acts Ltd
Interview | George Kousiouris | Harokopio University
Interview | Fabrizio Dipeppo | GFT
Interview | Andre Hennecke | Fujitsu TDS GmbH
Interview | Volkan Gezer | German Research Center for Artificial Intelligence [DFKI]
Interview | Theophile Lohier | CybeleTech
Interview | Carlos Sanchez | ATOS
Interview | Alessandro Mamelli | Hewlett Packard Enterprise
PHYSICS presentation

Table 13 - Hackathon category of YouTube videos.

Title of the Video
Introduction to the 1st PHYSICS Hackathon
2nd PHYSICS Hackathon

Table 14 - Webinar category of YouTube videos.

Title of the Video
Building Versatile Serverless Applications Across the Cloud Edge Continuum
Webinar: Opening up the Cloud Edge Continuum to new generations of applications

Table 15 - Training/Demo category of YouTube videos.

Title of the Video
CISOSE 2023: Introduction to the PHYSICS Design Environment
PHYSICS Pilot workshop: "Presentation and usage of the project outputs by external communities."
PHYSICS Reusable Artefacts Marketplace Platform RAMP
PHYSICS RAMP How to Upload an Asset
Reasoning Framework of PHYSICS platform
Load Generator NodeRed Flow
Design Environment of PHYSICS platform
Cloud Platform Services for a Global Space-Time Continuum Interplay (WP4)

Despite the small number of subscribers (23 subscribers), according to Figure 61 there are 590 total views and 13.7 watch time, since the year two of the project in which the project's YouTube channel was generated (November 2022).

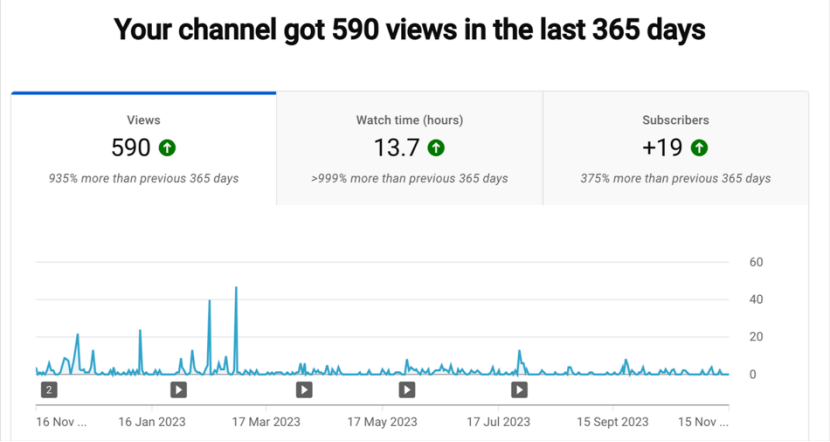

Figure 61 - YouTube Statistics 2023.

7. SUMMARY OF THE DISSEMINATION AND COMMUNICATION ACTIVITIES ACROSS THE PROJECT'S LIFECYCLE

7.1 Strategy Overview

Dissemination and communication activities were essential for ensuring the wide and timely distribution of the research and practical outcomes of the PHYSICS project. These activities involved all consortium partners and aimed to reach the appropriate target audiences using suitable methods. Additionally, it was crucial to establish an effective communication channel with external stakeholders.
The dissemination strategy of the PHYSICS project focused on the following key pillars:

1. Raise awareness about the advancements and issues addressed in PHYSICS towards different audiences, while also seeking relevant resources for external experimentation and federation.
2. Facilitate engagement and knowledge sharing with different audiences through publications, press releases, webinars, videos, and workshops via social media, YouTube channel, and the project's website.
3. Engagement with stakeholders in the PHYSICS pilots.
4. Dissemination of scientific and technical outcomes with scientific journals, conferences, articles, and social and electronic media.
5. Increasing through social media, website, and newsletters the engagement with major stakeholders, promoting the PHYSICS and RAMP.

7.2 Objectives

The dissemination and communication activities aimed at increasing the project's visibility and impact while establishing regular networking with the Cloud, FaaS, AI, and Big Data communities. These communities include policymakers (such as central governments, public authorities, and EU institutions), members of EOSC, Gaia-X, BDVA, and essential research working groups (like the SPEC Cloud WG). In particular, an additional objective is to actively participate (e.g., in the EOSC Liaison, Use Cases, Marketplace, etc.) to raise awareness of the challenges and developments carried out in PHYSICS and to request appropriate assets for additional external dissemination. The mobilization of partners to create an engaged and vibrant community around the project's bundles and market platform (RAMP) is critical for the success of the project. To achieve this objective, it is imperative that the project significantly increases engagement with the major stakeholders of the RAMP. This necessitates gaining sufficient traction on both the demand and supply sides of the RAMP, which requires taking specific actions that consider the different business and operational needs of the various stakeholders, ensuring that they are targeted with tangible benefits.

To this end, various types of relevant events were identified per stakeholder category (e.g., hackathons for external developer communities), and potential synergies were exploited to raise awareness of PHYSICS from the very outset of the project. Furthermore, these events aim to facilitate interactions between stakeholders that lead to concrete actions and outcomes.

The partnership and project branding, therefore, hold significant importance in achieving this objective. By establishing an environment of collaboration and knowledge exchange, with effective communication channels and fostering engagement, the project seeks to stimulate active participation and maximize the impact and visibility of its work.

7.3 Summary of Communication Activities

The following tables (Table 16, Table 17, Table 18) present the KPIs regarding the activities on communication, stakeholder engagement community development, and dissemination. Specifically, Table 16 displays the communication that the project occurred during the three-year period of the project, which aimed to achieve a wider audience – stakeholders. Table 17 illustrates the tactics of how the community was developed as well as a summary of the activities of the stakeholder's engagement. Following Table 18 with the dissemination KPIs, with conferences and specific synergies on-site demonstrations and presentations, open access publications etc.

Table 16 - Communication KPIs.

Measure	**Target**	**Achievements**	**Additional Details**
Monthly Web Content Monthly Web Content	YR1: min. 2/month YR2: min. 3/month YR3: min. 4/month Total: 108	Total: 156	
In house Newsletters	YR1: min. 6; YR2: min.8; YR3: min. 10 Total: 24	Total: 26	
Promotional Material, including video content	YR1: min. 3; YR2: min.6; YR3: min 12 Total: 21	Total: 168	Total Visuals Blog posts: 27 Total Videos on YouTube: 27 Total Visuals for Social media posts: Y1: 4, Y2: 44, Y3: 35 Total Roll-up Banners: 2 Total Flyers: 2
Press release for major stakeholders	YR1: min 2; YR2: min 1; YR3: min 2 Total: 5	Total: 10	10 press releases by partners towards their related stakeholder groups
Press release for general public	3 press clippings	Total: 27	9 Press Releases to include basic updates about the project, released by the PHYSICS website 16 videos (included in Table 12)
Visibility of PHYSICS in channels used by different stakeholder categories	20 back-links across major stakeholders 50 responders identified PHYSICS	Totals: >20 back links >50 respondents	Examples of mentions and reposts of major stakeholders demonstrating community engagement are presented in Figure 62, Figure 63. Twitter average views 200-400 per month LinkedIn average views 15-45 per month Website users: 2.3K

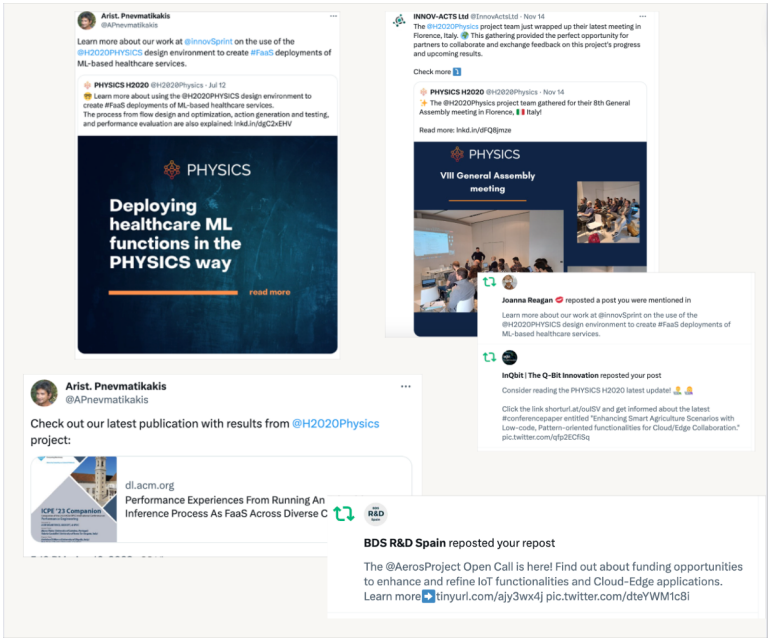

Figure 62 - Examples of Reposts

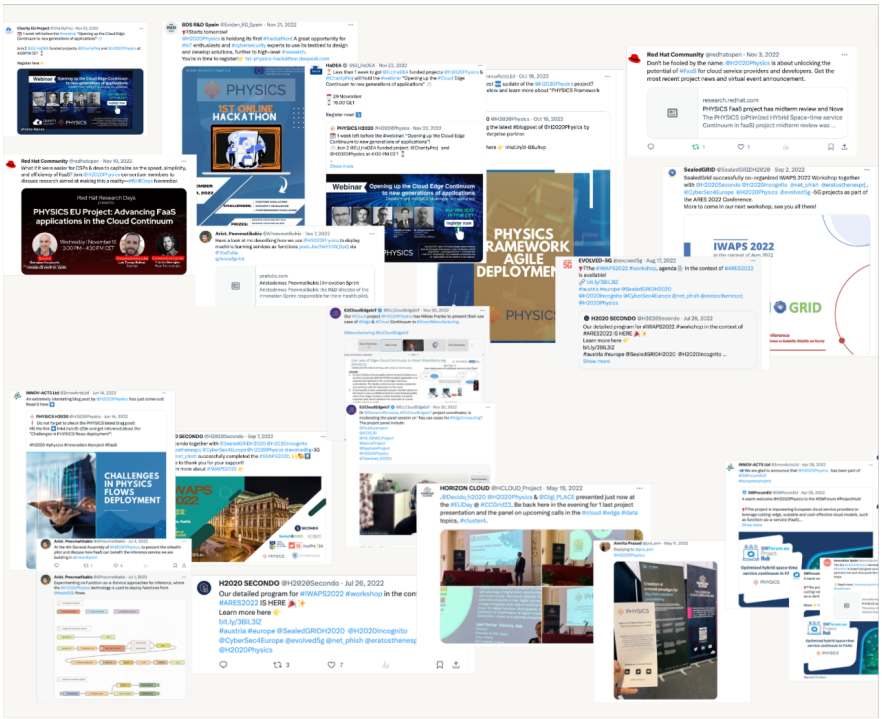

Figure 63 - Examples Mentions

Table 17 - Summary for activities on stakeholder engagement and community development.

Measure	Target KPI	Achievements	Additional Details
Social Media Content: Twitter	KPIS of total posts during the 3 years: 504	Total: 875	Posts with project content: 151 Reposts of relevant content: 720 (approx..)
Social Media Content: LinkedIn	KPIS of total posts during the 3years: 156	Total: 185	Posts with project content: 146 Reposts of relevant content: 38 (approx..)
Stakeholder database	100 profiled stakeholders by M12; over, 200 by M24, and 400 by M36 Total: 700 stakeholders	Total: 643 stakeholders	Mailing list subscribers: 173 subscribers (2.3K users on the PHYSICS' website) Total Social media and YouTube followers: 322 Events: 148
Exhibitions/ workshops with free access	1 exhibitions/workshops 50 non-specialized attendees	Total exhibitions/workshops: 2 Total participants: 132	-External Stakeholders Evaluation:"Strategies for enhancing application modernization in the serverless cloud/edge era.", Participants: 24 -Pilot workshop: "Presentation and usage of the project outputs by external communities.", Participants: 18 -HUA Invited talk in the Department of Mechanical Engineering of the National Technical University of Athens where the main concepts of Node-RED were presented as well as patterns and their role in the Smart Agriculture Use Case, Participants: 50 -Dagstuhl Seminar: 50 participants
Online and/or F2F training sessions	1 online session 50 non-specialized attendees	Total Online Sessions: 3 Total F2F/Hybrid Sessions: 2 Total participants: 183	-Webinar on Building Versatile Serverless Applications Across the Cloud Edge Continuum, Participants: 80

			-Webinar on Opening up the Cloud Edge Continuum to new generations of applications, Participants: 53 -3 Hackathons, Participants: 55
F2F interactions with local people	1 local events 3 appearance in media	Total events: 7 Total appearance in media:10	Local events: - HANNOVER MESSE 2023 -Red hat Research Days event: Advancing FaaS applications in the Cloud Continuum -GFT internal event presenting PHYSICS to the cloud community -DFKI inhouse event with SmartFactory partners -HPE Company Internal strategic dissemination event -CYBE Internal event for the demonstration of PHYSICS Design Environment and pattern used in smart agriculture use case Appearance in Media: - Articles in the following online newspapers: tgcom24, marketscreener.com (450K monthly visitors/month, milanofinanza (10K visitors/ month) -SPEC RG newsletter -H-Cloud newsletter -EUCloudEdgeIoT newsletter -GFT Internal Newsletter 'News For You' -GFT Online newspaper: GFT Italia: coordina progetto Physics in programma Ue innovazione Horizon 2020 -HPE Leverage of the Italy Technology Show Room Centre and the HPE Marketing Business Unit taskforce to share PHYSICS acknowledgements and added value with customers (especially within the Hybrid IT division customers)

			-HPE Services Italy newsletter
Free trials for general public	5 testers	Total testers: 5	-Google Summer of Code 2022 (HUA has issued a topic for mentoring through ELLAK, the greek open source community, with a direct link with PHYSICS for Google Summer of Code 2022 (1 tester) -AI4EOSC project access request (2 testers) -Use cases (2 testers)
Marketing events/ tradefairs	Min. 1 in YR2 and 2 in YR3	Total:4	-Technical community event organized by HORIZON-CLOUD in collaboration with PHYSICS and SMARTCLIDE projects - HANNOVER MESSE 2023 - Design & Deployment of FaaS apps at the edge-cloud Event - Invited Talk at IEEE CISOSE 2023 Conference -Presentation at Edge Intelligence on 'Scheduling at the edge-cloud Continuum' - Athens K8s Meetup
Hackathon organisation	1 in YR2, 2 in YR3, 30 participants per activity Total participants: 90	Total: 3 Hackathons Total participants: 55	Reported in Section 4.1

Table 18 - Dissemination KPIs.

Measure	**Target KPI**	**Achievements**	**Additional Details**
Organization and/or attendance to conferences and exhibitions	100 visitors, 10 speakers	Speakers: 16 Visitors: 144 visitors/ participants	Listed in Appendix 1
Synergies established at local,	6 synergies established	6 synergies	-Google Summer of Code

national or international level for uptake of the marketplace			-DFKI participation in the event “Innovationstag 2022” of the “Technology Initiative SmartFactory-KL e.V” -Postgraduate program of the Department of Informatics and Telematics, Harokopio University of Athens -Department of Mechanical Engineering of the National Technical University of Athens -DevConf -Edge Intelligence
Synergies for sharing knowledge, collaboration and standardisation	> 3 projects	Total synergies: 8 projects/clusters	-H-Cloud: Monthly participation and reporting in H-Cloud community meetings, Presentation in H-Cloud Community Event, PHYSICS as part of the Consultation Expert Group -EUCloudEdgeIoT: Monthly participation and reporting in the project’s community meetings -AI4PublicPolicy: Webinar collaboration and external entity involvement investigation -PLEDGER: collaboration o find common technical points for further development. -HUB4CLOUD: collaboration for identifying future research challenges. -FLOSS: coordination by the HUA of the FLOSS (ELLAK) team coordination on Open Source software and Open Standards -Cloud WG of SPEC: Participation in the activities of SPEC RG CLOUD WG from 3/2021 and on a biweekly basis -Future Cloud Cluster: contribution of PHYSICS in discussions and collaboration for research and innovation initiatives that address next

			generation Cloud Computing challenges
On-site demonstrations and presentations	3 responders 2 on-site demos	Total: 14 (5 on-side + 9 online) Total Respondents:	-3 x Hackathon Introductory Sessions/Demos: "Introduction to the 1st PHYSICS Hackathon" (Online), "2nd PHYSICS Hackathon – Intro and Challenges" (Hybrid), "3rd PHYSICS Hackathon" (on-site) - ISOSE 2023 Introduction to the PHYSICS Design Environment Demo (on-site) - HANNOVER MESSE 2023 (on-site) - Google Summer of Code 2022 (on-site) - 8 YouTube videos (included in Table 15)
Open Access publications	> 15 publications	Total Publications: 18	
Online publishing (online magazines, blogs, etc.)	> 500 views / publications / year	Total Website visits: 2.3K Total YouTube videos views: 590 Total Publications downloads on Zenodo: 293	Also remarkable indirect visibility on articles about the projects in local online newspapers: tgcom24, marketscreener.com(450K visitors/ month, milanofinanza. (10K visitors/month) and external newsletters (SPEC RG, H-Cloud, EUCloudEdgeIoT newletters)
Customisable marketing packages (videos, how-to demos, press kit etc.),	> 10 produced >50 distributions	Total: 156	156 Customisable marketing packages, distrubuted to social media, website and and YouTube and the users/ stakeholders repost them.

8. STANDARDIZATION & OPEN-SOURCE ACTIVITIES

As stated in the previous deliverable (D7.2, D7.3) the main target of PHYSICS is to contribute to standardization mainly through contributions to relevant upstream open-source projects and their communities, which represent de-facto software standards. For example, by contributing to Kubernetes which is the de-facto standard for container orchestration.

During the first year of the project (D7.2) the focus was on identifying the initial set of standardization bodies and open-source projects that were relevant to PHYSICS and defining our approach on how to get engaged and contribute to them. During the second year of the project (D7.3), thanks to having a more clear and defined architecture, more contributions were made as well as further alignment with them. During the final year the impact has been even bigger due to having clear needs and more synergies with upstream projects. It can be highlighted the great collaboration with both Knative and especially Kepler upstream projects and communities. This was partly thanks to keeping close track of relevant upstream projects, ensuring alignment with them as well as to joining forces when possible.

In order to keep track of the partners' record and interests on this matter, we have maintained a template where the different partners were recording both their contributions (both upstream code and community engagement) as well as the future/tentative plans to keep track of evolution over time. Table 19 and Table 20 summarize all relevant contributions regarding code/bug contributions and different type of community engagement respectively.

PHYSICS has contributed to open source in different ways (and plans to keep contributing after project finishes):

- releasing complete components as open source, in a public github (https://github.com/physics-faas) where different repositories associated with different components are linked.
- identifying relevant upstream communities and projects where part of the PHYSICS contributions fitted – for example Kubernetes Scheduler, OCM, Submariner or Kepler.
- working on creating new communities around new/starting projects, such as Microshift for low footprint edges.
- collaborating with upstream communities in bug reporting and fixing, as well as identification of missing features, specially related to FaaS use cases – for example Submariner or Kepler.
- enriching collections of available artifacts in existing and widely used open-source projects, such as NodeRed.
- Presenting (talks, blog posts, conferences) new features, components and projects in relevant conferences to attract interest. One example was the Red Hat research days that materialized in discussion with Knative community about needs to better handle function as a service use cases.

As part of the above, we have been working closely on the next projects:

- the Submariner project (multicluster Kubernetes interconnect) that we leveraged to provide multicluster connectivity between PHYSICS components. We have identified several bugs and worked in their resolution.
- Kubernetes Scheduler and related components (Kubelet and CRI-O) to support the image layer locality aware scheduler that is better suited for FaaS model.
- New incubation project for a low footprint Kubernetes (MicroShift) which targets the low footprint resources at the edges. We have worked on creating community around it through talks, as well as tested and worked on its integration with Submariner. We plan to continue that path, and for instance help with adding support to manage those edge nodes in a centralized manner via Open Cluster Management
- New flows and nodes collection, contributed to the flow repository of Node-RED, the node repository of Node-RED as well as the npm node repository.

- Kepler project for energy metrics monitorization. We have worked with the community identifying gaps for FaaS use cases, such as sampling rate. We have also collaborated on the identification and resolution of important bugs. The most notable one was to support Kepler on top of Cloud Provider, such as when running Kubernetes on top of Amazon or Azure (as we do in our testbed).

In addition to that, Red Hat organized an "open-source workshop", where all PHYSICS partners were present, whose topic was about how to contribute to open-source communities. The main idea behind this workshop was to take advantage of Red Hat's "know-how" working with open-source communities and projects and use it to guide the PHYSICS' partners to either contribute to existing projects, or build their own one and bring attention to it, creating a community behind. One of the main intentions for this is to try to make software components that outlive the project duration and make a bigger impact. As part of this effort, RYAX is trying to upstream its modifications to the scheduler so that it can be used and maintained by the community after the project ends. Similarly for the Kepler contributions.

The next table details the information about the open-source contributions already or in progress.

Table 19 - Open-source contributions

Partner	**Upstream project**	**Contributions**	**Status**
RYAX	Kubernetes	Developed a new Kubernetes scheduler to consider the different layers of the container images to minimize its starting time (less time needed to pull the image).	Provided as open source in RYAX public repositories and PHYSICS github project Working with Kubernetes Scheduler SIG to fully upstream the efforts and make it available in each Kubernetes installation
RYAX	Kubelet	Modification to support the extra information about the images at the nodes (needed for the scheduler)	Provided as open source in RYAX public repositories and PHYSICS github project Working with Kubernetes Scheduler SIG to fully upstream the efforts and make it available in each Kubernetes installation
RYAX	CRI-O	Modifications to provide the extra information about the container layers to the kubelet	Provided as open source in RYAX public repositories and PHYSICS github project Working with Kubernetes Scheduler SIG to fully upstream the efforts and make it available in each Kubernetes installation
RHT	Open Cluster Management	Submariner integration: discussions with submariner folks related to its integration Reported issues related to cluster upgrades and uninstall process	Done, RHT will keep working on the upstream project
RHT	Submariner	Several bug reports, which also lead to upstream documentation.	Done, RHT will keep working on the upstream project

		Discussions about how to fix or reproduce the issues with the community and bug fixes: ▪ Support for ovn-kubernetes CNI, which was broken . We identified the problem, and report the solution for it: https://github.com/submariner-io/submariner/issues/1608 ▪ https://github.com/submariner-io/submariner/issues/1631 Integration with Open Cluster Management, also working on bug reporting and fixing ▪ https://github.com/submariner-io/submariner/issues/1625 Integration with MicroShift, by supporting different CNIs, such as weavenet: ▪ (bug report) https://github.com/submariner-io/submariner-operator/issues/2144 ▪ (fix) https://github.com/submariner-io/submariner-operator/pull/2146	
RHT	MicroShift	Promoting, testing and helping to mature this k8s distro for low-footprint/edge devices Integration with Submariner (related to the CNI and submariner, see submariner block)	Missing complete integration with Open Cluster Management, to be done after the end of the project as part of the evolution of MicroShift. Done for RHT downstream version (RHACM)
RYAX, RHT	Kepler	Reported several bugs and discussed with the upstream community about its resolution. The most important one related to working on top of cloud providers: https://github.com/sustainable-computing-io/kepler/issues/594	Done

		Also submitted new PRs to ▪ update a few configurations to solve deployment issues on Kepler thought their helm-chart: https://github.com/sustainable-computing-io/kepler-helm-chart/pull/6 ▪ improve the sampling rate to focus on FaaS use cases: https://github.com/sustainable-computing-io/kepler/issues/539, https://github.com/sustainable-computing-io/kepler/pull/942#event-10436063440 ▪ issues loading BPF programs: https://github.com/sustainable-computing-io/kepler/issues/790	
RHT	KEDA	Adaptation and testing of different autoscalers for the FaaS case	Done
RHT	Knative	Make use of Knative functionality and adoption of its Function as a Service modules. Also engagement with upstream community and discussions that end up on DevConf workshop and support for WorkflowCRD https://github.com/knative/func/discussions/1624	RHT will continue contributing to Knative
HUA	OpenWhisk	Bug report related to cold start error messaging: https://github.com/apache/openwhisk/issues/5359	Done
HUA, INQ	Node-RED flows repository	HUA contributed flows and subflows related to functionality created in the context of the PHYSICS project (e.g., patterns, controlling flows, created nodes etc.) INQ developed ready to use flows for security and privacy functionalities that are used in the PHYSICS projects as well as json logic nodes.	Contributed flows as part of flow repository of Node-RED, the node repository of Node-RED as well as the npm node repository

BYTE, INNOV, HUA	Ontology repository	The PHYSICS ontologies are provided openly in the RAMP or/and W3 repository which contains a variety of ontology repositories.	Provided as open source models through RAMP and Github
UPM	Co-allocation strategies component	Algorithm for deciding the most suitable deployment of a function in a cluster according to the requirements of the workflow it belongs to and the current resource consumption	Distributed as open source component, together with the webhook framework
BYTE, INNOV	Physics semantic component	Both BYTE and INNOV ACTS contributed to the semantics block that is part of PHYSICS, provide the code as an open-source project in GitHub	https://github.com/yannispoulakis/physics_semantics_block
RYAX	Function Bench	Adapted some of the functions available in the FunctionBench benchmark. It was designed to Azure, AWS and Google Cloud. We provided adaptations to Openwhisk: https://github.com/ddps-lab/serverless-faas-workbench/tree/master/openwhisk	Done
RHT	Workflow CRD Operator	Operator that offers and API for registering functions on different platforms (OpenWhisk and Knative), and provides extra inputs needed by other PHYSICS components (e.g., collocation)	Distributed as open source component in the PHYSICS github repository
RHT	Cluster Onboarding	Even-driver functionality to onboard new clusters by installing and configuring some PHYSICS component on them and connecting them across different clusters (leveraging Knative, OCM and submariner)	Distributed as open source component in the PHYSICS github repository
RHT	PHYSICS Webhook	WebHook for selection of scheduler per pod as well as to enable collocation engine	Distributed as open source component in the PHYSICS github repository
INNOV	OpenWhisk health monitor	A service to monitor the health of OpenWhisk clusters. This application continuously checks the availability of your clusters by invoking a mock function to each registered cluster, then stores the response over time to	Distributed as open source component in the PHYSICS github repository

		calculate a weekly availability score. Changes in the availability score are tracked and logged accordingly.	

Besides the code contributions (of several types: code, bug fixes, bug reports, discussions with community members, …) we have also pushed for standardization through engagement in upstream/community activities. During the initial phase of the project, we focused on giving some presentations to create awareness about the needs and direction of the efforts. During the last part of the project we put more effort on presentation of the actual features as well as engagement with upstream communities as a result of them. The complete list is detailed in the next Table (Table 20).

One example to highlight was the talk about the PHYSICS project presented at the Red Hat Research Days (November 16th, 2022), where both Red Hat engineers and researchers around the world join together to present the result of fruitful collaboration and exploit the synergies between both groups. As a result of this talk, we were contacted by one of the groups leading the development of Knative (https://knative.dev/docs/), an open-source solution to build Serverless and Event Driven Applications. This started a collaboration with them, focusing on what they can learn from development done in PHYSICS projects as well as the other way around, issues that they have already solved and how we could leverage them. This resulted in improvements in Knative, as well as action points in PHYSICS side:

- Installation of Knative in our testbed
- Devconf Workshop/Hackathon organized, with involvement from Knative community, around the PHYSICS project and how to build Kubernetes operators that support Knative function registration, similarly to what WorkflowCRD was doing for OpenWhisk.
- Initial support of Knative (together with OpenWhisk) as another platform to run functions in our WorkflowCRD component – this was also a result of the DevConf hackathon.

Table 20 - Open-source community engagement activities

Partner	**Activity/Event**	**Description of the activity**	**Status/Year**
RHT	Kubernetes local meetups	Present some of the contributions made as part of PHYSICS at local Kubernetes in Athens	Two presentations made: Submariner (year1) and MicroShift (year2)
RHT	OpenStack Project Team Gathering, Slack, IRC, mailing list	Involvement in upstream development communication tools and gatherings. Sync on the best way of doing feature X, maximizing their impact and adoption	Actively involved in all of them, and in several projects: ▪ Kubernetes ▪ Submariner ▪ OCM ▪ MicroShift ▪ Knative ▪ Kepler
RHT	Presenting and attending big community events such as Open Infra Summits	Present relevant PHYSICS related components in their relevant community gatherings	Attended OpenInfra Summit, Berlin 2022 Talk submitted to KubeCon, waiting for acceptance

	and/or KubeConf		
RHT, RYAX	Attendance and presenting at DevConf	Present Physics contributions on the DevConf conference (open source community conference	Talk about submariner (https://www.youtube.com/watch?v=-HE9iq34Zj8, Year 1) Talk about microshift (https://www.youtube.com/watch?v=qwTGn8Iyp4k&t=1s, Year 2) Talk about PHYSICS project , Year3 Talk about Image Layer Locality Aware Scheduler, Year 3 Hackathon/Workshop on building Go operators for registering/deploying Knative functions, Year 3
RHT	Blog posts at research.redhat.com	Several blogpost and press releases completed during the project lifecycle	Blog post about Red Hat role at Physics at https://research.redhat.com/blog/research_project/physics-optimized-hybrid-space-time-service-continuum-in-faas/ As well as about the GA gatherings: ▪ https://research.redhat.com/blog/2022/04/14/the-third-physics-project-general-assembly-meeting/ ▪ https://research.redhat.com/blog/2022/09/20/physics-4th-general-assembly-held/
HUA RYAX, RHT	Red Hat Research Days	Research Days are virtual and in-person events that showcase the research initiatives Red Hat supports at various universities and research institutions worldwide. It aims to connect researchers with Red Hat engineers, customers, and partners, to move great research ideas into open source communities	We presented the PHYSICS project in the November edition (Year 2) https://research.redhat.com/events/research-days-physics/

RHT	Knative community	Thanks to the research day talk we got contacted by Knative community to foster collaboration and benefits both projects. As part of this support for Knative was added into workflowCRD and DevConf hackathon was organized	Done in the last year of the project, once the support for Function as a Service has matured in Knative
HUA	Greek FOSS community	HUA is leading the work on the group on open source software and open standards (https://opensource.ellak.gr/, https://openstandards.ellak.gr/) and is coordinating relevant actions in the context of the project activities and scope.	One meeting completed (Year1), focus on taxonomy of open-source tools, inclusion of cloud related topics
HUA	HUA Student Community	HUA engaged with the student community during the 1st project hackathon. 1 external artifact has been contributed to the project following this action. Furthermore, 1 more external artifact has been contributed, as a result of B.Sc. thesis mentored by HUA participants in PHYSICS	The activity was repeated in the hackathons and future relevant thesis are expected to be issued
HUA	Google Summer of Code Mentoring	HUA mentored one student during the GSoC 2022. The student produced 4 artefacts that have also been contributed to the Node-RED flows repository as well as the PHYSICS RAMP	1 completed in 2022, expect to perform 1 more for GSoC 2023
INNOV	Blog post	Blog post in the scope of metadata management for the deployment of serverless applications in	Done: https://physics-faas.eu/modelling-faas-graphs-the-semantic-building-blocks/

		multi-clouds using the semantic representation of both cloud resources and application descriptions.	
INQ	Blog post	Blog post about the utilization of cybersecurity and privacy in the context of FaaS architectures. https://physics-faas.eu/main-challenges-in-securing-faas-services/	Done
UPM, HUA	Lectures	UPM: Presentation to master students of the FaaS model, technical challenges and the PHYSICS platform HUA: Presentation to B.Sc and M.Sc students of the FaaS model, performance challenges and design patterns as well as functionality from the PHYICS platform (DE, load generation, performance monitoring, etc.)	Done

Following up on these activities, towards the next months we plan to:
After:

- Make the presentation of submitted talks if accepted, for example the KubeCon about the multi-tier scheduling
- Continue the work upstreaming the Kubernetes image layer locality aware scheduler. This requires modifications on different layers and discussion upstream has been a bit slower than expected. But the plan is to continue this work and make a bigger impact by making the scheduler available to anyone using Kubernetes, which will ensure maintainability too

9. CONCLUSIONS

The current deliverable represents the updated and final version of D7.4 – Communication, Dissemination, and Standardization Plan and Activities. This document highlights the processes conducted throughout the entire duration of the PHYSICS H2020 project, while also emphasizing the results achieved in the third year. Where applicable, the report includes relevant comparisons.

Overall, the project's dissemination and communications activities have aligned with the project's plan and KPIs. Consequently, it can be concluded that our dissemination efforts are on track. Dissemination and communication at the project level have been implemented on a weekly basis for the entire three-year duration. The progress made by the consortium in this regard is notably visible to the community and external stakeholders.

The project's performance in relation to its key KPIs is also reported in this deliverable illustrating the results obtained throughout the entire duration of the project. This demonstrates the PHYSICS projects' level of visibility, accessibility, and promotion of its results. These results have been a collaborative effort across the project's partners, accomplished through various methods, including dissemination through stakeholders' websites, presence on relevant social media accounts (including those maintained by partners, pertinent accounts, and potential stakeholders), dedicated presentations of project results at scientific conferences and events, participation in webinars, events, and hackathons, as well as collaborations with other relevant projects. Furthermore, the project has published numerous scientific publications, further enhancing its impact and reach to the academic community. Along the same lines, the use of social media channels (e.g., Twitter, LinkedIn, YouTube) was intensified aiming to boost the project's outreach towards the public and also enhance its efforts in distributing newsletters, hosting presentations and webinars and also develop synergies with other stakeholders and/or projects. The collaborative endeavors in this regard have significantly contributed to enhancing the project's visibility, ensuring exposure to a wider audience.

Along the same lines, PHYSICS has made significant contributions to the open-source community through diverse initiatives and intends to sustain these efforts post-project completion. The contributions include releasing complete components on GitHub with distinct repositories for various components. The project has identified and engaged with relevant upstream communities, exemplified by involvement in them (e.g., Kubernetes Scheduler, OCM, Submariner, and Kepler). Furthermore, PHYSICS initiated the creation of new communities, such as Microshift for low footprint edges. The project also enriched existing open-source projects and promoted its effort on standardization through presentations at conferences, talks, and blog posts, fostering discussions and partnerships with communities.

APPENDIX

Following presenting all the conferences which PHYSICS have taken part in.

- **International Conference:** Functionalities, Challenges and Enablers for a generalized FaaS based architecture as the realizer of Cloud/Edge continuum interplay on April 2021.
- **International Conference:** 40th IEEE International Performance Computing and Communications Conference. "A self-adaptive batch request aggregation pattern for improving resource management, response time and costs in microservice and serverless environments" on October 2021 in Austin, Texas, USA
- **International Conference:** Entwicklung und Auswahl geeigneter Use Cases und KPIs zur erfolgreichen Einführung neuer Hochtechnologie am Beispiel von „Function-as-a-Service"on September 1, 2022 in Germany.
- **Open Source Community Conference:** DevConf Europe, AI at the Edge with MicroShift on January 2022 in the Czech Republic.
- **International Event:** Red Hat Summit in 2022.
- **Red Hat Research Days Presentation "PHYSICS EU Project**: Advancing FaaS applications in the cloud continuum," on November 16, 2022, virtual.
- **Research Conference:** 7th Workshop on Hot Topics in Cloud Computing Performance (HotCloudPerf 2024). "Measuring Baseline Overheads in Different Orchestration Mechanisms for Large FaaS Workflows", in March 2022, in China.
- **International Conference:** HPE Tech Con 2024, (2023 (Submission)
- **Conference:** 2021 IEEE Symposium on Computers and Communications (ISCC) "Short-Term Ambient Temperature Forecasting for Smart Heaters", 05-08 September 2021 in Athens, Greece.
- **International Conference:** Cluster, Cloud and Internet Computing BANGALORE, INDIA, MAY 1-4, 2023 "The Benefits of Considering Heterogeneity on Scheduling Policies for Serverless Platforms"
- **International Conference:** 19th International Conference, GECON 2022 HOCC, An ontology for holistic description of cluster settings" in Izola, Slovenia, September 13–15, 2022.
- **International Conference:** 2022 IEEE International Conference on Cloud Computing Technology and Science (CloudCom) "Knowledge Graphs and interoperability techniques for hybrid-cloud deployment of FaaS applications", in 2022 in Bangkok, Thailand
- **International Conference:** ICPE '23 Companion of the 2023 ACM/SPEC International Conference on Performance Engineering "A Pattern-based Function and Workflow Visual Environment for FaaS Development across the Continuum" on April 2023
- **International Conference:** Performance Experiences From Running An E-health Inference Process As FaaS Across Diverse Clusters, in April 2023.
- **International Conference:** Tutorial on Serverless Computing in the context of IEEE CISOSE 2023 Conference, in Greece.
- **International Conference Workshop:** DEVCONF.cz | Hackathon/workshop about writing k8s operators for knative functions on June 16.
- **Conference Publication:** DCOSS-IoT 2023, "Enhancing Smart Agriculture Scenarios with Low-code, Pattern-oriented functionalities for Cloud/Edge collaboration" Coral Bay, Pafos, Cyprus, June 19-21, 2023

- **Conference Publication:** IEEE CloudCom: THE 14TH IEEE INTERNATIONAL CONFERENCE ON CLOUD COMPUTING TECHNOLOGY AND SCIENCE “Enhanced Routing for Serverless Functions: A Performance-based Approach with Runtime Adaptation” on December 04, 2023, in Napoli, Italy.
- **International Conference** in Cyprus (The paper presents lessons learned during PHYSICS platform development)

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