



## D8.3: Outreach activities mid-term report

Revision: v.1.0

<b>Work package</b>	WP 8
<b>Task</b>	Tasks 8.1 and 8.2
<b>Due date</b>	30/06/2024
<b>Submission date</b>	06/07/2024
<b>Deliverable lead</b>	Dimitra Tsigkari (TID)
<b>Version</b>	1.0
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<b>Abstract</b>	This deliverable reports on the activities carried out by Task 8.1 on dissemination and communication and Task 8.2 on standardisation, open source, and policies contributions in the first reporting period (M1-M18). Moreover, it provides an overview of the next steps to be made in the following period.
<b>Keywords</b>	Dissemination, Communication, Standardisation, Open Source Policies, Policy making, Press, Outreach, Liaisons, Events, KPIs



## Document Revision History

Version	Date	Description of change	List of contributor(s)
V0.1	19/04/2024	ToC	Dimitra Tsigkari (TID)
	26/06/2024	Standardisation, open source and policies contributions	Dimitra Tsigkari (TID), João Leitão (NOVA)
	25/06/2024	Dissemination and communication report	Amrita Prasad (Martel)
V0.2	06/07/2024	Minor revisions according to the feedback received by the internal reviewers	Dimitra Tsigkari (TID)
V1.0	06/07/2024	Final version	Dimitra Tsigkari (TID)

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SEN	Sensitive, limited under the conditions of the Grant Agreement	
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\* R: Document, report (excluding the periodic and final reports)

DEM: Demonstrator, pilot, prototype, plan designs

DEC: Websites, patents filing, press & media actions, videos, etc.

DATA: Data sets, microdata, etc.

DMP: Data management plan

ETHICS: Deliverables related to ethics issues.

SECURITY: Deliverables related to security issues

OTHER: Software, technical diagram, algorithms, models, etc.



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## EXECUTIVE SUMMARY

The document at hand, developed in the context of Work Package 8, builds upon what has been outlined in D8.1 (Dissemination and Communication Strategy and Plan); the document serves the main purpose of offering an in-depth report on the project's communication, dissemination, and community-building strategy that has been developed in the first half of the project. The strategy has been followed by all project partners to maximise the impact of TaRDIS project and ensure that the following communication-related project objectives are met:

- Ensure TaRDIS' broad visibility by spreading knowledge about project activities and its results.
- Reach, stimulate, and engage a critical mass of relevant stakeholders to ensure that the project results are effectively showcased, leading to widespread validation, improvement, and further adoption of the developed technologies and concepts.
- Facilitate exploitation of project outcomes and promote the development of innovative solutions based on the TaRDIS technologies and architecture.
- Foster an impactful contribution to relevant standardisation bodies.
- Ensure close coordination with the EuCEI community and establish liaisons with relevant initiatives, such as BDVA, SNS-JU, etc.

Besides describing the communication, dissemination, and community-building activities conducted by the TaRDIS consortium during M01-M18 of the project, D8.3 presents actions taken to address recommendations offered during the previous project review, plans of activities after the project's end, and offers an overview on standardisation plans developed by project partners.

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## ABBREVIATIONS

BDVA	Big Data Value Association
CCSDS	Consultative Committee for Space Data Systems
EBDVf	European Big Data Value Forum
EC	European Commission
ECSS	European Cooperation for Space Standardization
EU	European Union
EuCEI	European Cloud Edge IoT
D	Deliverable
ETSI	European Telecommunications Standards Institute
ICT	Information and Communication Technology
IDE	Integrated development environment
IEC	International Electrotechnical Commission
IEEE-SA	Standards Association of the Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IoT	Internet of Things
ITU	International Telecommunication Union
M	Month
Q1	Quarter 1
R&I	Research and Innovation
RIA	Research and Innovation Action
SDO	Standards Development Organisations
WIPO	World Intellectual Property Organization
WP	Work Package
W3C	World Wide Web Consortium



## 1 INTRODUCTION

During the period from M1 to M18 of the project, WP8 was dedicated to implementing an extensive range of tools and initiatives to initially disseminate information and engage with relevant stakeholders. WP8 worked in close collaboration with other WPs in the TaRDIS project, the EuCEI community, the European Commission, and other pertinent swarm computing projects.

### 1.1 PURPOSE OF THE DOCUMENT

The Outreach Activities Mid-Term Report for the reporting period (Jan 2023 – June 2024) presents an overview of the communication and dissemination activities of the TaRDIS project. This deliverable expands upon the strategic framework established in Deliverable 8.1, "Dissemination and Communication Strategy and Plan" and aims to achieve the following objectives:

- Describe the implemented communication and engagement activities, as well as the monitoring and evaluation processes.
- Illustrate how the methods, tools, and promotional materials have been utilised in the project's dissemination and communication efforts.
- Provide a comprehensive summary of the communication activities. The report focuses on the key actions carried out during the initial communication phase of the project. This phase aimed at proactively engaging target stakeholders, generating interest in TaRDIS' activities and outcomes, and establishing a robust foundation for the planned dissemination activities.

### 1.2 STRUCTURE OF THE DOCUMENT

The sections of this deliverable are organised in the following manner: After the introductory Section 1, Section 2 depicts communication and dissemination activities and tools used during the first half of the project (M1-M18). Section 3 describes the collaboration and liaisons with other projects and initiatives, section 4 describes the tools behind assessing impact. Section 5 describes the standardisation, open source, and policy recommendation activities undertaken by the project. And finally, Section 6 concludes the document.

## 2 DISSEMINATION AND COMMUNICATION

Communication and dissemination activities are central to the overall TaRDIS effort. They are being closely monitored and coordinated to ensure an effective engagement of all targeted stakeholders, including those in the broader cloud-edge-IoT and decentralised swarm ecosystems, as well as related vertical domains. To raise awareness and maximise the impact of the project, a comprehensive communication and dissemination plan was developed in Q1 of the project (see D8.1 for details). Its execution began at the early project stages and continued at a steady pace throughout its whole duration. Building upon the activities outlined in the Dissemination and Communication Strategy and Plan (D8.1) - a set of dedicated online and offline activities, outlined below, has been pursued to support the achievement of project objectives and ensure a broad promotion and effective showcasing of developed concepts, technologies, use cases, and project results. These activities are conducted under MARTEL's leadership and guidance, with active contributions from all TaRDIS project partners.

WP8 leads a set of dedicated dissemination and communication actions with the following objectives:

- Ensure broad visibility and awareness of TaRDIS, promoting project knowledge and establishing a recognizable identity to support promotional and marketing efforts.
- Engage and stimulate a critical mass of relevant stakeholders to effectively showcase project results, leading to validation and further adoption of the developed technologies.
- Contribute significantly to relevant scientific domains and standardisation bodies as appropriate and relevant to planned exploitation plans and project outcomes.
- Establish liaisons and ensure close collaboration with relevant initiatives in the industry and R&I domains, particularly those in the EuCEI community, and other similar initiatives.

### Communication and Dissemination Phases

In the reporting period, dissemination and communication activities were carried out related to the first and second phases of communication and dissemination activities, as defined in D8.1, section 2.1.

During the first and the second phases, the primary focus was on engaging target stakeholders and presenting the results of the project. The following communication strategy and activities were carried out:

- Organising the first workshops: TaRDIS project organised a series of internal workshops in collaboration with the technical work packages of the project in order to generate the use-case requirements and initiate other technical discussions.
- Presenting project results: TaRDIS showcased the initial outcomes and milestones at various events and conferences.
- Producing videos to raise awareness: These promotional videos were created to highlight the project's objectives, achievements, and impact.

- Animating social media channels: The project team actively engaged with stakeholders and the public through various social media platforms.
- Publishing news items on the project website and media: Regular updates were posted to keep stakeholders informed about the project's progress.
- Distributing newsletters: Periodic newsletters were sent out to stakeholders to maintain interest and update them on project milestones.
- Participating in events: Team members attended events to network, share knowledge, and promote the project.

## 2.1 COMMUNICATION AND DISSEMINATION ACTIVITIES M1-M18

### 2.1.1 Project Website

The TaRDIS website <https://www.project-tardis.eu/> (see Figure 2), has been developed to act as an information hub presenting the project's goals, activities, and achievements. The website was launched in January 2023 at the time of the official start of the project and features the following:

- General information about the project, its vision, objectives, and anticipated impact.
- Information about project use cases and enabling functions.
- A brief introduction to all members of the consortium.
- News items and press releases.
- List of relevant events.
- A repository of resources, such as scientific publications, presentations/talks, promotional materials, videos, and public deliverables.
- Contact forms and information.
- An acknowledgment and reference to the European Union's Horizon Europe Research and Innovation programme and the Swiss Confederation Federal Department of Economic Affairs, Education and Research (acknowledging the funding agency for the Swiss Associate partner).



Figure 1: TaRDIS website

The website is being periodically updated according to the evolution of the project. All data represented in the current document are based on the analytics from June 2024. In terms of reach/engagement, in the reporting period, the website counts **2249 unique visitors** that have generated **4890 page views** and an average visit duration of **1 min and 35 seconds**, as shown in Figure 2.

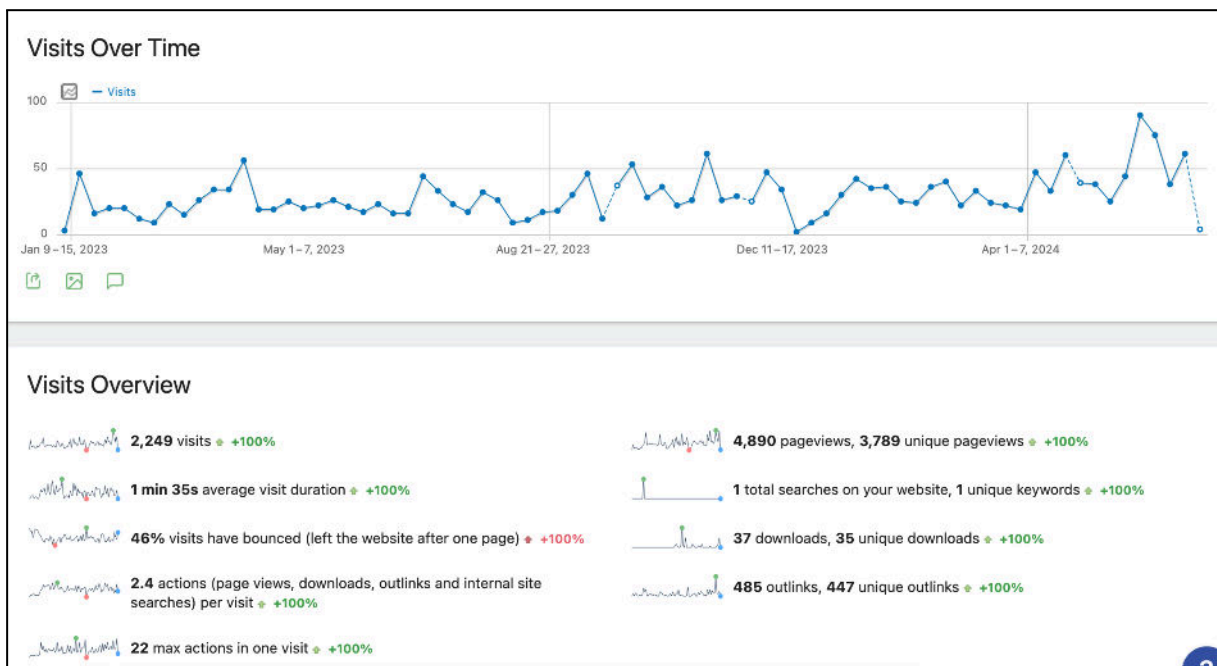


Figure 2: TaRDIS website analytics

The most viewed pages of the website are (see Figure 3):

## Pages

PAGE URL	PAGEVIEWS	UNIQUE PAGEVIEWS
<a href="#">/index</a>	2,510	1,827
<a href="#">news</a>	538	433
<a href="#">consortium</a>	354	281
<a href="#">about-tardis</a>	352	272
<a href="#">use-cases</a>	268	230
<a href="#">deliverables</a>	188	160
<a href="#">event</a>	211	157
<a href="#">contacts</a>	98	90
<a href="#">events</a>	93	81
<a href="#">promo-materials</a>	69	67
<a href="#">scientific-publications</a>	49	44
<a href="#">subscribe</a>	46	42

Figure 3: TaRDIS website individual page views

## Visitor Map

2,249 visits

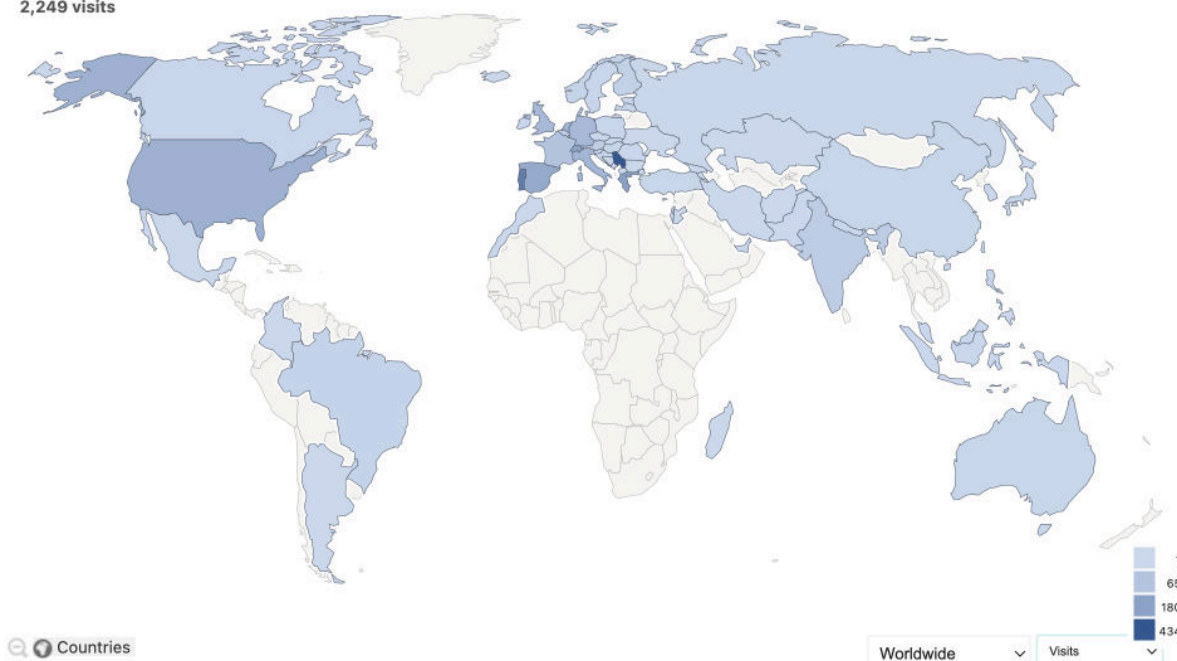


Figure 4: Geographical distribution of the visitors of TaRDIS website

Most visits, seen in Figure 4, are from Serbia, Portugal, Greece, and Switzerland. This reflects, in part, the composition of the consortium and the communication activities undertaken by partners.

Based on the provided analytics data for the TaRDIS website for the period of Jan 2023 to Jun 2024, we have the following traffic sources:

- **Direct:** 1199 visits (53%): Direct traffic occurs when users type the website's URL directly into their browser's address bar, access it through browser bookmarks, or click on a link in an email or a document (e.g., a PDF). This traffic source often reflects users who are already familiar with the project or have visited the website before.
- **Organic Search:** 674 visits (30%): Organic search traffic refers to users who found the website through a search engine (e.g., Google, Bing, Yahoo) by entering relevant keywords.
- **Referral:** 248 visits (11%): Referral traffic is generated when users visited the website by clicking on a link from another website. This can include links in blog posts, news articles, or online directories.
- **Social:** 128 visits (5%): Social traffic comes from users who find and visit the website through social media platforms (e.g., Twitter, LinkedIn).

### Measures to improve website traffic:

**1. Enhance Organic Search Traffic:** Organic search accounts for 30% of the total traffic, indicating that there is significant room for improvement. To boost organic search traffic, we will focus on:

- Conducting thorough keyword research and incorporating relevant keywords into the website's content.
- Improving on-page SEO by optimising metadata (title tags, meta descriptions, header tags, etc.) and creating high-quality, informative content that engages visitors.
- Utilising internal and external links to improve site navigation and build a strong backlink profile.
- Regularly updating and maintaining the website to ensure optimal performance and user experience.

**2. Strengthen Social Media Presence:** Social media contributes to only 5% of the total traffic, indicating potential growth in this area. To increase social traffic, we will consider:

- Developing a consistent and engaging social media strategy that includes regular content updates, audience engagement, and promotion of the website.
- Leveraging various social media platforms such as Twitter and LinkedIn to reach a wider audience.
- Creating shareable content (e.g., blog posts, infographics, videos) to encourage our audience to share your content on their social media profiles.

**3. Boost Referral Traffic:** With referrals accounting for 11% of the total traffic, there's room to increase this metric. To enhance referral traffic, we will consider:



- Establishing partnerships with relevant industry websites, blogs, or online communities.
- Engaging in guest posting on authoritative websites in the TaRDIS niche.
- Offering valuable resources, such as whitepapers or webinars, that can be shared by other websites.

**4. Direct Traffic:** Direct traffic constitutes more than half of the website's traffic, 53%. It is important to understand the source of this traffic and identify potential growth opportunities. We will consider:

- Ensuring that the website is easily accessible through clear navigation, fast loading times, and mobile-friendly design.
- Encouraging repeat visitors by offering valuable content.
- By focusing on these recommendations, we can work towards a more balanced traffic acquisition strategy and increase the overall performance of the TaRDIS website.

All information and e-mails collected are protected under the General Data Protection Regulation (GDPR). Contact is and will continue to only be made with people who have submitted inquiries. Similarly, the newsletters are and will continue to be sent out only to individuals who have explicitly requested to receive them. Any person who has subscribed can request for their e-mail address to be removed from the list. The website provides information on the data kept and how they are used in alignment with the GDPR under the Privacy policy link (footer of the webpage).

Last but not least, TaRDIS opted for an environmentally responsible website hosting platform, which has been designed to be as energy efficient as possible to limit the unnecessary waste of resources. The web hosting provider, GreenGeeks, puts back three times the power consumed into the grid in the form of renewable energy.

### 2.1.2 Social Media Channels

TaRDIS established its presence on social media channels to regularly promote project activities and outputs while encouraging a wider discussion on topics related to swarm computing research and development as well as topics like AI/ML, programming language, cloud-edge-IoT, distributed computing, etc. The project has built a fair follower base on prominent social media channels, namely X/Twitter and LinkedIn, which are all linked to the project's website.

For most of the promotional posts, social media cards are created following the brand identity of the project (or of the event), and these social media cards are used for the promotion of project events, international days of relevance, newsletter announcements etc. Some examples of social media cards produced for TaRDIS project are :





Figure 5: TaRDIS project social media cards

### 2.1.2.1 X (Former Twitter)

TaRDIS uses X/Twitter, as it is a very dynamic social network covering the news in real-time at a global level. To date, the TaRDIS X account (@TARDIS\_EU) has attracted **218 followers**. The project follows 114 accounts, mostly projects, and initiatives in similar fields. The project’s X account is used predominantly to promote and disseminate project activities and developments but also to learn about and cross-share relevant and interesting events and initiatives and to establish meaningful connections with relevant stakeholders, including policy makers, industry, and the general public.



Figure 6: TaRDIS X Channel



### 2.1.2.2 LinkedIn

LinkedIn, as one of the biggest business networks in the world (over 150 million users in more than 200 countries and territories), is a useful tool for TaRDIS. It allows the project to network with individuals and organisations within the industry and beyond, share relevant information about project activities, and stay up to date on the latest developments in the field. To date, the TaRDIS LinkedIn account (tardis-project) has attracted **406 followers**. Similar to X, the LinkedIn account is used to promote project activities and learn about and cross-share relevant events and activities. Figure 7 presents the project's LinkedIn profile.

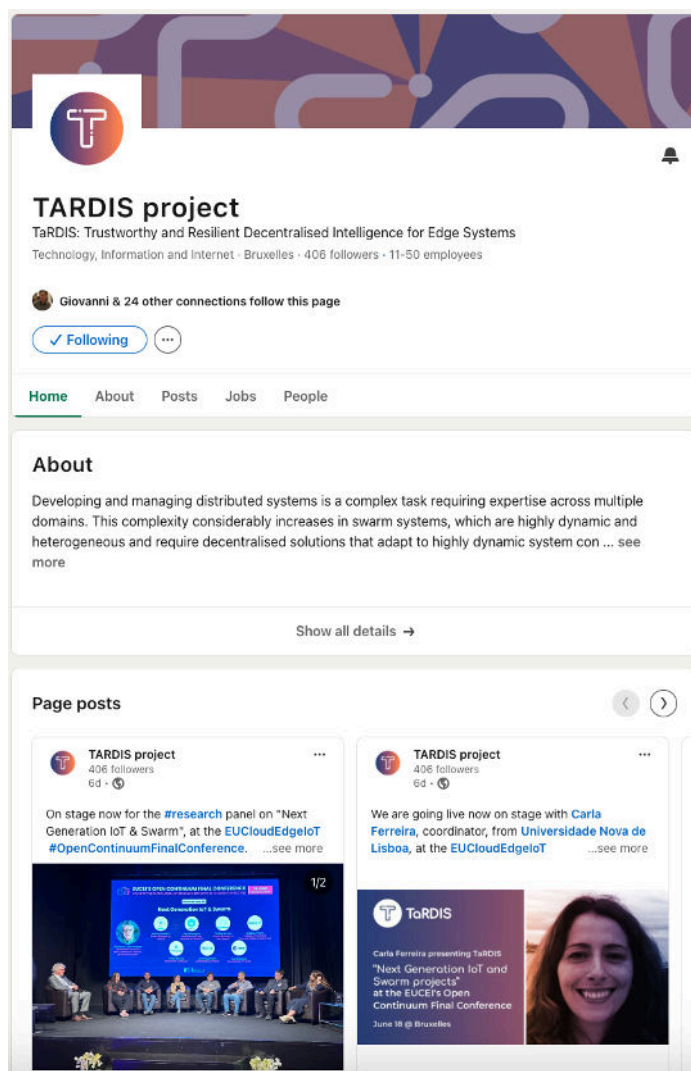


Figure 7: TaRDIS LinkedIn page

### 2.1.3 News items, press releases

The TaRDIS consortium keeps the community and the general public informed about relevant activities, undertakings, and events by publishing news items and press releases. To date, **13 news items** and **1 press release** have been published on the project website.

Figure 8 shows the news items published on the website.

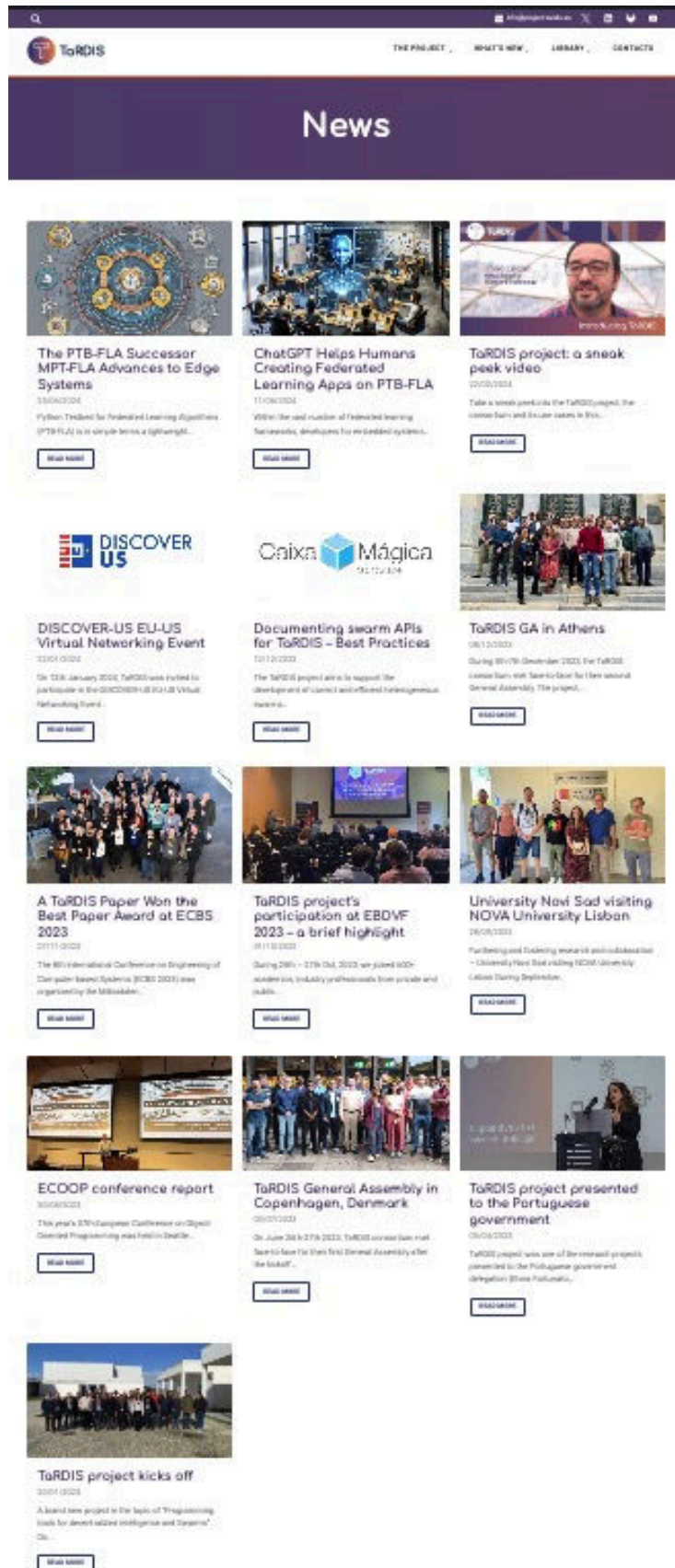


Figure 8: TaRDIS project News webpage

### 2.1.4 Newsletters

The TaRDIS periodic newsletter is sent out twice a year, providing updates on the swarm computing topics, programming languages, cloud-edge-iot, AI/ML ecosystems as well as on the project activities, findings, and results. The project newsletters also contain information on the upcoming tasks, events, as well as any relevant news and announcements from individual project partners when relevant. A mailing list based on subscription has been created, giving the possibility to share the newsletter via mass mailing. A registration functionality allowing interested visitors to subscribe to the newsletter has been available on the project website since the beginning of the project. The design of each newsletter is aligned with the TaRDIS brand identity. The newsletter is also fully responsive to ensure its readability on any device.

All issued newsletters are being uploaded on the website upon their distribution to subscribers. To date, 2 newsletters have been sent out (see Figure 9).

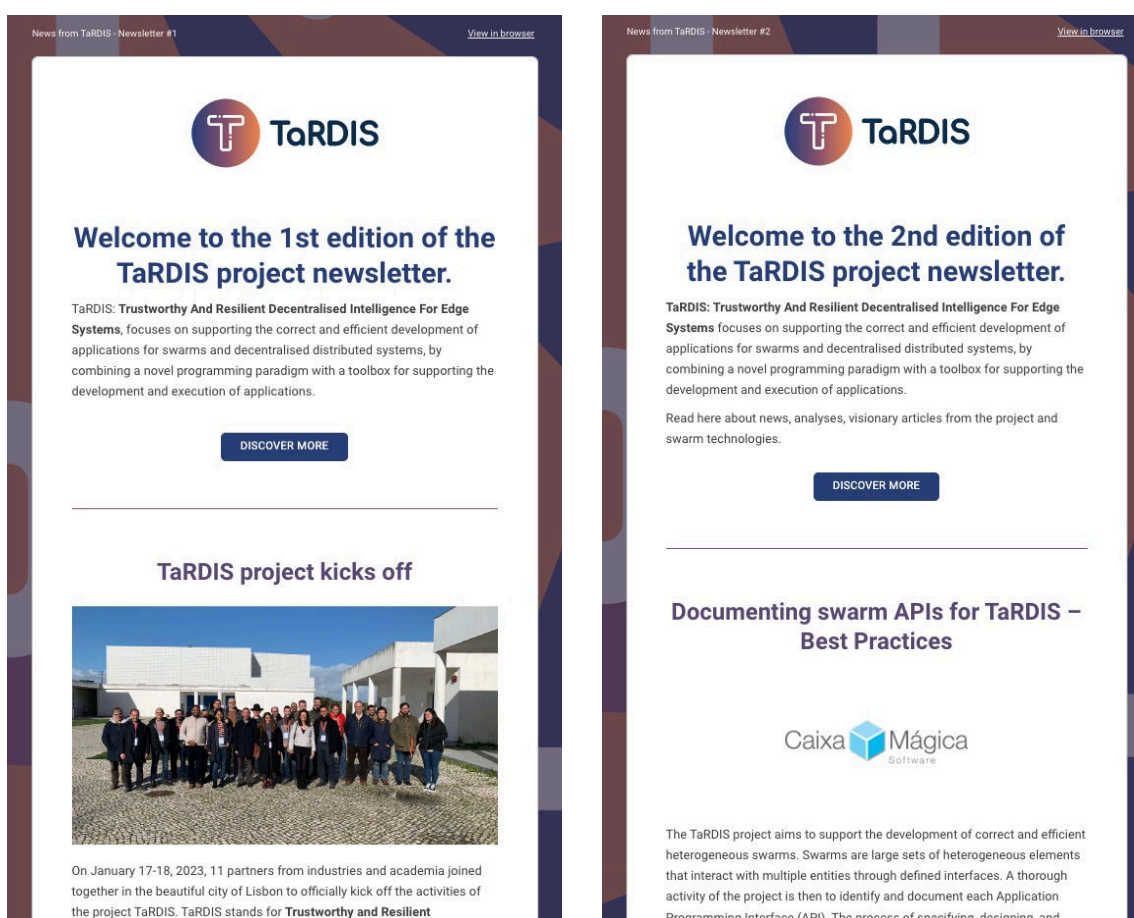


Figure 9: TaRDIS published newsletters

### 2.1.5 Publications

The TaRDIS consortium is committed to bringing research results closer to the public and adheres to the Open Access guidelines set by the Horizon Europe work programme. All project partners are strong supporters of Open Access as it enables all interested parties to use published research results irrespectively of their location or income, boosting the transfer of knowledge between science, the economy, and society at large. The project has been very active in that sphere since its early stages. Table 1 below lists all the accepted/published papers stemming from TaRDIS in the reporting period.

Table 1: TaRDIS project scientific publications

Title	Authors	Place of publication
<b>Empowering 6G maritime communications with distributed intelligence and over-the-air model sharing</b>	Menelaos Zetas, Sotirios Spantideas, Anastasios Giannopoulos, Nikolaos Nomikos, Panagiotis Trakadas	Frontiers Journal
<b>A Hierarchical Namespace Approach for Multi-Tenancy in Distributed Clouds</b>	Miloš Simić, Jovana Dedeić, Milan Stojkov, Ivan Prokić	IEEE Journal
<b>Machine learning in orbit estimation: A survey,</b>	Francisco Caldas, Cláudia Soares	Acta Astronautica
<b>PeersimGym: An Environment for Solving the Task Offloading Problem with Reinforcement Learning</b>	Frederico Metelo, Stevo Racković, Pedro Ákos Costa, Cláudia Soares	ECML 2024
<b>PTB-FLA Development Paradigm Adaptation for Generative Large Language Models</b>	Miroslav Popovic, Marko Popovic, Ivan Kastelan, Miodrag Djukic, Ilija Basicevic	Computer Science and Information Systems: ComSIS
<b>AtomiS: Data-Centric Synchronization Made Practical</b>	Hervé Paulino, Ana Almeida Matos, Jan Cederquist, Marco Giunti, João Matos, António Ravara	Proceedings of the ACM on Programming Languages, Volume 7
<b>Anticipation of Method Execution in Mixed Consistency Systems</b>	Marco Giunti, Hervé Paulino, António Ravara	SAC 2023: Proceedings of the 38th ACM/SIGAPP Symposium on Applied Computing
<b>Data-Dependent Confidentiality in DCR Graphs</b>	Eduardo Geraldo, João Costa Seco, Thomas Hildebrandt	PPDP 2023: 25th International Symposium on Principles and Practice of Declarative Programming
<b>Rollback Recovery in Session-Based Programming</b>	Claudio Antares Mezzina, Francesco Tiezzi, Nobuko Yoshida	"COORDINATION 2023 Lisbon Portugal"
<b>Programming language implementations with multiparty session types</b>	Nobuko Yoshida	"ABS Workshop Lyon France"
<b>Dynamically Updatable Multiparty Session Protocols: Generating Concurrent Go Code from Unbounded Protocols</b>	David Castro-Perez, Nobuko Yoshida	ECOOP 2023 Seattle USA



<b>Designing Asynchronous Multiparty Protocols with Crash-Stop Failures</b>	Adam D. Barwell, Ping Hou, Nobuko Yoshida, Fangyi Zhou	ECOOP 2023 Seattle USA
<b>Orchestration of Federated Learning Algorithms from the Perspective of Formalization and Verification</b>	Ivan Prokić, Silvia Ghilezan, Simona Prokić, Miroslav Popović, Marko Popović, Ivan Kaštelan	SANU AI 2023, Belgrade, Serbia
<b>Over-the-Air Computation with Quantized CSI and Discrete Power Control Levels</b>	Christos Tsinos, Sotirios Spantideas, Anastasios Giannopoulos and Panagiotis Trakadas	Hindawi Journal
<b>P4R-Type: A Verified API for P4 Control Plane Programs</b>	Jens Kanstrup Larsen, Roberto Guanciale, Philipp Haller, and Alceste Scalas	OOPSLA 2023, Cascais, Portugal
<b>Developing Elementary Federated Learning Algorithms Leveraging the ChatGPT</b>	Miroslav Popović, Marko Popović, Ivan Kaštelan, Miodrag Đukić, Ilija Bašičević	TELFOR 2023, Belgrade, Serbia
<b>Local-First at Actyx</b>	Roland Kuhn, José Duarte	PLF @ SPLASH'23, Cascais, Portugal
<b>Correct orchestration of Federated Learning generic algorithms: formalisation and verification in CSP</b>	Ivan Prokić, Silvia Ghilezan, Simona Prokić, Miroslav Popović, Marko Popović, Ivan Kaštelan	ECBS 2023, Västerås, Sweden
<b>A Federated Learning Algorithms Development Paradigm</b>	Miroslav Popović, Marko Popović, Ivan Kaštelan, Miodrag Đukić, Ilija Bašičević	ECBS 2023, Västerås, Sweden
<b>VeriFx: Correct Replicated Data Types for the Masses</b>	Kevin De Porre, Carla Ferreira, Elisa Gonzalez Boix	ECOOP 2023, Seattle USA
<b>Behaviorally Typed State Machines in TypeScript for Heterogeneous Swarms</b>	Roland Kuhn, Alan Darmasauptra	ISSTA 2023, Seattle USA
<b>Behavioural Types for Local-First Software</b>	Roland Kuhn, Hernán Melgratti, Emilio Tuosto	ECOOP 2023, Seattle USA
<b>Studying the Workload of a Fully Decentralized Web3 System: IPFS</b>	Pedro Ákos Costa, João Leitão, Yiannis Psaras	DAIS 2023: Distributed Applications and Interoperable Systems
<b>A Simple Python Testbed for Federated Learning Algorithms</b>	Miroslav Popović, Marko Popović, Ivan Kaštelan, Miodrag Đukić, Silvia Ghilezan	ZINC 2023, Novi Sad, Serbia
<b>Set in Stone: Analysis of an Immutable Web3 Social Media Platform</b>	Wenrui Zuo, Aravindh Raman, Raul Mondragon, and Gareth Tyson	WWW '23: Proceedings of the ACM Web Conference 2023

<b>Will Admins Cope? Decentralized Moderation in the Fediverse</b>	Ishaku Anaobi, Aravindh Raman, Ignacio Castro, Haris Bin Zia, Dami Iboiola, and Gareth Tyson	WWW '23: Proceedings of the ACM Web Conference 2023
<b>Task queue implementation for edge computing platform</b>	Veljko Maksimović, Miloš Simić, Milan Stojkov, Miroslav Zarić	ICIST 2023, Kopaonik, Serbia
<b>Access control in a distributed micro-cloud environment</b>	Tamara Ranković, Miloš Simić, Milan Stojkov, Goran Sladić	ICIST 2023, Kopaonik, Serbia
<b>Authentication and identity management based on zero trust security model in micro-cloud environment</b>	Ivana Kovačević, Milan Stojkov, Miloš Simić	ICIST 2023, Kopaonik, Serbia

### 2.1.6 Project Videos

The TaRDIS project has a YouTube channel for its videos. So far **2 videos** have been published on the website, a Project Overview video and a short video created during the EuCEI Concertation Event in 2023.

Figure 10 shows the videos page on the website.

## Videos

Workshops, webinars and project's interviews.

Follows us and subscribe our [YouTube channel](#).

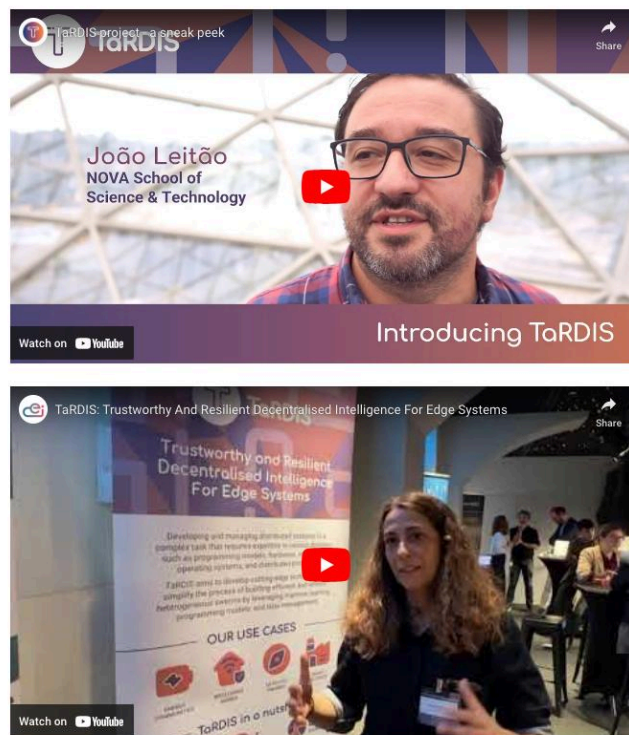


Figure 10: TaRDIS published videos on the website

### 2.1.7 Digital and printed promotional materials

The TaRDIS project started in the post COVID world which meant that activities were mostly taking place requiring physical presence. Since the beginning of the project, the partners have been very active in participating in various events and conferences where they have carried the promotional materials, such as rollup, flyers etc, as per the occasion required. We have produced 1 version of the rollup and 5 versions of the flyer so far.

All promotional materials are printed as well as uploaded on the website.



Figure 11: TaRDIS project promo materials (demo flyers and rollup)



Figure 12: TaRDIS project promo materials (postcard)

### 2.1.8 Events

Event organisation and attendance are an important aspect of the TaRDIS' communication and dissemination's strategy. Since the project kicked off in January 2023, TaRDIS coordinator and project partners have taken a very proactive step in raising awareness about the project in the European and global swarm computing and cloud-edge-IoT communities.

Table 2 provides further details on attended events for the reporting period.

Table 2: TaRDIS Events Overview



No	Name of the event	Type of event	Location and date	Focus/target stakeholders	URL	Planned presence	Partner involved
1	Nova University Portuguese Government delegation event	Scientific event	Lisbon, 29 Mar 2023	Academics	<a href="https://www.project-tardis.eu/news/2023/04/05/tardis-project-presented-to-the-portuguese-government/">https://www.project-tardis.eu/news/2023/04/05/tardis-project-presented-to-the-portuguese-government/</a>	Presentation	NOVA
2	EUCEI Concertation event	Seminar	Brussels, 10-11 May 2023	Industry, academia	<a href="https://eucloudedgeio.t.eu/concentration-and-consultation-meeting-on-computing-continuum-uniting-the-european-ict-community-for-a-digital-future/">https://eucloudedgeio.t.eu/concentration-and-consultation-meeting-on-computing-continuum-uniting-the-european-ict-community-for-a-digital-future/</a>	Presentation	NOVA, Martel
3	Babel Framework Tutorial	Tutorial	Lisbon, 19 Jun 2023	Academics	<a href="https://www.discotec.org/2023/tutorials">https://www.discotec.org/2023/tutorials</a>	Tutorial	NOVA
4	Discotec 2023	Conference	Lisbon, Portugal	Academia	<a href="https://www.discotec.org/2023/tutorials">https://www.discotec.org/2023/tutorials</a>	Organisation	NOVA
5	EBDVF 2023	Workshop, panel	Valencia, October 2023	Industry, academia	<a href="https://european-big-data-value-forum.eu/session/european-efforts-on-creating-sustainable-heterogeneous-warm-systems-across-computing-continuum/">https://european-big-data-value-forum.eu/session/european-efforts-on-creating-sustainable-heterogeneous-warm-systems-across-computing-continuum/</a>	Presentation, Panel	Martel, NOVA
6	NWPT 2023 workshop	Conference	23.11.2023	Academic	<a href="https://conf.researchr.org/details/nwpt-2023/nwpt-2023-papers/16/A-New-Take-on-Join-Patterns">https://conf.researchr.org/details/nwpt-2023/nwpt-2023-papers/16/A-New-Take-on-Join-Patterns</a>	Presentation	DTU
7	Discover-USA CSA networking event	Webinar	15.01.2024	Industry, academia	Not public event	Presentation	NOVA, GMV, Actyx
8	Dagstuhl seminar 24051 "Next Generation Protocols for Heterogeneous Systems"	Seminar	Schloss Dagstuhl, 28 Jan - 2 Feb 2024	Academia, industry	<a href="https://www.dagstuhl.de/en/seminars/seminar-calendar/seminar-details/24051">https://www.dagstuhl.de/en/seminars/seminar-calendar/seminar-details/24051</a>	Presentation	Actyx, DTU, Oxford
9	13th International Conference on Information Society and Technology (ICIST 2023)	Conference	Kopaonik, Serbia 12 - 15 Mar 2023	Academia	<a href="https://www.eventiotic.com/eventiotic/conference/icist2023">https://www.eventiotic.com/eventiotic/conference/icist2023</a>	Presentation	UNS
10	8th IEEE Zooming Innovation in Consumer Technologies International Conference (ZINC 2023)	Conference	Novi Sad, Serbia 29 - 31 May 2023	Academia, industry	<a href="https://www.gozinc.org/">https://www.gozinc.org/</a>	Presentation	UNS

11	8th International Conference on Engineering of Computer-based Systems (ECBS 2023)	Conference	Västerås, Sweden 16 - 18 Oct 2023	Academia	<a href="https://conf.researchr.org/home/ecbs-2023">https://conf.researchr.org/home/ecbs-2023</a>	Presentation	UNS
12	31st Telecommunications Forum (TELFOR 2023)	Conference	Belgrade, Serbia 21 - 22 Nov 2023	Academia, industry	<a href="https://www.telfor.rs/">https://www.telfor.rs/</a>	Presentation	UNS
13	Artificial Intelligence Conference 2023	Conference	Belgrade, Serbia 26 - 27 December 2023	Academia	<a href="https://www.mi.sanu.ac.rs/~ai_conf/">https://www.mi.sanu.ac.rs/~ai_conf/</a>	Presentation	UNS
14	Dagstuhl seminar 24051 "Next Generation Protocols for Heterogeneous Systems"	Seminar	Schloss Dagstuhl, 28 Jan - 2 Feb 2024	Academia, industry	<a href="https://www.dagstuhl.de/en/seminars/seminar-calendar/seminar-details/24051">https://www.dagstuhl.de/en/seminars/seminar-calendar/seminar-details/24051</a>	Presentation	Actyx, DTU, Oxford, UNS
15	ST30	Workshop	Portugal 22-23 October 2023	Academia	<a href="https://2023.splashcon.org/home/st-anniversary-30">https://2023.splashcon.org/home/st-anniversary-30</a>	Presentations and participation	Oxford, Nova, DTU
16	PPDP 2023	Conference	Cascais, Portugal 22-23 October 2023	Academia	<a href="https://ppdp2023.webs.upv.es/">https://ppdp2023.webs.upv.es/</a>	Presentation	NOVA
17	OOPSLA 2023	Conference	Cascais, Portugal	Academia	<a href="https://2023.splashcon.org/track/splash-2023-oopsla">https://2023.splashcon.org/track/splash-2023-oopsla</a>	Presentation	NOVA
18	EuCEI RIA Showcase Webinar - Tackling the ever-increasing complexities of developing efficient heterogeneous swarm systems	Webinar	Online, 28 May 2024	Academia, industry	<a href="https://www.project-tardis.eu/event/eucloud-edgeiot-webinar/">https://www.project-tardis.eu/event/eucloud-edgeiot-webinar/</a>	Presentation, Panel	NOVA, Martel
19	EuCEI's Open Continuum Final Conference 2024	Seminar	18th June 2024, Brussels	Academia, Industry, policy makers, EC	<a href="https://eucloudedgeiot.eu/event/euceis-open-continuum-final-conference-registration-now-open/">https://eucloudedgeiot.eu/event/euceis-open-continuum-final-conference-registration-now-open/</a>	Panel	NOVA

At the time of writing this deliverable, TaRDIS is planning to organise a technical workshop in the upcoming EBDVF 2024, 2-4 October at Budapest. There is ongoing discussion with cluster projects OASEES and INCODE to present the cutting edge technologies of these projects. The details of this workshop will be reported in the next Outreach activities report.

### 3 COLLABORATION AND LIAISONS WITH OTHER PROJECTS AND INITIATIVES

#### 3.1 LIAISONS WITHIN THE EUCEI ECOSYSTEM

The European Cloud Edge & IoT Continuum is an umbrella initiative that was brought to life by the OpenContinuum and the UnlockCEI projects to coordinate and support the European Cloud, Edge and IoT continuum ecosystems. The European Cloud & Edge IoT Continuum goal is to unlock the potential of these transformative technologies by understanding the supply and demand value chains in Europe.

The ECloudEdgeIoT (EuCEI) brings an inclusive vision supporting actionable recommendations and solutions for the next generation of Cloud-Edge-IoT for researchers, industry, and policymakers. Through effective partnerships, the initiative guides its stakeholders towards defining an integrated, open ecosystem built around open source, open standards, and the seamless and effective blending of cloud, IoT and edge.

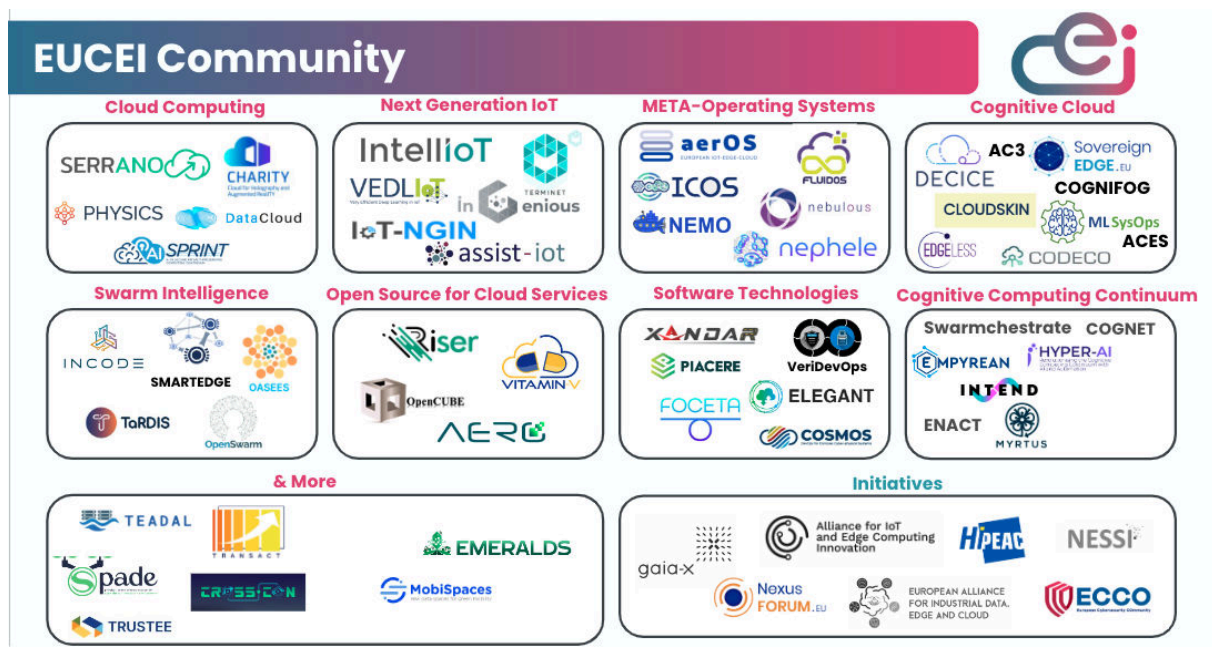


Figure 13: The EuCEI community

TaRDIS is one of the over 50 RIAs that are part of this vibrant ecosystem and a number of activities are coordinated and supported by this initiative.

The EuCEI is supported by the European Commission, therefore in case of the need to understand the advancement in one of the focus areas, an event is organised to generate the inputs.

TaRDIS joins the **Task Force 6 from the EuCEI community** which is on communications and dissemination. There are more than 50 RIA projects and some initiatives like HiPEAC, that join this call regularly. The communications task force calls takes place monthly and there is possibility to include projects news and events on the EuCEI website, newsletters and further echo via EuCEI social media channels.

### 3.2 LIAISONS AND EVENTS - RELEVANT INITIATIVES AND PROJECTS

TaRDIS has participated in a number of events organised by the EuCEI initiative.

On 10-11 May 2023, TaRDIS participated in the EuCEI's organised Concertation event, located in Brussels. Dr. Carla Ferreira, the coordinator of the TaRDIS project, participated in the event with an introductory presentation about the project.

TaRDIS organised a session at EBDVF 2024, that took place in Valencia. This session, "European efforts in creating sustainable heterogeneous swarm systems across computing continuum", was jointly organised and sponsored by TaRDIS and INCODE (a swarm computing cluster project). The session started with a short presentation each on TaRDIS and INCODE followed by a panel discussion where the panellists were from organisations like EuCEI, Digital4Planet, TaRDIS, INCODE.

On 15th of January 2024, TaRDIS was invited to participate and present in the DISCOVER-USA networking event. This was an invitation based webinar and TaRDIS (along with all the other swarm computing cluster projects) were invited to give a brief introduction to the project with an introduction to the use cases. The DISCOVER-USA project tries to bridge the European projects with NSF (USA) projects. Dr. Carla Ferreira and use case partners from EDP and Actyx had participated in this webinar.

On 28th of May 2024, TaRDIS together with INCODE, organised and hosted the EuCEI RIA showcase webinar on the topic "Tackling the ever-increasing complexities of developing efficient heterogeneous swarm systems". During this event, Dr. Carla Ferreira, the coordinator of the TaRDIS project presented the project, current developments, and participated in the panel discussion hosted by the coordinator of OpenContinuum CSA (one of the CSAs behind the EuCEI initiative). In this webinar all 5 of the swarm computing projects participated and shared the challenges and lessons learnt.

On 18th of June 2024, Dr. Carla Ferreira, participated in the EuCEI "OpenContinuum" Final Conference, that took place in Brussels. In this event, Dr. Ferreira participated as a panellist in the research panel on "Next Generation IoT and Swarm".

During the course of the writing of this document, the dissemination partner is planning to organise a technical workshop at the upcoming EBDVF 2024, taking place during 2-4 October in Budapest. We are in discussions with projects OASEES and INCODE for a joint session to present the current technological outputs of the project and discuss the synergies between these projects.

TaRDIS is also participating in the discussions with the Horizon Result Booster team in order to create an impactful dissemination and exploitation of the project results. All 5 projects from the cluster have come together to avail this service offered by the Horizon Result Booster team which is an initiative supported by the European Commission. A detailed outcome of this activity will be presented in the final version of the Outreach Activities deliverable (D8.4).

## 4 IMPACT ASSESSMENT

### 4.1 DISSEMINATION AND COMMUNICATION KPIS

The following metrics, Table 3, are used to monitor and assess the progress of the communication and dissemination activities and provide some measurable outcomes related to their impact created (as far as this is feasible from a quantitative point of view).

*Table 3: Dissemination and Communication KPIS*

Tool/Activity	KPI	Target value	Value at M18
<b>Website</b>	Unique visitors average (yearly)	1500	2249
<b>Social media</b>	Number of followers (by project end) on X Number of followers (by project end) on LinkedIn	≥ 1000 (both accounts)	X - 218 LinkedIn-406
<b>Promo materials</b>	Number of flyers Number of posters/rollups	6 4	5 1
<b>Videos</b>	Number of published videos	≥ 6	2
<b>Press releases</b>	Number of press releases tailored to specific target groups	≥ 4	1
<b>Newsletters</b>	Number of newsletters sent out	6	2
<b>Fairs, conferences &amp; events</b>	To diffuse results to the academic community and industry, receive feedback and discover scientific cooperation opportunities.	≥ 9	19
<b>Demos</b>		4 demos	-
<b>Publications</b>		≥ 30	29
<b>Workshops</b>		≥3	2

### 4.2 IMPACT CREATION DELIVERABLES AND MILESTONES

*Table 4: List of planned deliverables for the Communication Dissemination and Standardisation Work Package*

Number	Name	Lead partner	Dissemination level	Due date	Status at M18
D8.1	Dissemination and Communication Strategy and Plan	MARTEL	PU	M03	Submitted
D8.2	Exploitation and sustainability strategy and plan	CAIXA MAGICA	SEN	M18	Pending

D8.3	Outreach activities mid-term report	TID	PU	M18	Current document
D8.4	Exploitation and sustainability roadmap	CAIXA MAGICA	PU	M36	Pending
D8.5	Outreach activities final report	TID	PU	M36	Pending



## 5 STANDARDISATION, OPEN SOURCE, AND POLICIES CONTRIBUTIONS

This Section reports on the activities carried out within Task 8.2. on Standardization, Open Source, and Policies contributions of the TaRDIS project. In particular, it provides an overview of the objectives and strategies of this task, as well as it reports on activities carried out so far within the project.

### 5.1 STANDARDISATION

#### 5.1.1 Objectives and Strategy

Concerning the standardisation activities, the main objectives of this task are the following:

1. Identify the applicable standards and the standardisation potential of the TaRDIS outcomes
2. Use the standardisation system as a tool for dissemination, market acceptance of the project results and for interaction with the market stakeholders.

Specifically, this task aims at identifying the technical standards which will enable applicability and seamless integration of the TaRDIS project with the state-of-the-art solutions and will recognize the outcomes that could be standardised. Throughout this task, there will be bidirectional communication with standardisation technical committees and the relevant standardisation bodies.

In order to achieve the aforementioned objectives, the strategy was defined as follows:

1. Collection of key topics of interests and standards to study because of their relevance to the project's outcomes.
2. Identification of the standardisation bodies that are relevant to the project and project outcomes that could impact decisions on these bodies.
3. Guidance of the project partners through providing information about and guiding them through the procedure of standardisation. This could be done through working groups and technical committees meetings to ensure an active representation, reporting on the project advances and raising awareness about potential or ongoing standardisation efforts.
4. Promotion of collective decisions and participation in targeted events and networking sessions and organisation of targeted workshops within the consortium.

As the TaRDIS toolbox is still shaping, the standardisation activities within the period M1-18 are concentrated mainly on the first two steps above. For this reason, a survey was conducted within the TaRDIS consortium in order to identify the main topics of interest and standards to study. This allows us to identify the relevant standardisation bodies/committees where the consortium could contribute to. Moreover, at this stage and guided by the collected inputs, Task 8.2 aims at informing the partners about possible ways of participation in the standardisation process.

Before reporting on the actions taken so far and their outcomes, we will provide an overview of standards and standardisation processes. This overview is the result of the initial research conducted for this task during the first months of the project. This will also introduce the

terminology that is necessary for the rest of this section and present the lifecycle of a standard.

### 5.1.2 Overview of Standards and Standardisation Processes

We first provide some necessary definitions:

A **standard** (French: norme, German: Norm) is a document that provides rules, guidelines or characteristics for activities or their results, for common and repeated use<sup>1</sup>. Some of the types of documents referred to as Standards are:

- Standards,
- International Standards,
- Technical Specifications,
- Technical Reports,
- Guides/Recommendations.

**Standards Development Organisations (SDOs)** are organisations whose statutory purpose is to develop standards and that put in place formal, well-defined procedures to guarantee a fair development process. A few examples of SDOs are: ISO (International Organization for Standardization), IEC (International Electrotechnical Commission), ETSI (European Telecommunications Standards Institute), ITU (International Telecommunication Union), IEEE-SA (Standards Association of the Institute of Electrical and Electronics Engineers), IETF (the Internet Engineering Task Force), and W3C (World Wide Web Consortium). The logos of these SDOs are depicted in the following figure.



Figure 14: Examples of SDOs

In particular, the table below gives the technical scope of some well-established SDOs in the domain of information and communication technology (ICT).

Table 5: SDOs and technical scope in ICT field [1]

<sup>1</sup> Retrieved from the official website of the European Committee for Standardization (CEN): <https://www.cencenelec.eu/european-standardization/european-standards/types-of-deliverables/>



Organisation	Technical Scope of Activity
ITU-T	Interoperable telecom specifications including architecture, services, protocols, addressing/numbering plans.
ISO	ICT architecture (OSI model), services, protocols including application layer protocols.
IEC	Electrotechnical standards, including connectors, electrical safety, and tests.
ETSI	Interoperable ICT specifications including architecture, services.
CEN	Household appliances, Intelligent Transportation and Mobility, Smart Grids and Smart Metering, Cybersecurity, Blockchains.
CENELEC	Electrotechnical standards, incl. connectors, switches, plugs, sockets, electrical installation, electrical safety and tests, electromagnetic compatibility, communication systems using the electricity supply lines, Smart Grids and Smart Metering,
IEEE	Electrical and Electronics: LANs, MANs (IEEE 802), Emerging technologies (AI, IoT, automotive, robotics, home automation... ).
IETF	All Internet-related specifications, including protocols, generic applications, addressing rules (IP, URL, etc.).

Following the fundamental definitions concerning the standardisation ecosystem, we provide a review of the life cycle of standardisation documents. While the steps that are contained in the life cycle of standards documents may differ from one SDO to another, there are some common points among the various procedures designed by the SDOs. Figure 15 depicts the main steps of the standards lifecycle.

The first step is related to the identification of the need for a new standard that initiates the procedure. This starts with the submission of a proposal to the SDO. Once the submitted proposal passes some kind of formal approval from the involved SDO, the SDO prepares a detailed workplan, while defining how it is to be carried out within its own organisation, the time schedule, the final target outcomes, and the allocation of relevant resources.

Once the planned workplan comes into place, the relevant standardisation documents enter a "drafting" phase that involves technical and editorial work. When the documents are considered mature and stable, they transit into an "approval" phase to be officially released. However, if this is not the case, then the documents can transit between the drafting and approval phases multiple times. Once published, a standard is considered a "living" document. The introduction of changes in the document requires going through the aforementioned steps.

The final step of a standard's life cycle corresponds to its withdrawal due to obsolescence. This is usually initiated due to the assessment that new standards are replacing one or more established standards. Once withdrawn, a standard is usually still retrievable in the SDO's repository, to keep track of the evolution.

The procedure described above is a typical application of the top-down standards development approach that is followed by SDOs such as CEN/CENELEC and ETSI [1].

However, IETF adopts a bottom-up process where a standard proposal is first submitted as a draft by participants of a working group and is revised until it becomes an Internet Draft. Drafts are discussed and reviewed by the working group and potentially are accepted as a workgroup item, with the chairs having the final decision. Then, the draft is forwarded to the Internet Engineering Steering Group where it might be revised and updated. It is later submitted for review to the IETF community, which may initiate discussions on remaining issues and their solutions. After approval, it is published as a Request for Comments (RFC).

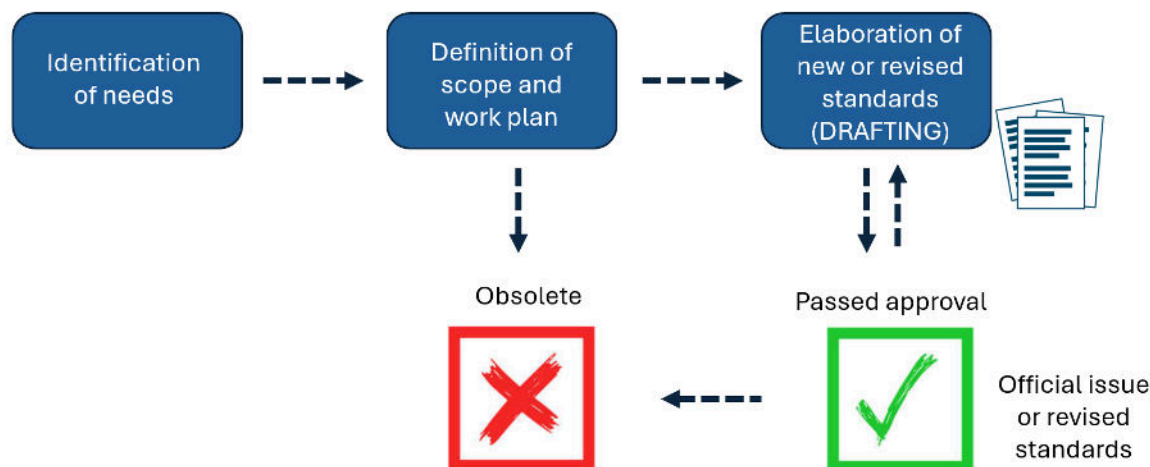


Figure 15: The standards life cycle (image based on the information in [1])

In what follows, we provide details on the survey on standardisation that was conducted for the purposes of Task 8.2.

### 5.1.3 Conducted Survey

The effort regarding the collection of data on standardisation efforts relevant to TaRDIS is carried out within Task 8.2. Specifically, a survey was conducted among all partners involved in technical WPs/tasks, i.e., WPs 2 to 7, in order to collect the following information, per work package, per task, and per partner:

- i. The key topics that each partner is or will be involved in during their participation in the project, per task.
- ii. The standards each partner is already using for the performance of each Task.
- iii. The standards each partner is planning on using for the performance of each Task.
- iv. The standardisation bodies/committees of which each Task member is part.

The survey was conducted by circulating a dedicated Excel file among the consortium and collecting the filled files. Below, snippets of this file are provided.

A	B	C
1 Dear Partner,		
2 In order to organize the standardization activities within the TaRDIS project (Task 8.2), we kindly ask you to fill in the following.		
3		
4 Partner's Name:		
5		
Description of the Basic Role of the Partner (e.g., WP2 leader and Task 7.1 leader):		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

**Table 1: Please state as a list the key topics you will be involved in during your participation in the project per Task.**

Note: For your convenience, the information of the WP and the Task Name have been drawn from the agreement and can be selected from the available dropdown menus. One organization can insert more than one lines, since they may be involved in many WPs | Tasks | Topics. In blue below you may find an example on how to fill the table.

WP Title	Task Name	Key Topics/Keywords (at least 5)
e.g., WPG: Data Management and Distribution Primitives	e.g., Task 6.1: Decentralised membership and communication primitives	e.g., secure communications, peer-to-peer communications, data management, ...
WP2: Definition of heterogeneous swarms		
WP3: Programming Abstractions for the Cloud-Edge Continuum		
WP4: Programming Logic and Analysis Framework		
WP5: Decentralised Machine Learning		
WP6: Data Management and Distribution Primitives		
WP7: Implementation and Evaluation		

Figure 16: Table for collection of key topics/keywords

**Table 2: For each of the topics that you have identified in Table 1, please indicate the standards you are a) already using (top) and b) planning to investigate/use (bottom).**

Note: In blue below you may find an example and a list of some standards issuing organizations that may provide standards related to the project. A dropdown menu is available to fill in the relevant project task.

Related Standard Issuing Organization	Related Standard Identifier	Related Standard Title	Related TaRDIS Task
e.g., IEEE, ISO, ETSI, UL standards, IEC, ...	e.g., ISO/IEC 29151:2017	e.g., Information technology -- Security techniques -- Code of practice for personally identifiable information protection	e.g., Task 6.1: Decentralised membership and communication primitives
<b>Standards you are currently using and are related to TaRDIS</b>			
<b>Standards you are planning to investigate on their relevance to TaRDIS</b>			

Figure 17: Table for collection of related standards

Table 3: Do you personally or your organization take part in any standardization activity?			
If yes, please provide the details (e.g. Standardization Organization   Title of committee or standard   Type of participation   Status of effort). If no, leave blank. In blue below you may find an example.			
<i>e.g., ISO</i>	<i>e.g., ISO 27032</i>	<i>e.g., Contributor</i>	<i>e.g., Contribution in the definition of swarm based on the findings of WP2</i>
Standardization Organization	Title of committee or standard	Type of participation	Status of effort related to TaRDIS (if any)

Figure 18: Table for collection of partners’ involvement in standardisation activities/bodies.

In the next subsection, we provide some preliminary results following the partners’ inputs in the conducted survey.

### 5.1.4 Preliminary standards survey results

Below, we provide the results of the key topics collection depicted in a word cloud. We note that the keywords with the largest number of occurrences were: requirements (12 occurrences), implementation (12 occurrences), use case (9 occurrences), learning (8 occurrences), IDE (6 occurrences), and specification (6 occurrences).

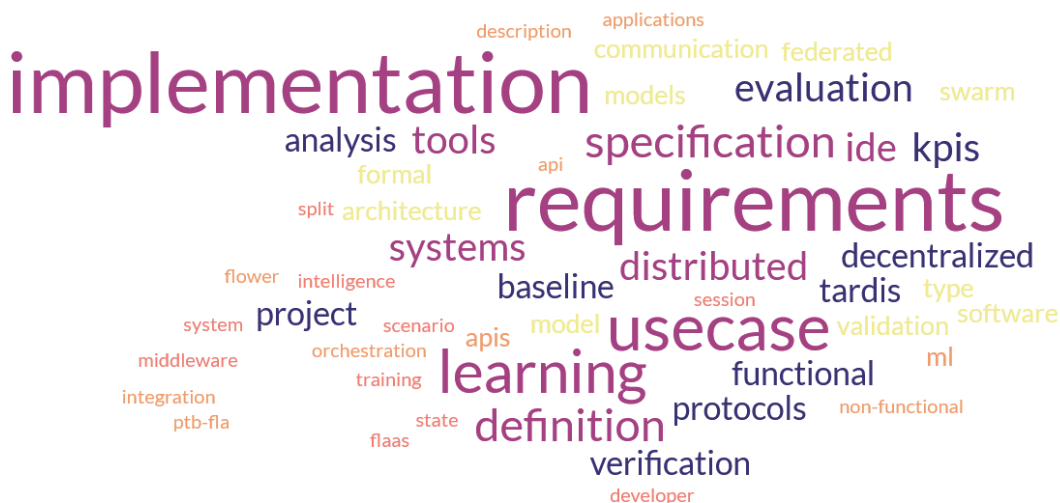


Figure 19: Word cloud created from the collected input of key topics/keywords in TaRDIS project

As mentioned earlier, the project partners were asked to provide a few standards each that are relevant to the tasks they are involved in. The purpose of this collection is to study the

state-of-the-art, identify needs for standardisation, and thus be able to initiate the procedure of contributing to a standard. The list of the collected standards is provided below.

*Table 6: : Standards the consortium complies with*

<b>Standard Issuing Organisation</b>	<b>Standard Identifier</b>	<b>Standard Title</b>	<b>Related TaRDIS task</b>
P4 Language Consortium / Linux Foundation	P4	P4 Language Specification, P4 Runtime Specification	Task 4.1

*Table 7: Collected standards to be studied for their relevance to the project*

<b>Standard Issuing Organisation</b>	<b>Standard Identifier</b>	<b>Standard Title</b>	<b>Related TaRDIS task</b>
IEEE Standards Association	IEEE 2785-2023	IEEE Standard for Architectural Framework and General Requirements for Smart Home Systems	Task 7.3
IEEE Standards Association	IEEE 3652.1-2020	IEEE Guide for Architectural Framework and Application of Federated Machine Learning	Task 5.1
IEEE Standards Association	IEEE 2986-2023	IEEE Recommended Practice for Privacy and Security for Federated Machine Learning	Task 5.1
IEEE Standards Association	IEEE 1903.1-2017	IEEE Standard for Content Delivery Protocols of Next Generation Service Overlay Network	Task 6.1
IEEE Standards Association	P2958	Standard for a Decentralized Identity and Access Management Framework for Internet of Things	Task 6.1
ETSI	ETSI TR 104 031 (technical report)	Securing Artificial Intelligence (SAI); Collaborative	Tasks 6.1 and 7.3

		Artificial Intelligence	
ETSI	ETSI GS ZSM 012 (group specification)	Zero-touch network and Service Management (ZSM); Enablers for Artificial Intelligence-based Network and Service Automation	Task 6.1
ETSI	ETSI TS 128 105 (technical specification)	5G; Management and orchestration; Artificial Intelligence/ Machine Learning (AI/ML) management	Task 7.3
ISO	ISO/IEC 30118-5:2021	Open Connectivity Foundation (OCF) Specification, Part 5: OCF device specification	Task 6.1
IETF	RFC 5280	Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile	Task 6.1
IETF	draft-ietf-suit-mud-08	Strong Assertions of IoT Network Access Requirements	Task 6.1
IEC	IEC 62443-3-3:2013	Industrial communication networks - Network and system security - Part 3-3: System security requirements and security levels	Task 2.2
IEC	IEC 61907:2009	Communication network dependability engineering	Task 2.3
IEC	IEC 62559-2	Use case methodology - Part 2: Definition of the templates for use cases, actor list and	Task 2.2

		requirements list	
CCSDS	CCSDS 133.0-B-1	Space Packet Protocol	Task 6.1
ECSS	ECSS-E-ST-70-41	Packet Utilization Standard	Task 6.1
ECSS	ECSS-E-ST-40C	Software development	Task 7.1
ECSS	ECSS-Q-ST-80C	Software product assurance	Task 7.1

We observe that the majority of the collected standards are issued by the SDOs that have been already mentioned earlier, i.e., IEEE SA, ETSI, ISO, IEC, and IETF, since their technical scope is relevant to the project. We note that the CCSDS (Consultative Committee for Space Data Systems) and the ECSS (European Cooperation for Space Standardization) are SDOs specifically related to one of the use cases, namely the use case “Distributed navigation concepts for LEO satellites constellations” related to swarms of satellites.

### 5.1.5 Participation in Standardization

Taking into consideration the collected standards that are relevant to different tasks of the project, we identify major SDOs that could be the potential host for the standardisation efforts of the consortium. As mentioned above, these are: IEEE SA, ETSI, ISO, IEC, and IETF. As a first step, an initial research on how project partners could participate in the technical committees of the aforementioned SDOs, especially for the partners with minimum involvement in standardisation efforts.

First of all, the task identified 3 consortium members that are ETSI members: DTU, NKUA, and TID<sup>2</sup>. The membership is established typically after an application and payment of fees that depend on the size of the company or organisation. The membership also comes with voting rights while entities with the status of observer don't have any voting right<sup>3</sup>. Among a large number of different committees and specification groups at ETSI<sup>4</sup>, we identified -among others- the Zero touch network & Service Management (ZSM) group as a group of interest for the project's outcomes and we will further study how the project could contribute.

Another identified SDO of interest is IETF whose main focus is the Internet. The IETF makes voluntary standards that are often adopted by Internet users, network operators, etc. Unlike ETSI that was discussed above, there is no membership in the IETF since it mainly operates through mailing lists and online meetings. Anyone can participate by signing up to a working group mailing list, or registering for an IETF meeting. All IETF participants are considered volunteers and expected to participate as individuals, including those paid to participate. Among around 500 mailing lists/working groups operated under the umbrella of IETF<sup>5</sup>, some working groups of interest might be:

- In the Internet Area: “IPv6 over Networks of Resource-constrained Nodes”

<sup>2</sup> <https://www.etsi.org/membership/members>

<sup>3</sup> <https://www.etsi.org/membership/become-a-member>

<sup>4</sup> <https://www.etsi.org/committees>

<sup>5</sup> <https://datatracker.ietf.org/wg/>



- In the Security Area: “Authentication and Authorization for Constrained Environments”, and “Lightweight Authenticated Key Exchange, Transport Layer Security”.

Moreover, IETF organises *hackathons*<sup>6</sup> that are free to attend and open to everyone. Unlike other hackathons, they are collaborative events and not competitions. IETF Hackathons aim at collaborations and development of ideas, sample code and solutions that show practical implementations of IETF standards. This can reach larger audiences than a typical SDO and promotes the collaborative spirit of open source development within IETF.

Further, the Task 8.2 will continue working towards identifying relevant SDOs (e.g., IEEE, IEC, etc.) and the current involvement of partners in such committees/working groups, as well as ways of participating and actively contributing to them. Deliverable 8.5 (M36) will further report on this.

Finally, this task recognises the coupling of standardisation efforts and patents, especially for the consortium partners that are active in standardisation and/or the ones in the industrial domain. This coupling concerns the potential conflict between patents and standards, especially in the case where the implementation of a standard is tightly linked to the use of technology protected by one or more patents. In order to minimise this risk of conflict and to assure a smooth and wide dissemination of standardised technology and the project’s outcomes, this task will discuss such issues and inform the consortium about common practices. A useful guideline could be the resources available on the website of the World Intellectual Property Organization (WIPO).<sup>7</sup>

### 5.1.6 Next steps

As next steps, Task 8.2 plans to continue collecting the necessary information that can help identify SDOs and standards relevant to TaRDIS. It will also continue to investigate how TaRDIS outcomes could comply with ongoing standards and, more importantly, how project findings could be standardised, when applicable. Moreover, Task 8.2 will guide the project partners through the procedure of standardisation by providing necessary information. This will be achieved through dedicated meetings or workshops within the consortium.

## 5.2 OPEN SOURCE AND POLICIES

### 5.2.1 Objectives and Strategy

Concerning the open source and policies activities, the main objectives of this task are the following:

1. Ensure that TaRDIS becomes available as an open source interoperable and extensible toolbox through collective decisions and coordination within the consortium
2. Coordinate efforts that ensure that the results of the project are effectively showcased to the community of policymakers.

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<sup>6</sup> <https://www.ietf.org/meeting/hackathons/>

<sup>7</sup> <https://www.wipo.int/patent-law/en/developments/standards.html>



In order to achieve the aforementioned objectives, the strategy was defined as follows:

1. Collection of TaRDIS-related repositories and partners' practices (developer platforms<sup>8</sup> of choice, licences, distribution methods)
2. Initiation of discussions within the consortium that can lead to collective decisions either through dedicated meetings or workshops.
3. Circulation of information on how TaRDIS toolbox becomes available in an organised manner so that its discoverability is increased.
4. Coordination of efforts towards reaching policymakers through dedicated events.

### 5.2.2 Collection of TaRDIS repositories and survey on developer platforms

The collection of the TaRDIS repositories was managed through an excel file that contributors of the TaRDIS toolbox were invited to fill. In the figures below, we show how this excel file was organised.

<p><b>Dear Partner,</b>                  In order to organize the efforts on open-source policies within the TaRDIS project (Task 8.2), we kindly ask you to fill in the following tables (first and second tab).</p>		
<p><b>Partner's Name:</b></p>		
<p><b>Description of the Basic Role of the Partner</b> (e.g., WP2 leader and Task 7.1 leader) :</p>		
<p style="text-align: center;"><b>Please report on the use of developer platforms in the context of TaRDIS</b></p>		
<p>Name of the developer platform(s)/version control system(s) you are using in the context of TaRDIS (e.g., GitHub, GitLab, ...)</p>	<p>Describe in 1-2 phrases the reasons for which you chose this platform (e.g., ease of use, premium subscription provided by my organization)</p>	<p>Report on any previous experience with this platform (e.g., I have been using it since 2 years ago, Used it in previous EU projects)</p>

Figure 20: Table for collection of habit/trends related to developer platforms among the TaRDIS partners

<sup>8</sup> Also called collaborative or distributed version control platform/site.

Please provide information on the repositories related to TaRDIS, *one line per repository*						
Related TaRDIS tool(s) / use-case baseline (e.g., TID's baseline implementation)	Type of licence used (e.g., Creative Commons, MIT, ...)	Maturity level of code (select from the dropdown menu)	Is the code publicly available? (select Yes/No)	If the code is publicly available, has it been used/mentioned/cited by a third party (i.e., outside of the TaRDIS consortium)?	If the code is publicly available, is TaRDIS mentioned/acknowledged in this repository?	Comments possibly related to previous entries (e.g., explain why the tool/baseline is not open source)

Figure 21: Table for collection of the TaRDIS-related repositories

This led to a collection of 44 repositories, 23 of which are functional while 21 of them are under development/testing at the time of the collection. The collected repositories cover a large number of WPs and tasks. In particular, they cover Tasks 3.2, 4.1, 5.1, 5.3, 6.1, 6.2, 7.1, 8.1. We believe that this collection is useful for the purposes of the project's management. Further findings concerning the habits of the consortium members about the developer platforms, the open source licences, and distribution methods are presented in the next sections.

### 5.2.3 Open source survey results

So far, most of the repositories are hosted on GitLab, while there are some hosted on GitHub and Google Colab. The exact numbers are provided in Figure 22.

Within the internal survey/questionnaire, we asked the project partners to provide the reasons for which they prefer to use a version control platform. The most dominant reason was the ease of use. Other reasons include: 1) the fact that is open source, 2) premium or in-house instances are provided by their organisation, 3) the fact that it is free, 4) the fact that it is well-established in respective communities, 5) due to previous experience with the specific developer platform, 6) reliability, and 7) the fact that it is cloud-based. We provide the statistics collected in the figure below. Finally, we note that all of the contributors of the collected repositories have at least a few years of previous experience with the platforms they are using.

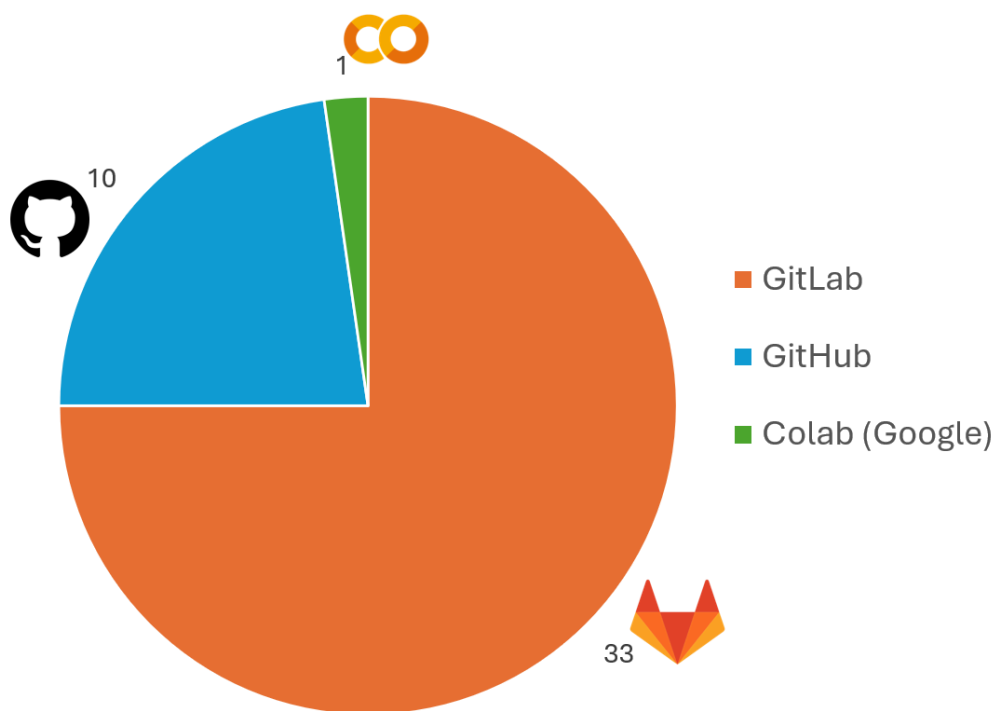


Figure 22: Distribution of TaRDIS-related repositories (as reported/collected in M18) among different developer platforms.

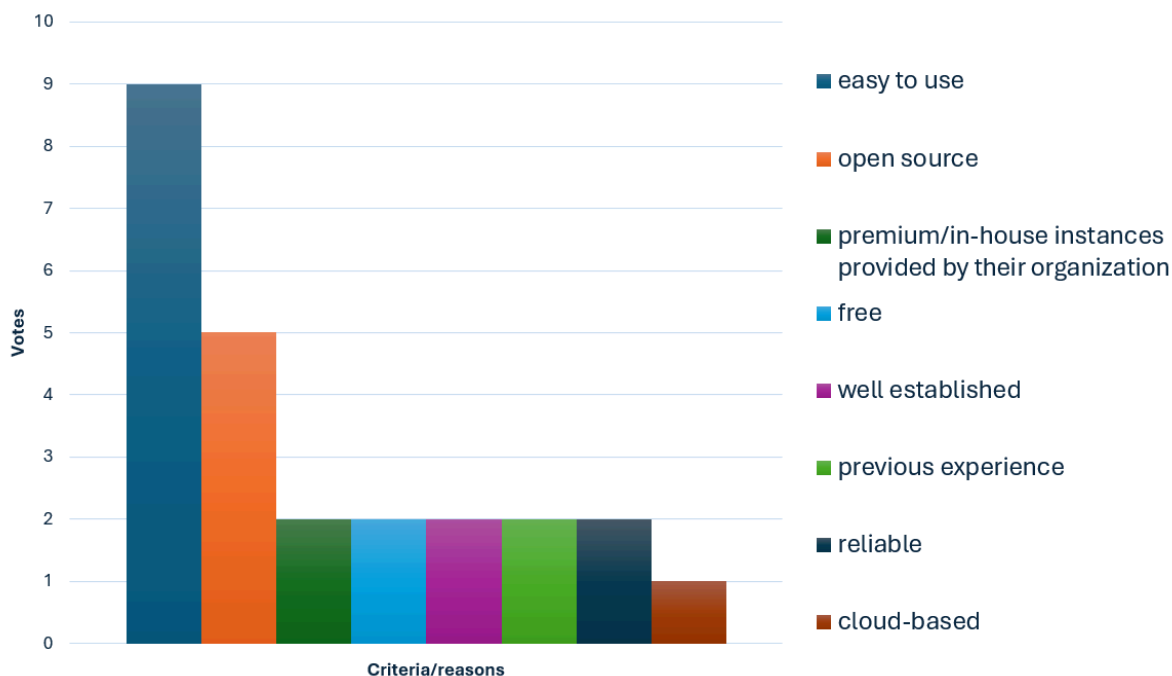


Figure 23: Most common reasons for choosing a developer platform (according to the internal survey)

As shown in the screenshots of the survey provided in the previous section, one of the questions in the survey was about the acknowledgement of the project in the open source repositories. The majority of the repositories that are available online acknowledge TaRDIS,

and screenshots of 2 such repositories are provided in the figure below. All the repositories that are linked with a publication acknowledge the project in the publication and sometimes in the repository as well. Besides, it was reported that 7 of the collected repositories have been either used or cited or mentioned by third parties (i.e., outside of the TaRDIS consortium).

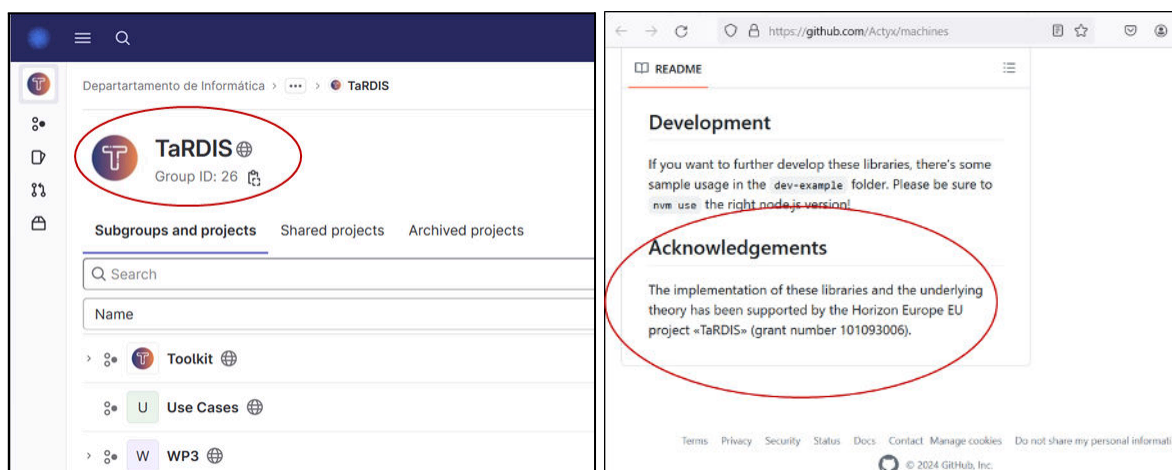


Figure 24: Screenshots of some repositories related to TaRDIS and their acknowledgement to the project

Moreover, TaRDIS' website contains a link to a collection of repositories on Gitlab dedicated to the TaRDIS toolbox. A screenshot is provided in Figure 25.

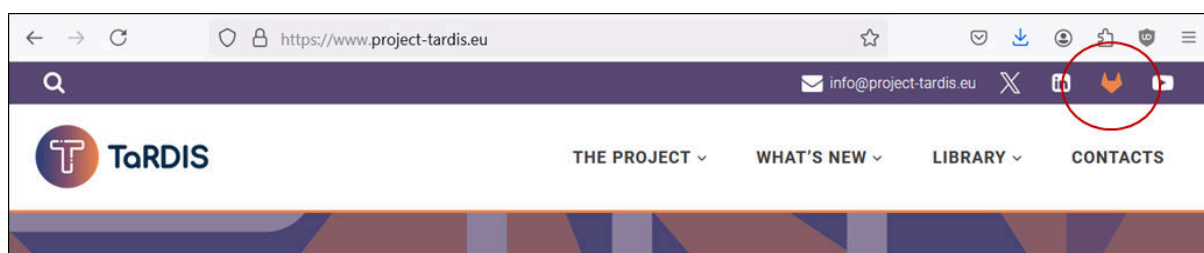


Figure 25: Link to the collection of repositories on GitLab at TaRDIS' homepage

## 5.2.4 Open Source Software Licences

An open source licence is a legal contract between the developer/owner and end user that describes the conditions under which a piece of software can be used, modified, and shared. This licence is what turns software components into open source components, allowing developers to use that software so long as they respect the specific terms and conditions laid out in the licence. There are two widely recognized types of open source licences: Copyleft and Permissive licences. Both grant permission to change and distribute the software in question. Typically, they require attribution and disclaim liability. Popular examples of copyleft licence include the GNU GPL, Mozilla Public License and Eclipse Public License. On the other hand, popular examples of permissive licence include MIT, BSD, and Microsoft Public License (Ms-PL). We also note that software may not necessarily be associated with any licence, although this can lead to both legal liability for the developer, and lack of protection of his own intellectual property.

A variety of licences are used within the repositories that are publicly available. The most common ones are: MIT licence, EPL v2.0, Apache 2, and GPL-3.0. Their logs are depicted in the figure below.



Figure 26: The top 4 open source licences used in TaRDIS-related repositories according to the survey/collection of repositories

The “popularity” of the various open source licences in TaRDIS is in line with the general trend observed in open source repositories as shown in the figure below.

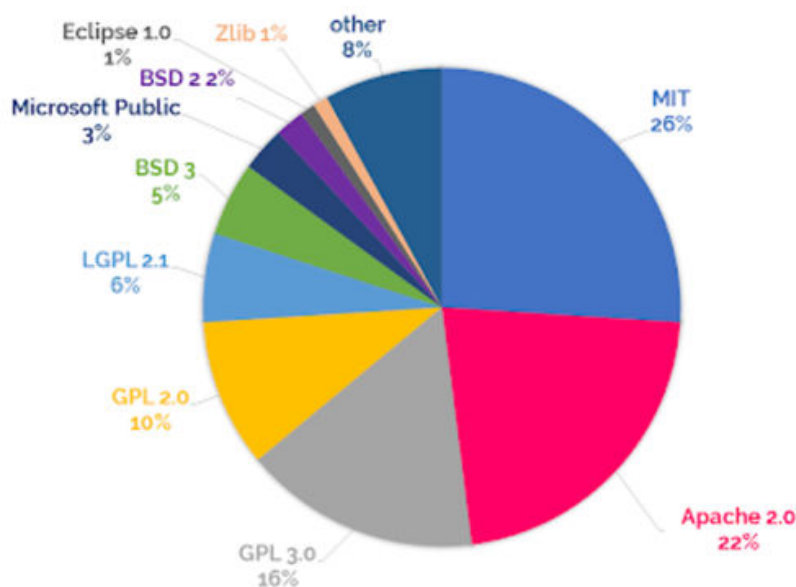


Figure 27: The top Open Source licences in 2018 (Source: WhiteSource Software through [www.activestate.com](http://www.activestate.com)<sup>9</sup>)

The TaRDIS consortium is currently in the process of defining a recommended policy for the adoption of open source licences on the publicly available artefacts produced by the project, namely the different components in the TaRDIS toolbox. As discussed above, the use of licences is important from various perspectives. Specifically:

- from a public image standpoint: to make it clear that the output of the project are effectively within the realm of the open source community;
- from a legal standpoint, to protect the consortium from possible liability on the usage of the provided tools, particularly considering that many of them are still evolving as

<sup>9</sup> <https://www.activestate.com/blog/the-developers-guide-open-source-software-license-comparison/>

result of the research and development being conducted by TaRDIS. Moreover, it is important to protect the intellectual property of both the TaRDIS consortium as a whole, and individual partners that have led the design and development of particular tools in the TaRDIS toolbox.

### 5.2.5 Distribution

A question that arises when one thinks of open source policies is the distribution (or packaging) of the developed code/software. This concerns the process of delivering software to the end user, that, in the case of TaRDIS, is the swarm developer. The idea is to collect, assemble, and configure the software components built so that it can essentially be used "as it is".

When one decides on the distribution of a software toolkit, the following properties are important to consider: universality, user and developer-side simplicity, security, OS integration, transferability, and discoverability. Given the aforementioned criteria, nowadays, the following software distribution methods have come to dominate the software distribution market:

- 1) Zipped folder,
- 2) Installer or package or library (e.g., Windows Installer Packages .msi)
- 3) Repository (e.g., GitLab or GitHub)
- 4) App store for mobile applications (e.g., Google Play)

We also note that there exist language-specific tools for distribution. As an example, in the case of Python, one can easily build a package using `setup.py` and distribute it publicly on PyPi (<https://pypi.org/>) or privately using a Git repository. Also, in the domain of Java, maven appears as a somewhat equivalent alternative.

The purpose of this task is to provide the necessary information concerning the different options of distributing the different components of the toolbox and guide discussions within the TaRDIS consortium in order to achieve a collective decision on this matter. This is planned to be achieved through dedicated meetings and discussions

So far, TaRDIS tools that are built are mostly available in open source repositories (see Section 5.2.3) since they are often linked to publications or collective projects. As is common in research, code accompanying a publication is available online on the most common developer platforms (e.g., GitHub, GitLab, etc.). Since publications are often deadline-oriented, the current repositories can benefit from a collective decision on the distribution of TaRDIS toolbox.

Focusing on distribution of the components of the TaRDIS toolbox, we have to consider the nature of these elements. In fact, tools in the toolbox belong to different classes and hence the way they can be leveraged on by developers building their own swarm application is different and benefits from a different distribution strategy. To help the reader in understanding this aspect of distribution allow us to provide a few examples:

- *Software modules that can be used as a library*: Some of the components in the TaRDIS toolbox are distributed protocols or frameworks that are used in development



time directly by the developer. This includes tools/software such as the Babel framework, or a concrete implementation of a distributed protocol for this framework. Such components of the TaRDIS toolbox are therefore more suitable for distribution through a public repository (e.g., a maven repository) which has the advantage of simplifying the distribution of fixes and patches to the community as these tools evolve.

- *Software systems that are used as services by swarm applications and that have their own execution lifecycle*: This category captures (distributed) services that can be used as a building block but whose life cycle is independent of the swarm application being developed. Most cloud computing services fall in this category, for instance, think of a distributed database such as Cassandra or CosmosDB. For tools like this, that in the TaRDIS toolbox includes storage solutions such as Arboreal or PotionDB, the best distribution strategy is through binaries accompanied by tools to assist the developer in installing/setting up these systems (these tools can be either, packages that define services in Linux, or simply shell scripts that accompany the binary, among others).
- *Developer centred tools*: These tools include Integrated Development Environments (IDEs) such as Eclipse, and local stand alone tools that the programmer can use in his machine to, for instance, verify static properties of code of the application (an example of these in TaRDIS is our IDE - an extension of Eclipse, and verification tools being produced by WP4). For this type of tools, the best distribution is through installers that developers can run on their operating systems (MSI for Windows, dmg for Mac).

In conclusion, a unified approach to the distribution of the TaRDIS toolbox could provide a convenient way of distributing the toolkit as a single unit, including any configuration or auxiliary files which might be needed for a developer to build a swarm. This is particularly important for the visibility and discoverability of the project's outcome and can further promote the minimization of the swarm developer's effort.

### 5.2.6 TaRDIS and policy makers

An analytical framework for policy making has impact on the following main categories<sup>10</sup>:

- Wellbeing of individual, society, and social life
- Trade and economy
- Environment
- Geopolitical strategies
- Technology (system characteristics, design and use, data)

With the proliferation of Artificial Intelligence, more and more questions are raised concerning technology policies that the society and governments should adopt. Given the relevance of the TaRDIS project to Artificial intelligence, this task plans to monitor discussions and initiate such discussions among the consortium members.

The participation of TaRDIS members in events, networking meetings/webinars further ensures that the consortium is in touch with developers, regulators, policy advisers, consumers or decision-makers. This can foster discussions on the rapidly emerging technologies and the challenges related to their use, governance and potential regulation.

<sup>10</sup> Based on the information in: [2]

As a first step, TaRDIS participated and/or was represented in several networking events online and in an in-person meeting in Italy in June 2024 between EU and the United States of America, and more specifically with the National Science Foundation. These events were organised in the context of the DISCOVER-US Horizon project<sup>11</sup> whose goal is to establish a bridge between the European and American research efforts towards distributed learning and swarm intelligence. Such joint efforts have a larger impact not only on future research directions but also on policy makers and technology in general.

Finally, the consortium recognises the coupling among all the different topics in this document (i.e., communication and disseminations activities, standardisation efforts, open source policies and discoverability of the project's outcomes) and exploitation plans with the policy making and the broad impact on technology and future research directions. For this reason, Task 8.2 on Standardisation, Open Source, and Policies Contributions will continue to coordinate these efforts, guide the project partners, and be in liaison with the other Work Packages and Tasks (technical and non-technical) in order to ensure that TaRDIS has a positive impact on technology and society.

### 5.2.7 Next steps

Given the partners' input and the research conducted within Task 8.2 on open source policies and policymaking, a further step to be taken is the organisation of dedicated discussions within the consortium on these matters either in steering committee meetings or dedicated workshops. One of the goals is the compilation of the consortium's manifesto concerning licences, distribution, and availability methods at large of the TaRDIS toolbox. Moreover, this task will further explore the connection of open source policies with the exploitation plan of Task 8.3. The results of Task 8.2 will be further reported in the deliverable 8.5 at the end of the project (M36).

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<sup>11</sup> <https://discover-us.eu/#/>

## 6 CONCLUSIONS

The TaRDIS project has made significant progress in its impact creation activities during the reporting period. In the next period, the consortium will focus on actively engaging and supporting the adoption and deployment of the concepts and tools offered by TaRDIS through dedicated promotional activities. To achieve this, the project will participate in events, organise events and workshops in swarm programming languages concepts to educate stakeholders on the project's outcomes, organise thematic webinars to present the project's results and foster liaisons with relevant projects and initiatives, and organise workshops and demos to engage the research community.

In parallel, further promotional materials, news items, newsletters will be created and distributed. At the same time, the partners will continue to publish scientific publications in renowned journals and conferences. 1. Technical reports showcasing the project's progress. 2. Additional e-newsletters' editions to keep stakeholders informed. 3. Presenting results and lessons learned at relevant events and platforms. By focusing on these activities and measures, the TaRDIS project aims to create a lasting, sustainable impact on the European swarm and decentralised computing landscape, fostering innovation and promoting the adoption of its concepts and tools across various sectors.

Furthermore, an initial research on the standardisation landscape and on identifying the standards and standardisation bodies relevant to the project outcomes has been conducted. This research included a survey where the different partners provided information on the specific work packages and tasks they are leading and their (or their organisation's) involvement in standardisation processes. This research will continue and the consortium will be informed and guided through any standardisation initiatives and contributions.

As for the open source and policy approaches of the consortium, a collection of information on these matters was conducted and showcased in the present document. This is the stepping stone towards a unified approach of the consortium towards the availability and discoverability of the TaRDIS toolbox in audiences outside of the consortium.

## REFERENCES

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- [2] International Science Council, A guide for policy-makers: Evaluating rapidly developing technologies including AI, large language models and beyond, Paris, France, International Science Council, 2024