D5.2 OPEN CALL ANALYTICS

Revision: v.2.0

Work package	WP 5
Task	5.1 and 5.2
Due date	31/12/2025
Submission date	31/12/2025
Deliverable lead	Digital for Planet D4P
Version	2.0
Authors	Valentina Margaria (D4P)
Reviewers	Tima Wauters (IMEC), Carl Udora (Bristol), Ali El Essaili (EDD), Peter Van Daele (IMEC)
Abstract	This deliverable presents the relevant statistics and results of the Open Call participation.
Keywords	FSTP, Open Call, OC, cascade fundings

www.spirit-project.eu

Co-funded by the European Union

Project funded by

Grant Agreement No.: 101070672
Call: HORIZON-CL4-2021-HUMAN-01

Topic: HORIZON-CL4-2021-HUMAN-01-25
Type of action: HORIZON-IA

Document Revision History

Version	Date	Description of change	List of contributor(s)
V1.0	01/12/2025	1st version of the template for comments	Valentina Margaria
V1.1	17/12/2025	Draft for revision	Valentina Margaria

DISCLAIMER

Co-funded by the European Union

Project funded by
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

The information, documentation and figures available in this deliverable are written by the "*Scalable Platform for Innovations on Real-time Immersive Telepresence*" (SPIRIT) project's consortium under EC grant agreement 101070672 and do not necessarily reflect the views of the European Commission.

The European Commission is not liable for any use that may be made of the information contained herein.

This work has received funding from the **Swiss State Secretariat for Education, Research and Innovation** (SERI).

COPYRIGHT NOTICE

Project co-funded by the European Commission in the Horizon Europe Programme		
Nature of the deliverable:	**R**	
Dissemination Level		
PU	*Public, fully open, e.g. web (Deliverables flagged as public will be automatically published in CORDIS project's page)*	✓
SEN	*Sensitive, limited under the conditions of the Grant Agreement*	
Classified R-UE/ EU-R	*EU RESTRICTED under the Commission Decision No2015/ 444*	
Classified C-UE/ EU-C	*EU CONFIDENTIAL under the Commission Decision No2015/ 444*	
Classified S-UE/ EU-S	*EU SECRET under the Commission Decision No2015/ 444*	

* R: Document, report (excluding the periodic and final reports)

EXECUTIVE SUMMARY

This report details the implementation and results of the **Financial Support to Third Parties (FSTP)** program within the **SPIRIT** project ("Scalable Platform for Innovations on Real-Time Immersive Telepresence").

As SPIRIT aims to advance real-time immersive telepresence technologies across Europe, the Open Calls constitute a central instrument for engaging external innovators, broadening experimentation activities, and enriching the SPIRIT platform with new applications, components, and research contributions.

The document provides both quantitative and qualitative insights, focusing particularly on:

- the number and characteristics of the submitted proposals, including their geographical distribution and the diversity of targeted application sectors.
- the projects awarded under Open Calls 1 and 2, together with an overview of their main.
- contributions to the SPIRIT ecosystem and lessons learned.

Co-funded by the European Union

Project funded by

TABLE OF CONTENTS

Co-funded by the European Union
Project funded by

Co-funded by the European Union

Project funded by

LIST OF FIGURES

Co-funded by the European Union
Project funded by

LIST OF TABLES

Co-funded by the European Union
Project funded by

ABBREVIATIONS

3GPP: 3rd Generation Partnership Project.

5G/6G: Fifth and Sixth Generation mobile networks.

ABR: Adaptive Bitrate streaming.

AMR: Autonomous Mobile Robot.

API: Application Programming Interface.

AVC: Advanced Video Coding (H.264).

B5G: Beyond 5G.

CFD: Computational Fluid Dynamics.

CNN: Convolutional Neural Network.

cVM: Confidential Virtual Machine.

DMP: Data Management Plan.

EC: European Commission.

FPS: Frames Per Second.

FSTP: Financial Support to Third Parties.

GPU: Graphics Processing Unit.

HID: Human Interface Device.

HMD: Head-Mounted Display.

LCEVC: Low Complexity Enhancement Video Coding (MPEG-5 Part 2).

ML: Machine Learning.

MoQ: Media over QUIC.

NARF: Neural Articulated Radiance Fields.

NDA: Non-Disclosure Agreement.

NMP: Network Music Performance.

NOC: Network Operations Centre.

Co-funded by the European Union

Project funded by

OC1: Open Call 1.

OC2: Open Call 2.

ORAN: Open Radio Access Network.

PCC: Point Cloud Compression (G-PCC and V-PCC).

QoE: Quality of Experience.

QUIC: Quick UDP Internet Connections.

RAN: Radio Access Network.

SERI: Swiss State Secretariat for Education, Research and Innovation.

SFU: Selective Forwarding Unit.

SME: Small Medium Enterprise.

TPP: Third Parties Project.

TRL: Technology Readiness Level.

ULL-DASH-PC: Ultra Low Latency Dynamic Adaptive Streaming over HTTP for Point Cloud.

VM: Virtual Machine.

VVC: Versatile Video Coding (H.266).

WASM: WebAssembly.

XR / AR / VR / MR: Extended Reality, Augmented Reality, Virtual Reality, and Mixed Reality.

Co-funded by the European Union

Project funded by

1 SPIRIT OPEN CALLS OVERVIEW

1.1 OVERVIEW OF SPIRIT OPEN CALLS

1.1.1 Context and Purpose

The SPIRIT project ("Scalable Platform for Innovations on Real-Time Immersive Telepresence") aims to build Europe's first multi-site, interconnected testbed environment for advanced telepresence, integrating next-generation network, transport, application, and security enablers. To maximise impact, the project deployed a structured FSTP programme to bring in at least **25 external Third-Party Projects** (TPPs) through two waves of competitive Open Calls.

These Open Calls invited SMEs, industry, research centres, and academic institutions to test, validate, or extend immersive telepresence technologies using the SPIRIT infrastructure.

1.1.2 Open Call Strategy and Waves

Two Open Calls have been planned:

- **Open Call 1 (OC1)**
    - Launch: Early 2024
    - Focus: Validation of third-party applications, experimentation on the first SPIRIT platform release, and early platform enhancements
    - Duration for funded projects: 9 months
    - Targeted number of projects (at least): 10
    - Max grant amount per project: 200,000 €
    - Total funding: 2,000,000 €
- **Open Call 2 (OC2)**
    - Launch: November 2024
    - Focus: Validation and enhancement activities on the fully interconnected and improved SPIRIT platform
    - Duration for funded projects: 8 months
    - Targeted number of projects (at least): 15
    - Max grant amount per project: 100,000 €
    - Total funding: 1,500,000 €

Co-funded by the European Union
Project funded by

Both calls followed the process as described in Deliverable D5.1 Open Call Toolkit [1]and a transparent, external evaluation procedure.[i]

All information related to the Open Calls was made publicly available on the EU portal and the SPIRIT website, on the dedicated pages for OPEN CALL 1[2] and OPEN CALL 2[3].

In addition, each launch was accompanied by a public webinar presenting the technical status of the SPIRIT platform and outlining the administrative requirements for applicants. To further assist potential applicants, the SPIRIT consortium also offered an optional advisory service to assess proposal feasibility. While not mandatory, this step was strongly recommended, as it enabled applicants to verify the technical suitability of their proposed experiments before submitting the final application.

1.1.3 Objectives of the Open Call Mechanism

The Open Calls were designed to:

1. **Validate and test** third-party applications using the SPIRIT testbeds and tools.
2. **Provide new requirements** or feedback to guide the ongoing development of the SPIRIT platform.
3. **Enhance and extend** the platform with new transport, application, network, or security components provided by third parties.

Through the Open Calls, SPIRIT aimed to stimulate innovation across multiple vertical sectors such as education, healthcare, training, manufacturing, entertainment, and tourism.

1.2 TECHNICAL INFRASTRUCTURE AND RESOURCES AVAILABLE TO OPEN CALL PARTICIPANTS

The SPIRIT Open Calls provided access to an extensive range of technical capabilities, combining advanced testbeds, telepresence application platforms, and specialised tools

[1] Deliverable D5.1 Open Call Toolkit

[2] OPEN CALL1 dedicated webpage: https://spirit-project.eu/open-call-1/

[3] OPEN CALL2 dedicated webpage: https://spirit-project.eu/open-call-2/

Co-funded by the European Union
Project funded by

developed by the project consortium. The technical references can be found in the deliverables D2.1[4], D3.1[5], D4.1[6], D2.2[7], D3.2[8], D4.2[9]

1.2.1 SPIRIT Testbeds

1.2.1.1 Deutsche Telekom 5G Testbed (Berlin)

Participants can experiment with a private 5G Standalone network operating on the 3.7–3.8 GHz industrial band and supported by an on-premise edge cloud offering high-performance compute resources (Kubernetes cluster, GPUs, and multi-tenant access). The testbed supports both indoor and outdoor telepresence applications and enables remote deployment of containerised services.

1.2.1.2 University of Surrey 5G/6G Innovation Centre Testbed (Guildford, UK)

This fully operational infrastructure includes 4G/5G RAN, 3GPP-compliant core components, network slicing orchestration, and a containerised computing environment. Advanced monitoring, automation, and real-time analytics are supported through the testbed's Network Operations Centre (NOC).

1.2.1.3 University of Bristol 5G Testbed (Bristol, UK)

The testbed infrastructure includes 5G O-RAN connectivity, offering an extensive high performance computational private cloud platform, enabling Beyond 5G (B5G) research and experimentation. This is further enhanced with containerized environments utilizing Kubernetes and microK8S, with each cluster dedicated to specific functions, ranging from 5G cores to specialized AI platforms, providing support for varying telepresence applications and offering a collaborative platform for research groups and project partners for extensive experimentation.

1.2.1.4 IMEC'S VIRTUAL WALL INFRASTRUCTURE

At the time of OC2 opening a third test/bed was implemented by *imec* to provide sufficient resources for some computationally intensive and graphically complex many-to-many telepresence scenarios using volumetric video. The *imec*'s Virtual Wall (Ghent) was included in the project as an additional testbed to enable open call applications with high computing requirements in a controlled networking environment.

---

[4] Deliverable D2.1 First version of use case requirements, system architecture and interface definition

[5] Deliverable D3.1 Preliminary innovation platform enablers

[6] Deliverable D4.1 First version of SPIRIT platform

[7] Deliverable D2.2 Second version of use case requirements, system architecture and interface definition

[8] Deliverable D3.2 Second innovation platform enablers

[9] Deliverable D4.2 Second version of SPIRIT PLATFORM

Co-funded by the European Union
Project funded by

Together, these environments allow experimentation with diverse immersive telepresence scenarios, including edge computing, multi-site connectivity, and heterogeneous network conditions.

1.2.2 Application Platforms

Granted project in OC1 and OC2 were able to access to three major application platforms:

- **Holographic Communication Platform (Ericsson)** Supports real-time holographic telepresence using volumetric capture, mesh streaming, and consumer AR devices via WebRTC.
- **Real-time Animation and Streaming of Realistic Avatars (Fraunhofer HHI)** Provides cloud–edge rendering pipelines for photorealistic avatars, leveraging neural animation libraries and low-latency WebRTC transport.
- **Multi-source Live Teleportation Platform (University of Surrey/Bristol)** Enables synchronised, multi-source volumetric media streaming for shared virtual spaces.

1.2.3 Tools and Enablers

Participants could also integrate or extend several technical tools:

- **Autonomous Mobile Robot (AMR) with programmable APIs**
- **Diktyo: network-aware Kubernetes scheduler (IMEc)**
- **QoE subjective test datasets and predictive models (University of Klagenfurt)**
- **Trusted Execution Environment and confidential computing tools (DT Security)**

1.2.4 OC Committee and Patron Support

The governance and supervision of the SPIRIT Open Calls are ensured by the **Open Call (OC) Committee**, which is composed of one designated representative from each consortium partner. The OC Committee is responsible for overseeing the correct implementation of the Open Call process in accordance with the rules defined in D5.1 and the Horizon Europe FSTP framework. Its role includes supervising the application, evaluation, and selection procedures; ensuring transparency, fairness, and equal treatment of applicants; and endorsing all major decisions related to the Open Calls.

In addition, the OC Committee plays an active role during the pre-selection phase by supporting the **feasibility assessment** of submitted proposals. In particular, it contributes to the optional advisory service offered to applicants prior to full proposal submission, providing guidance on technical alignment with the SPIRIT platform and verifying the feasibility of proposed experiments in relation to the available infrastructure, tools, and resources.

Once projects are selected, each Open Call winner is assigned a **Patron**, i.e., a consortium partner acting as a technical mentor throughout the project lifecycle. Patrons support Third-Party Projects by facilitating access to the SPIRIT infrastructure, providing technical guidance, assisting in troubleshooting activities, and supporting the integration of third-party solutions into the SPIRIT ecosystem. Patrons also play a key role in monitoring project progress, reviewing mid-term and final reports, requesting clarifications where necessary, and confirming the successful completion of project objectives prior to the release of payments.

Co-funded by the European Union

Through the combined roles of the OC Committee and the Patron system, SPIRIT ensures both rigorous governance of the Open Call process and continuous technical support for third-party beneficiaries, thereby maximising the quality, feasibility, and impact of the funded experiments.

TABLE 1 LIST OF PATRONS

Platform Component	Description	Patron
TESTBEDS		
5G Testbed, Berlin	The Deutsche Telekom testbed offers an area of around 500 m² outdoor space and 1000 m² indoor space. The indoor area as well as the outdoor area is covered by a private 5G Standalone Network. Computing power is provided by an edge server that is located on premise and is connected via fibre to the 5G Network.	Deutsche Telekom T-Systems
5G Testbed, Surrey	The 5G Innovation Centre (5GIC) at University of Surrey, UK, is a fully operational network consisting of both self-contained 4G and 5G radio access network (RAN) and the core network components following 3GPP standards (up to R16). Furthermore, the testbed hosts a 3GPP compliant network operations centre (NoC) to orchestrate communication services over end-to-end 5G network slices. A containerised virtual machine (VM) based computing environment is provisioned for hosting different telepresence applications.	University of Surrey
5G Testbed, Bristol	The testbed infrastructure includes 5G O-RAN connectivity, offering an extensive high performance computational private cloud platform, enabling Beyond 5G (B5G) research and experimentation. This is further enhanced with containerized environments utilizing Kubernetes and microK8S, with each cluster dedicated to specific functions, ranging from 5G cores to specialized AI platforms, providing support for varying telepresence applications and offering a collaborative platform for research groups and project partners for extensive experimentation.	University of Bristol
Virtual Wall Infrastructure, IMEC	The Virtual Wall is a large-scale testbed hosted in the iGent building on Ghent University's Ardoyen campus, for advanced networking, distributed software, cloud, big data and scalability research and testing. The testbed contains 550+ bare metal and GPU servers which are fully configurable both in terms of their software installation (choice of	Imec

Co-funded by the European Union

Platform Component	Description	Patron
	operating systems, drivers, applications, etc.) as well as how their network interfaces are physically interconnected. The nodes can be assigned different functionalities ranging from terminal, server, network node, and impairment node. The nodes can be connected to test boxes for wireless terminals, generic test equipment, simulation nodes (for combined emulation and simulation) etc.	
APPLICATION PLATFORMS		
Holographic Communication	The application supports use cases of digital human-to-human interaction with a particular focus on one-to-one collaboration in real time using holographic communication technology with end devices such as mobile phones and AR glasses.	Ericsson
Real-time Animation & Streaming of Realistic Avatars	The application platform provides real-time animation and streaming of realistic avatars. This includes a variety of tools to capture media on a producer device, to animate the representation of a human as a volumetric object and to send both video and audio to a consumer user by making use of low latency mechanisms such as WebRTC.	Fraunhofer HHI
Multi-source Live Teleportation	The application platform supports applications using live teleporting people from multiple remote internet locations to a common virtual space of the audience such that the audience can have the immersive and multisensory perception that everyone is located in the common physical scene.	University of Surrey/Bristol
TOOLS		
Autonomous Mobile Robot (AMR)	In the Berlin testbed an Autonomous Mobile Robot (AMR) is available to be integrated in third party use cases. The AMR available for the project is the “Husky” Robot from ClearPath Robotics	Deutsche Telekom T-Systems
Network-aware Resource Scheduling	In SPIRIT, a network-aware scheduling component for Kubernetes that supports both computational and network resource efficiency, called Diktyo, can be used as an alternative for the default K8s scheduler.	IMEC
Quality of Experience (QoE)	SPIRIT performed a subjective QoE study on point cloud videos and provides results, a dataset, and a subjective test/presentation tool. The software, dataset, results (findings) from the subjective test,	University of Klagenfurt

Co-funded by the European Union

Platform Component	Description	Patron
Study and Resources	and the QoE models can be used by Open Call participants in use cases (applications) involving point cloud content in AR environments.	
Security – Trusted Execution Environment	In the project we provide tools to create confidential virtual machine images and to deploy and manage their operation in our test lab in Berlin, consisting of two AMD servers, one of them with NVIDIA GPU resources. These secure hosting services are available to all SPIRIT and open call partners to deploy cloud-enabled SPIRIT and third party components for demos and trials.	Deutsche Telekom Security

Co-funded by the European Union
Project funded by

2 EVALUATION AND SELECTION

2.1 EVALUATION PROCESS

The evaluation process for Open Call 1 and 2 was designed to ensure impartiality, transparency, and adherence to high ethical standards (FIG.1).

All submitted final applications were reviewed for eligibility by Digital for Planet and feasibility with support of consortium partners.

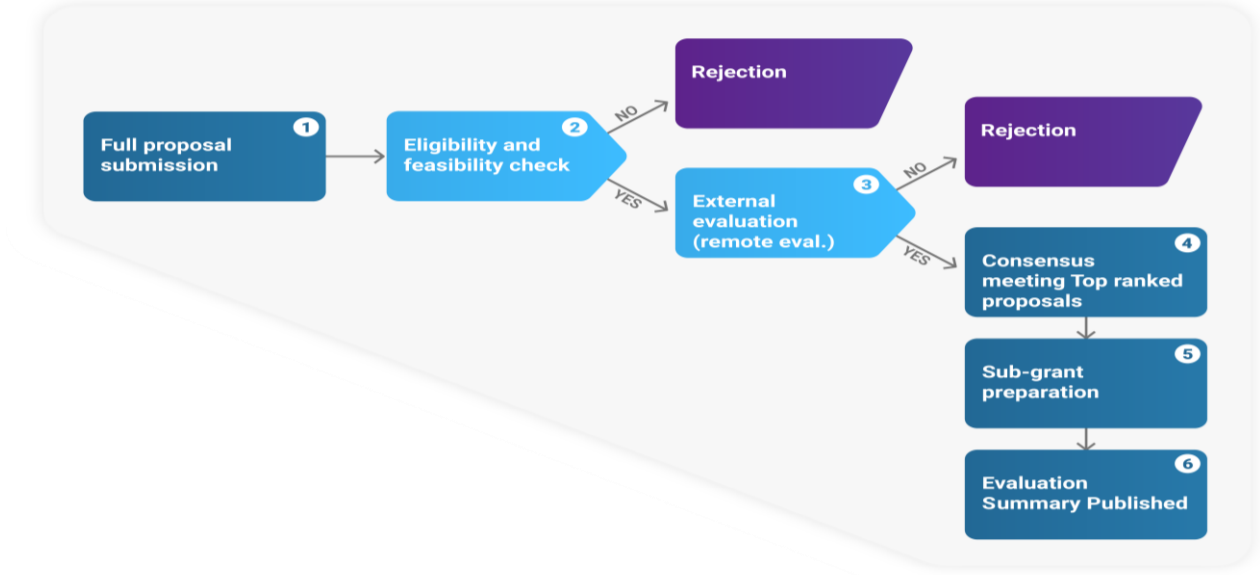

FIGURE 1 EVALUATION PROCESS

2.1.1 External Evaluators

Each proposal evaluated both eligible and feasible underwent a thorough review by two independent external experts (step 3 in diagram above FIG.1), who were required to sign a Non-Disclosure Agreement (NDA) to maintain confidentiality. To preserve objectivity, the external experts were not affiliated with the SPIRIT consortium and were prohibited from evaluating proposals in which they had any identifiable conflicts of interest.

The evaluation followed a comprehensive ranking system based on 10 defined criteria (Table 2), which were uniformly applied across all proposals to ensure a fair assessment.

Prior to commencing the evaluation process, the external reviewers were thoroughly instructed on the evaluation procedure. This included providing them with **written guidelines** detailing the process, as well as hosting a **dedicated workshop**. During this session, the SPIRIT project's background, the scope of the Open Call, and the evaluation criteria and rules were presented to ensure that all reviewers had a comprehensive understanding of their roles and responsibilities.

Co-funded by the European Union

TABLE 2 EVALUATION CRITERIA

Criterion	Short description	Weight	Maximum score	Minimum threshold
1	Clarity & methodology	2	10	5
2	Ambition	2	10	5
3	Impact	2	10	5
4	Replicability	2	10	5
5	Team capacity	2	10	5
6	Contribution to standardisation	1	5	2
7	Value for money	1	5	2
8	SME participation	1	5	n/a
9	Gender dimension awareness	1	5	2
10	Maturity of the proposing organisation	1	5	2
Total score			**75**	**33**

A total of 16 external reviewers participated in the process, each responsible for evaluating at least five proposals.

2.1.2 Evaluation and Winners Selection Process

To finalize the evaluation, a consensus meeting was held with representatives from all project partners. This collaborative session focused on reviewing the evaluators' scores, addressing any discrepancies, and reaching agreement on the final ratings for each proposal. In this phase the participation of SMEs as individual entities or part of consortia was also taken into account by scoring as per the table below.

TABLE 3 SMES SCORES

Short description	SCORE
Single organization SME	5
Consortia	
SME as leader	4
1 SME in the consortium	2
2 SMEs in the consortium	3
All SMEs in the consortium	5
SME as leader + 1 SME	5
No SME	0

To further ensure fairness and accuracy in the selection process, the following actions were undertaken:

- **Analysis of Evaluator Patterns:** Individual grading trends of evaluators were assessed to identify variations in scoring behaviour. This analysis revealed instances of consistently lenient or strict scoring, prompting adjustments to maintain uniform evaluation standards.

Co-funded by the European Union

- Normalization of Scores: A normalization filter was applied to evaluator ratings to account for identified grading patterns, ensuring that all proposals were assessed on a level playing field.

- **Refinement of Evaluation Criteria:** Special emphasis was placed on selecting projects with the highest potential for long-term impact, alignment with SPIRIT's testbed requirements, and strong engagement prospects with Patrons.

  - No actions required: As the winners' ranking was well balanced no action was taken

This rigorous process ensured that the proposals selected for funding not only met the eligibility and quality standards but also contributed strategically to the objectives of the SPIRIT project.

Co-funded by the European Union
Project funded by

3 PROJECT EXECUTION AND REPORTING

3.1 IMPLEMENTATION OF THE OPEN CALL PROJECTS, REPORTING OBLIGATIONS AND ADMINISTRATIVE DUTIES

3.1.1 Reporting

Following selection and contracting, each Third-Party Project (TPP) commenced its implementation period in accordance with the technical work plan submitted at application stage and under the supervision of the designated SPIRIT Patron. The implementation of the TPPs is governed by the administrative and technical procedures established by the SPIRIT consortium, ensuring compliance with Horizon Europe requirements and the SPIRIT FSTP framework.

All funded projects are subject to mandatory reporting obligations. Beneficiaries must submit two official reports both prepared using the official SPIRIT templates:

- a **Mid-Term Report**, due at M4 of the project, and
- a **Final Report**, due at the end of the project.

Each report was **evaluated by the assigned Patron**, who verifies the completeness, technical accuracy, and alignment with the approved work plan. Where necessary, Patrons may request clarifications or additional information to support the assessment. Only once the report is formally accepted by the SPIRIT Open Call Committee does the payment process proceed.

In addition, beneficiaries must present their progress and results during the corresponding internal review sessions. These sessions play an important role in fostering transparency and knowledge exchange within the project, as they enable Third-Party Projects (TPPs) to share their achievements, challenges, and technical insights with both the SPIRIT consortium and fellow experimenters. The review meetings were organised as interactive sessions, during which each TPP delivered a **15-minute presentation** followed by a **5-minute question-and-answer period**. All presentations were recorded and made available internally to ensure that the material could be consulted by partners and participants who could not attend, and to facilitate continued cross-project learning throughout the implementation period.

3.1.2 Payments

The payment structure, as defined in **D5.1**, consists of two instalments. The first instalment, corresponding to **75% of the maximum grant amount**, is released following approval of the Mid-Term Report and its presentation. The second instalment is paid after successful completion of the final review and approval of the Final Report. For each instalment, the project coordinator issues a Purchase Order, after which the beneficiary submits an invoice to IMEC. While no cost justification is required during implementation, beneficiaries must retain complete financial documentation for potential audits for up to five years after project completion.

3.1.3 Other Duties, Data Management Plan, Communication and Dissemination

Throughout implementation, beneficiaries are required to maintain comprehensive documentation of their work. This includes:

- detailed records of technical activities, milestones, and progress;

Co-funded by the European Union
Project funded by

- financial documentation (invoices, payroll evidence, accounting records);
- personnel timekeeping (timesheets or equivalent records);
- technical documentation covering research data, methodologies, software, algorithms, and system configurations;
- secure storage and archiving of all relevant material for audit purposes.

Each TPP must prepare or update its **Data Management Plan (DMP)** in line with the SPIRIT reporting template and appoint a Data Officer responsible for ensuring robust data governance and adherence to data-protection requirements.

Beneficiaries are further required to carry out communication and dissemination activities, including (see D6.2):

- completing the initial and final interview forms;
- presenting results at mid-term and final review meetings, including the EC final review;
- participating in relevant scientific and industry events, such as the planned **EURO XR** track;
- producing a one-minute project overview video;
- acknowledging SPIRIT and EU/SERI funding in all public communications using the official disclaimer.

Collectively, these reporting, administrative, and dissemination obligations ensured a transparent monitoring of TPP performance and facilitate the effective integration of external innovations into the SPIRIT platform, contributing to the overall scientific and technological impact of the project.

Co-funded by the European Union
Project funded by

4 OPEN CALLS RESULTS

4.1 OPEN CALL 1 IN NUMBERS

The objective of Open Call 1 (OC1) was to allocate a total budget of €2,000,000 to support at least 10 Third-Party Projects, each selected project eligible for a maximum funding allocation of €200,000. Both single entities as well as consortia (maximum 3 participants) were eligible. The projects funded under OC1 are expected to be completed within a duration of 9 months, fostering innovation and enabling significant advancements in the relevant fields. Detailed information for participation and submission are available on D5.1 Open Call toolkit as well as on the dedicated web page https://spirit-project.eu/open-call-1/

TABLE 4 OC1 CHARACTERISTICS

Opens Call number	Max funding per project [€]	Projects Duration [months]	Number of projects funded	Total funding [€]
SPIRIT-OC1	200,000	9	10 (at least)	2,000,000

4.1.1 Overview on Applications

The participation to Open Call 1 exceeded expectations. A total of 61 proposals were received, out of which 44 were deemed eligible and feasible, spanning vertical sectors such as Manufacturing, Entertainment, Healthcare, Education, Tourism, Cross-verticals, and others.

The total requested funding amounted to approximately €7.7 million, with an average funding request of €175,376 and a minimum request of €59,081.

The majority of applicants for Open Call 1 came from Europe, with Spain contributing the greatest number of proposals (FIG. 2).

Co-funded by the European Union

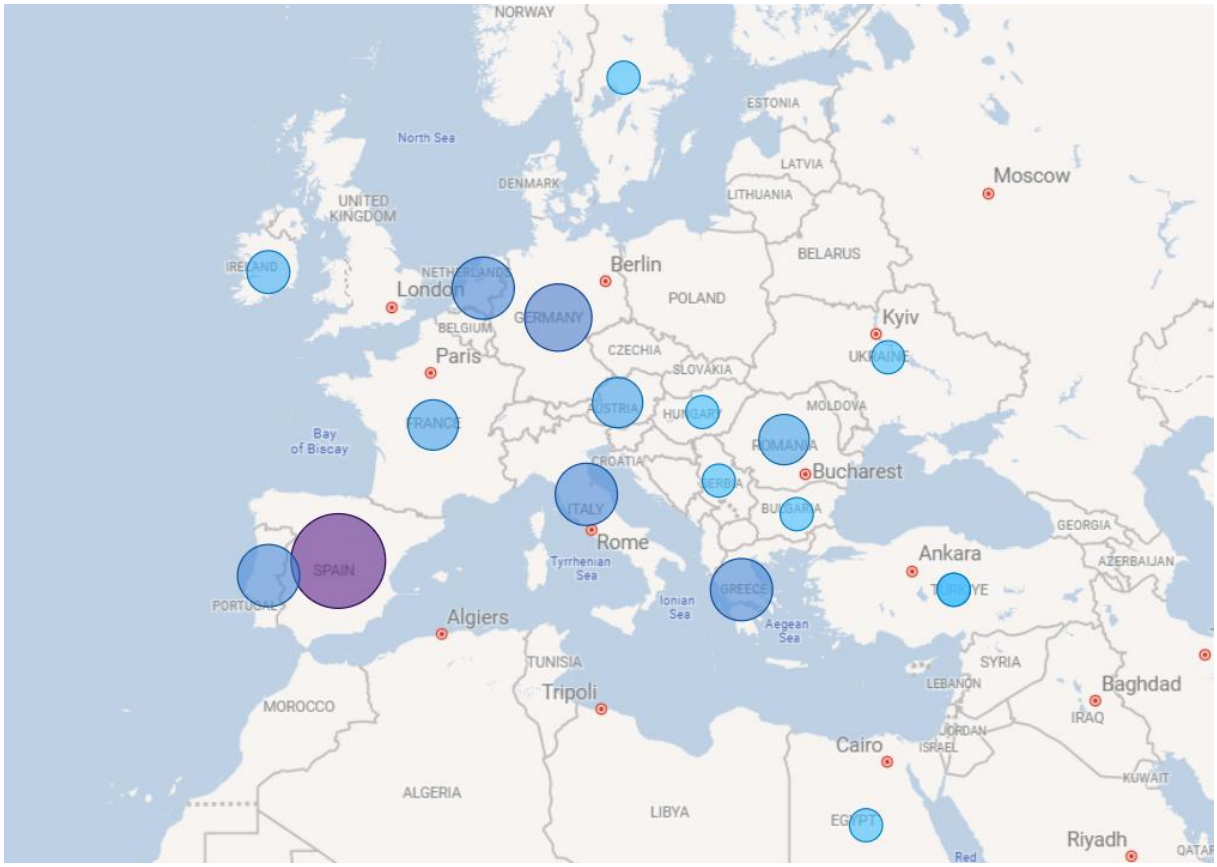

FIGURE 2 SUBMITTED PROPOSALS PER COUNTRY: BUBBLES DIAMETER IS DIRECTLY PROPORTIONAL TO NUMBERS OF PROPOSALS

The participation was diverse, encompassing SMEs, Academia, and Research centres, with proposals submitted by single entities or consortia. Noticeable, the majority of SMEs applied independently as single entity (FIG. 3).

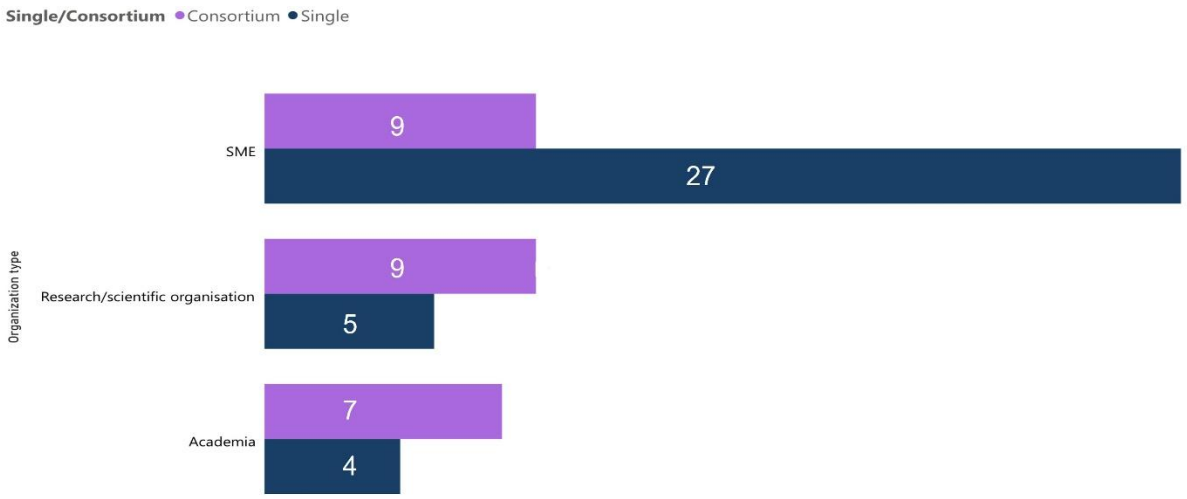

FIGURE 3 PROPOSALS PER TYPE OF ORGANIZATION AND STRUCTURE (SINGLE ENTITY VS CONSORTIUM)

The most represented vertical sector among the proposals was Manufacturing, followed closely by Entertainment, Healthcare and Education (FIG.4).

Co-funded by the European Union

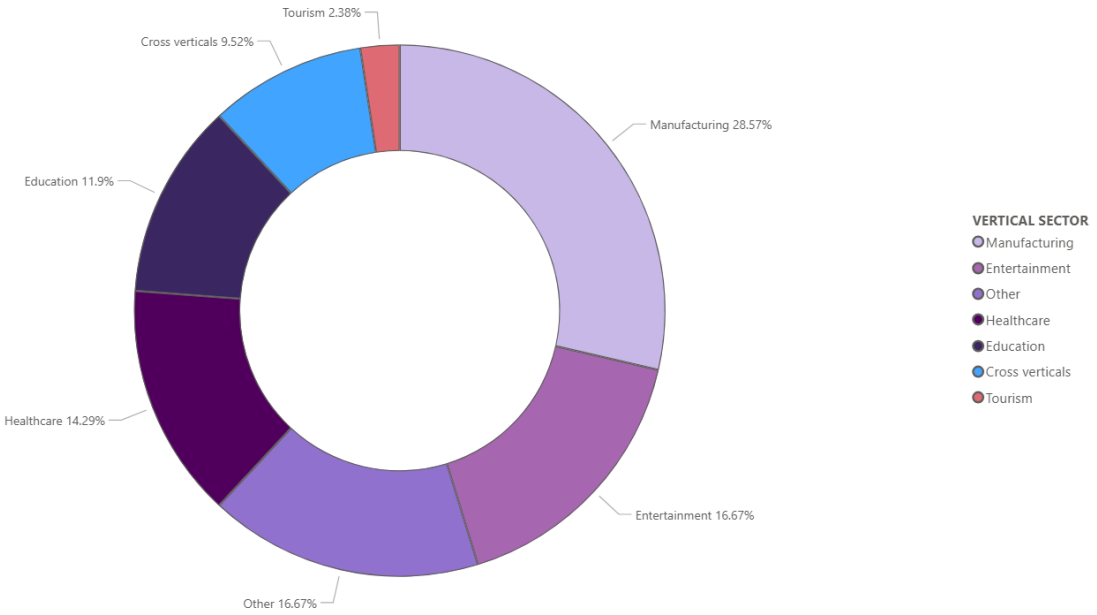

FIGURE 4 PERCENTAGE OF PROPOSALS PER VERTICAL SECTORS

4.1.2 OPEN CALL 1 awarded projects

Out of the 44 eligible proposals, a total of 11 projects were awarded funding (See table 1 below and table 6 for a comprehensive overview).

TABLE 5 OC1 PROJECTS RANKING

Rank	Proposal ID	REVIEWERS SCORE	SME POINTS	FINAL SCORE	Budget total	Budget to SMEs
1	45	64.19	5	69.19	€ 97,500.00	€ 97,500.00
2	49	64.15	5	69.15	€ 194,722.29	€ 194,722.29
3	15	60.81	5	65.81	€ 59,081.00	€ 59,081.00
4	60	59.76	5	64.76	€ 199,456.00	€ 199,456.00
5	18	62.65	2	64.65	€ 200,000.00	€ 70,000.00
6	55	58.99	5	63.99	€ 156,250.00	€ 156,250.00
7	33	60.79	3	63.79	€ 197,593.75	€ 60,000.00
8	2	61.59	2	63.59	€ 200,000.00	€ 50,000.00
9	27	59.41	2	61.41	€ 196,537.50	€ 70,000.00
10	58	61.29	0	61.29	€ 200,000.00	€ 0.00
11	56	61.07	0	61.07	€ 200,000.00	€ 0.00
13	53	57.5	3	60.5	reserve list	reserve list
14	57	55.45	5	60.45	reserve list	reserve list
15	59	55.15	5	60.15	reserve list	reserve list
16	35	54.75	5	59.75	reserve list	reserve list
17	14	57.63	2	59.63	reserve list	reserve list
18	25	58.71	0	58.71	reserve list	reserve list
20	38	53.62	5	58.62	reserve list	reserve list
21	8	55.69	0	55.69	reserve list	reserve list
					€ 1,901,140.54	€ 957,009.29

Co-funded by the European Union
Project funded by

The selected projects covered a range of vertical sectors, with Manufacturing leading the way with 50% of the projects (FIG.5).

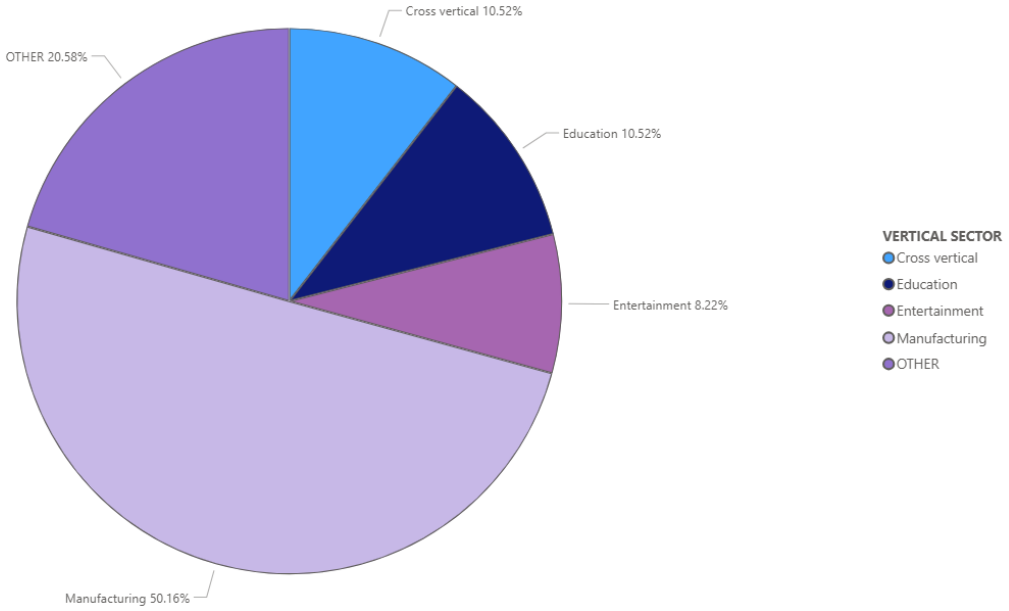

FIGURE 5 OC1 AWARDED PROJECTS' VERTICAL SECTOR

The 11 awarded projects collectively requested approximately €1.9 million in funding. The maximum funding granted to a single project was €200,000, while the minimum request was €59,000 (FIG. 6). Each of these projects was set to run for a duration of 9 months, with a completion date targeted for June 2025. Out of the total awarded budget of €1.9 million, €957,000 has been allocated to SMEs, either as individual participants or as part of a consortium. This was in line with the SPIRIT initial plan of assigning at least 50% of the grants to SMEs. Figure 7 and 8 are representative of the type of organization (SMEs, Research organization, Academia) leading the projects and the structure either as a single entity or consortium. Each awarded project was assigned to a Patron (FIG. 9).

Co-funded by the European Union
Project funded by

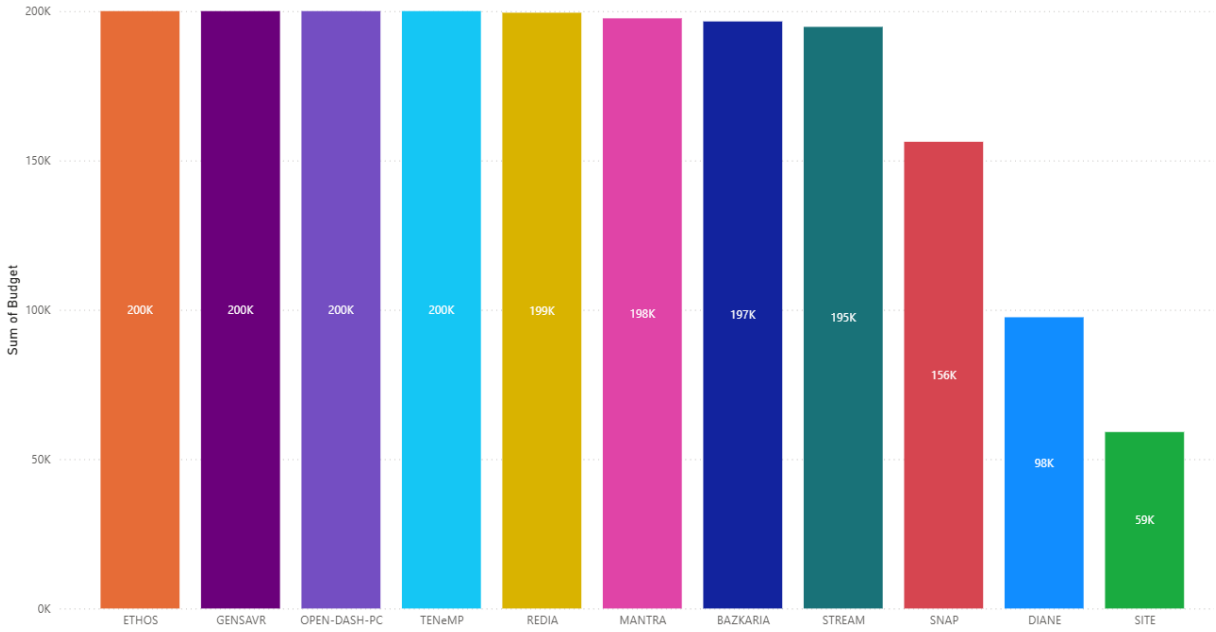

FIGURE 6 BUDGET AWARDED TO EACH PROJECT

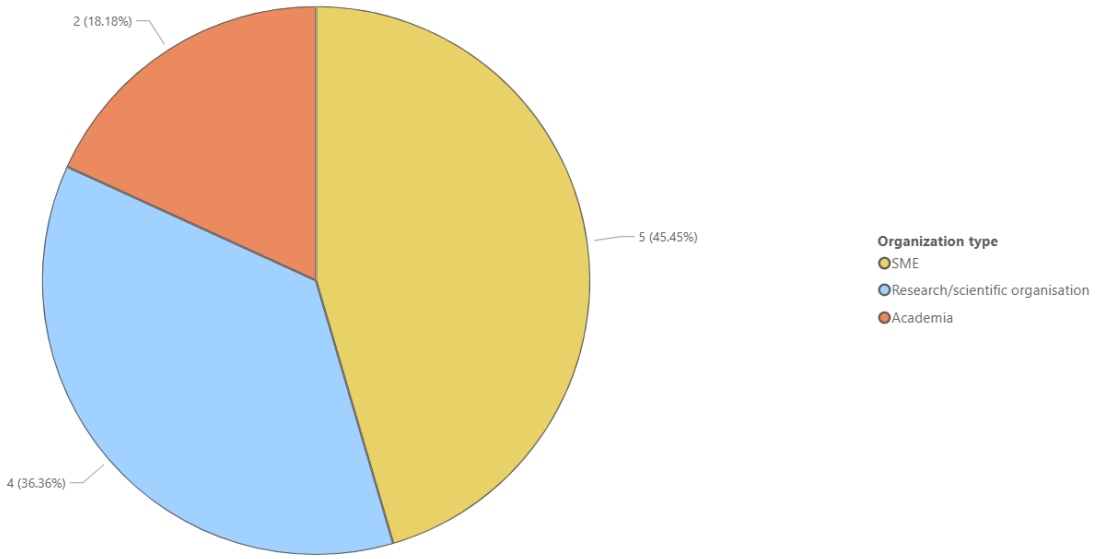

FIGURE 7 TYPE OF ORGANIZATION LEADING THE AWARDED PROJECT

Co-funded by the European Union
Project funded by

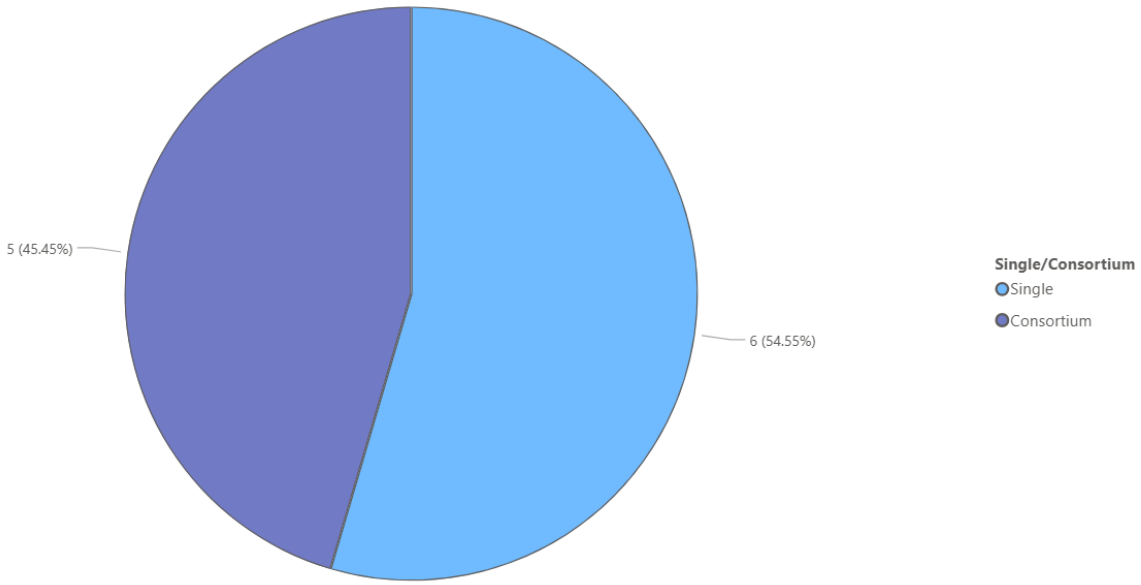

FIGURE 8 TYPE OF STRUCTURE SINGLE ENTITY VS CONSORTIUM

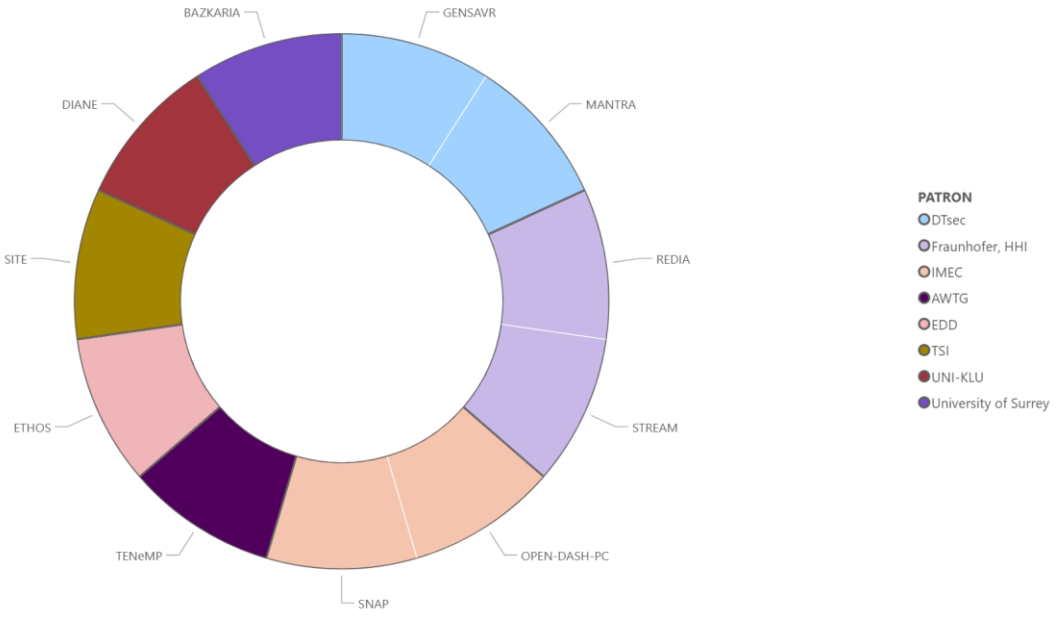

FIGURE 9 PROJECTS ASSIGNED TO EACH PATRON

The winners were geographically spread across Europe, with 5 projects from Spain, 2 from the Netherlands, 2 from Greece, 1 from Romania, and 1 from Italy, reflecting a broad European participation (FIG 10).

Co-funded by the European Union
Project funded by

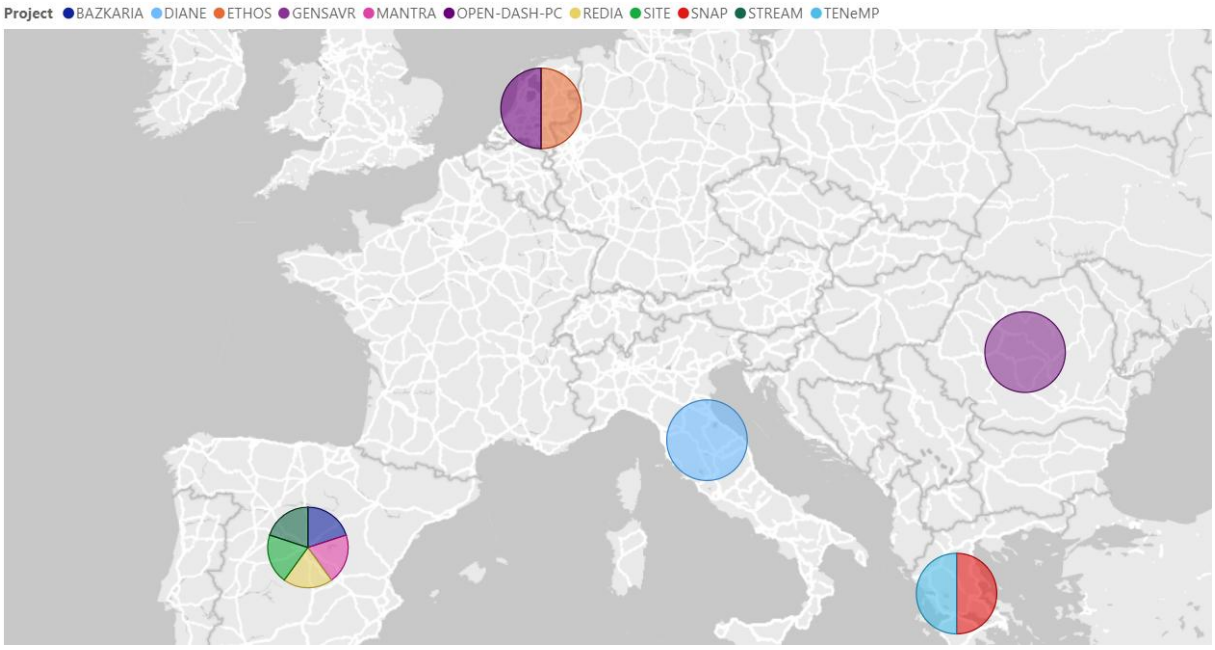

FIGURE 10 AWARDED PROJECTS GEOGRAPHICAL DISTRIBUTION

TABLE 6 OC1 AWARDED PROJECTS COMPREHENSIVE TABLE

	Project	Country	Leading Organization type	Total Budget	Budget to SMEs	Single/Consortium	Vertical Sector	PATRON	TEST BED
OC1	**OPEN-DASH-PC**	Netherlands	Research/scientific	**200,000.00 €**	50,000.00 €	Consortium	Cross vertical	IMEC	UoSurrey
OC1	**SITE**	Spain	SME	**59,081.00 €**	59,081.00 €	Single organisation	Manufacturing	TSI	Berlin
OC1	**ETHOS**	Netherlands	Research/scientific	**200,000.00 €**	70,000.00 €	Consortium	Manufacturing	EDD	Berlin
OC1	**BAZKARIA**	Spain	Research/scientific	**196,537.50 €**	70,000.00 €	Consortium	OTHER	University of Surrey	UoSurrey
OC1	**MANTRA**	Spain	Research/scientific	**197,583.75 €**	60,000.00 €	Consortium	Manufacturing	DTsec	Berlin
OC1	**DIANE**	Italy	SME	**97,500.00 €**	97,500.00 €	Single organisation	Manufacturing	UNI-KLU	UoSurrey
OC1	**STREAM**	Spain	SME	**194,722.29 €**	194,722.29 €	Single organisation	OTHER	Fraunhofer, HHI	UoSurrey
OC1	**SNAP**	Greece	SME	**156,250.00 €**	156,250.00 €	Single organisation	Entertainment	IMEC	UoSurrey
OC1	**TENeMP**	Greece	Academia	**200,000.00 €**	- €	Single organisation	Education	AWTG	Berlin
OC1	**GENSAVR**	Romania	Academia	**200,000.00 €**	- €	Consortium	Manufacturing	DTsec	UoSurrey
OC1	**REDIA**	Spain	SME	**199,456.00 €**	199,456.00 €	Single organisation	Manufacturing	Fraunhofer, HHI	Berlin
				OC1 total budget	**OC1 total budget to SMEs**				
				1,901,130.54 €	**957,009.29 €**				

4.1.3 Awarded projects short summary and results

The individual winning projects are described below in alphabetical order:

4.1.3.1 BAZKARIA (EATING TOGETHER THROUGH IMMERSIVE TELEPRESENCE):

Short description: Eating is a vital, social, and intimate experience. However, in the modern world we sometimes lack the time to physically meet or live far away from our friends and family. BAZKARIA (Basque word for lunch) aims to use XR technology and the platform offered by SPIRIT to create an immersive and augmented experience of eating together while far away. We aim to connect people eating in two different locations using immersive telepresence.

Submission summary: Eating is a vital, social, and intimate experience. Eating with others influences our health, e.g., prevents eating disorders in adolescents1, while “social isolation and subjective loneliness are risk factors for malnutrition among older people”2. Even the simple thought of eating together is pleasant3. However, sometimes we lack the time to physically meet. Many families have members living abroad, and some of us have friends and colleagues geographically spread out. We love to visit them and enjoy a meal together, but, at the same time, we are encouraged to travel less due to the unsustainability of travelling by plane or by car. BAZKARIA (Basque word for lunch) used the platform offered by SPIRIT to

Co-funded by the European Union

create an immersive and augmented experience of eating together while far away. We connected people eating in two different locations using immersive telepresence, understanding their interaction and focusing on three key challenges. The first one is to understand how remoteness changes the experience of eating and how technology must be designed and deployed in this specific use case and operational context. The second is to use volumetric video to provide immersion and co-presence, while coping with current technical limitations. The third is to develop and test technical enablers to go beyond the state in holographic communications. To achieve these results the team is formed by two partners MUGARITZ and VICOM. MUGARITZ is a creative ecosystem where cuisine is the excuse for multidisciplinary experimentation. The restaurant is yearly recognised as one of the best restaurants in the World and has been awarded with 2 Michelin stars. VICOM, an applied research centre, will provide scientific and technical capabilities, and leverage their research in volumetric video, XR interaction, and beyond 5G networks.

Main achievements/ results: The BAZKARIA project utilized XR technology and the SPIRIT platform to create an immersive and augmented telepresence experience for people dining remotely. The team connected individuals eating in two different locations, focusing on understanding how remoteness affects the dining experience and how technology can best mitigate this. Key technical achievements include the development of augmented interactions, separating important objects (like people, food, and cups) for enhanced co-presence, and the creation of a volumetric surrounding creator. The project successfully tested and leveraged SPIRIT's multi-component capabilities to advance the state of holographic communications for social eating.

4.1.3.2 DIANE (DISTRIBUTED PLATFORM FOR IMMERSIVE ORCHESTRATION OF MOBILE ROBOT FLEETS):

Short description: The DIANE project aims to develop a distributed immersive platform for teleoperating mobile robots equipped with stereo cameras. The operator will use a VR headset, such as the Meta Quest 3, to explore 3D scenes captured by the robot in real-time, transmitted as point clouds over a 5G network via WebRTC. The platform allows users to switch between multiple robots in remote locations using a Unity interface, offering two modes: teleoperation mode, where the operator directs the robot’s movement, and monitoring mode, where users observe and monitor the robot’s actions autonomously.

Submission summary: The aim of the DIANE project is to build a distributed immersive platform to allow operators to teleport into remote locations and take control of connected mobile robots equipped with stereo cameras. The operator will use a VR headset, such as, f.i., the Meta Quest 3, to explore the3D scene acquired in the form of point clouds through the stereo camera and sent in real-time by the mobile robot through a wireless internet connection using the WebRTC stack. The operator will be able to interact with multiple robots in different remote locations by switching between the connected available robots through a Unity user interface. Two different modalities will be implemented. In teleoperation mode, the operator can fully control the motion of the mobile robot with gestures and/or with the movement of the head while being immersed in the scene. In the monitoring mode, the operator can freely move in the reconstructed 3Dspace where the robot moves, being able to take different viewpoints. This mode of operation is useful to monitor the robot when it executes a given mission autonomously. The data channel used to send real-time commands and receive telemetry to/from the robot will be implemented using the WebRTC data channel. The project results will be demonstrated by implementing the proposed system in a real environment which will involve the University of Surrey infrastructure and a laboratory located in Bari, Italy. In particular, two robots will be located in Bari, Italy, provided by Quavlive. The point clouds sent from the robots through a mobile internet connection will be received by user equipped with a VR headset in the University of Surrey lab.

Co-funded by the European Union
Project funded by

Main achievements/ results: The DIANE project developed an immersive platform for teleoperating and monitoring mobile robots equipped with stereo cameras using a VR headset. This system allows operators to explore 3D scenes in real-time, transmitted as 30 FPS point clouds over a 5G network using a P2P WebRTC pipeline. Key achievements include implementing two operating modes, VR Teleoperation for direct control and Monitoring Mode for observing autonomous missions, demonstrated through the successful edge-based control of a remote robot located in Bari, Italy, from the University of Surrey. The platform achieved high performance, notably a control switching latency of less than one second between different connected robots.

4.1.3.3 ETHOS (ENHANCED TRAINING OVER HOLOGRAPHIC SCALABLE COMMUNICATIONS):

Short description: ETHOS will provide a holographic system designed to exploit next generation networks thanks to the Holographic Multipoint Control Unit, a distributed optimisation tool capable of maximising the scalability of holographic transmission in real time and between users remotely located.

Submission summary: The demanding bandwidth and processing needs are slowing down the use of XR applications and, in particular, of volumetric video for the representation of natural content, such us humans. Holographic communications are considered the next paradigms for human remote interactions in immersive environments, particularly useful in use cases oriented to remote training, where a feeling of human presence and natural interaction is needed. ETHOS will provide a holographic communication pipeline, specifically designed to make the most out of next generation networks such as 5G and 6G, thanks to the introduction of the Tiled Multipoint Control Unit or T-MCU, a distributed optimization tool capable of maximising the scalability of volumetric video transmission in real time and between users remotely located. Within ETHOS, the T-MCU will be an integrated part of the SPIRIT platform and infrastructure, becoming i) compatible to the Ericsson holographic communication system; ii) deployed on the Deutsche Telekom T-Systems infrastructure and iii) pushing the limits of the platform providing a new set of requirements thanks to the Quality of Experience benchmarking provided by University of Klagenfurt. The holographic communication system will be integrated in a use case focused on training in the manufacturing industry, validating the technology and defining the requirements in this vertical sector where remote presence is particularly relevant.

Main achievements/ results: The ETHOS project developed a novel holographic communication pipeline designed to **maximize the scalability of real-time volumetric video transmission** over next-generation 5G and 6G networks. The core achievement is the **Tiled Multipoint Control Unit (T-MCU)** , an advanced distributed optimization tool integrated into the SPIRIT platform for many-to-many holographic communication. The system demonstrated impressive performance metrics, including streaming at **30 FPS with less than 350 ms latency** and an uplink bandwidth requirement of **3-30 Mbit/s**, enabling realistic remote presence. These capabilities were validated through a targeted use case focused on **remote training in the manufacturing industry**, defining a new set of requirements for Quality of Experience in this vertical sector.

4.1.3.4 GENSAVR (GENBA SAFE VR):

Short description: The Genba SaVR Platform is an advanced Virtual Reality (VR) training tool designed for the manufacturing sector, aiming to enhance the SPIRIT platform by integrating digital twin technology and real-time communication through WebRTC. Its key objectives are to provide immersive, hands-on training in a risk-free environment, covering everything from machinery assembly to safety procedures.

Co-funded by the European Union
Project funded by

Submission summary: The GENSAVR platform is an innovative Virtual Reality (VR) training solution designed to revolutionize workforce training in the manufacturing industry sector. By combining immersive VR environments with real-time communication, GENSAVR provides trainees with hands-on learning experiences in a secure, risk-free, and interactive environment. The platform enables users to practice tasks such as equipment assembly, maintenance, and safety procedures while reducing operational risks and minimizing costs associated with physical training setups. Built on a robust architecture powered by Kubernetes, Docker, and 5G networking, GENSAVR ensures scalability and high performance, even in demanding multi-user scenarios. The integration of MageAI yields adaptive learning capabilities, personalizing training scenarios based on individual performance, while Nakama's backend services enable seamless real-time collaboration and communication. Meanwhile, the transition from classical VoIP to WebRTC introduced real-time communication improving on immersion and interactivity. These implementations deliver high scalability and reliability, allowing the platform to dynamically adjust to user demand while ensuring continuity through automated recovery and load balance. To ensure global scalability and accessibility, GENSAVR supports cross-platform compatibility, enabling usage on a wide range of VR devices, including standalone headsets and desktop systems. Security and data protection are integral to the platform design, featuring a multi-layered authentication system that integrates email/password and device-based authentication, supported by short-lived tokens that automatically refresh mechanisms. This approach ensures secure, seamless session management while maintaining a user-friendly experience. Using SPIRIT's infrastructure, GENSAVR offers an intelligent, scalable, and secure solution that empowers the manufacturing workforce, enhancing skill acquisition, safety awareness, and operational efficiency. As a powerful tool, GENSAVR supports cost-effective, accessible, and adaptable workforce training to meet the evolving demands of global manufacturing.

Main achievements/ results: The Genba SaVR Platform delivered an innovative and highly scalable Virtual Reality (VR) training solution for the manufacturing industry, leveraging SPIRIT's infrastructure. It provides trainees with immersive, hands-on learning for tasks like equipment assembly and safety procedures in a risk-free environment. Key technical achievements include a robust Kubernetes/Docker architecture that ensures high performance and scalability for multi-user scenarios, combined with the integration of WebRTC for enhanced real-time communication and immersion. Furthermore, the platform incorporates adaptive learning capabilities using MageAI to personalize training based on individual performance, significantly enhancing skill acquisition and operational efficiency.

4.1.3.5 MANTRA (MIXED-REALITY AUGMENTED NETWORKS FOR TELEOPERATED ROBOTICS APPLICATIONS):

Short description: MANTRA is a proposal focused on the development of enhanced remote-control capabilities of mobile robots. Its primary contributions span two key areas: communications and next-generation UI. These innovations are aimed at enabling real use cases in industry, such as remote inspection, which have a significant impact on economics and sustainability.

Submission summary: Telepresence in industrial settings, particularly in complex environments involving robots, is transforming European manufacturing. In scenarios where human presence is unsafe or impractical, telepresence supported by robots offers a vital solution. These systems enable experts to remotely operate and assess machinery, ensuring continuous and efficient production without the need for physical travel. Integrating Mixed Reality (MR) with multimodal feedback further enhances this user experience, facilitating detailed assessments and precise interventions . In this context, it is essential to support real-time communication between both ends, the worker and the industrial setting, requiring transferring a great volume of data while minimizing data loss. In MANTRA, we are developing a MR interface designed for teleoperating industrial robots incorporating multimodal feedback

Co-funded by the European Union
Project funded by

such as haptic interfaces. Our approach centres on participative design, engaging stakeholders through a series of co-design sessions, aiming to create a robust, user-friendly tool for remote operations. To support real-time bi-directional communication, new software mechanisms are targeted to enhance the capabilities of the 5G network provided by SPIRIT project partners (Deutsche Telekom) in terms of Wi-Fi and 5G interoperability and edge modules for XR and robot applications. MANTRA aligns with the use cases for "Real-time human-machine interaction applications" as defined in the SPIRIT project. Throughout the development, various tests will be conducted in SPIRIT's testbeds to ensure seamless integration of the developed components into the SPIRIT Platform. To bring the solutions closer to market readiness, FACTOR, a manufacturing SME based in Valencia, has joined the consortium. FACTOR will 1) provide its shop floor for additional real-environment testing, 2) participate in the co-design of the MR solutions, 3) offer feedback during the development process to ensure seamless integration of the technologies in an industrial scenario, and 4) participate in the evaluation and testing of the resulting prototype.

Main achievements/ results: The MANTRA project developed enhanced remote-control capabilities for mobile industrial robots, focusing on critical areas of communications and a next-generation User Interface (UI). A key achievement is the creation of a Mixed Reality (MR) interface that incorporates multimodal feedback, including haptic interfaces, to enable precise and intuitive teleoperation in complex industrial settings like remote inspection. To support this real-time, bi-directional communication, the project implemented new software mechanisms to enhance 5G network performance, achieving impressive metrics of over 200 Mbps for both uplink and downlink and a low round-trip latency of less than 30ms. The solution's design was validated through user tests and co-design sessions conducted with an industrial SME, ensuring market readiness for real-world industrial deployment.

4.1.3.6 OPEN-DASH- PC (OPEN-SOURCE ULL-DASH-PC FOR MULTI-PARTY REAL-TIME COMMUNICATION):

Short description: OPEN-DASH-PC tackles the limitations of current real-time, multi-user immersive communication protocols, which face scalability issues and require complex central server algorithms. We propose Ultra Low Latency Dynamic Adaptive Streaming over HTTP for Point Cloud content (ULL-DASH-PC), an open-source transport protocol that enables efficient, multi-quality, multi-user communication through point cloud data. OPEN-DASH-PC will be integrated into the SPIRIT platform and tested in the SPIRIT 5G testbed under real-world mobile network conditions.

Submission summary: Enabling real-time, multi-user, adaptive immersive communication is still an open challenge in the current research landscape, as currently used protocols for real-time immersive teleconferencing, such as WebRTC, require sophisticated algorithms in a central server to enable quality switching and offer poor scalability to multi-user scenarios. In our project OPEN-DASH-PC, we propose the use of Ultra Low Latency Dynamic Adaptive Streaming over HTTP for Point Cloud contents (ULL-DASH-PC), an open-source transport protocol that enables multi-quality, multi-user real-time communication using point cloud volumetric representation. OPEN-DASH-PC aims to make the component available to the SPIRIT platform and to the scientific community, to foster further development in the field. Moreover, the ambition of OPEN-DASH-PC is to evaluate the performance of the ULL-DASH-PC component in the SPIRIT 5G testbed, demonstrating its usage over realistic mobile network conditions, and to compare its results with respect to currently implemented protocols such as WebRTC. The results of our evaluation will serve as a benchmarking for future developments in the field, serving as a baseline for both academic and industrial research efforts, and will be applicable to a plethora of use cases and verticals. OPEN-DASH-PC's effort will directly contribute to the SPIRIT project in the form of a new transport protocol component that can be integrated in the existing SPIRIT platforms, as well as with benchmarking results that will provide new requirements for the SPIRIT project. The results of OPEN DASH-PC will also

Co-funded by the European Union
Project funded by

serve as important contributions to relevant standardization efforts, such as ISO/IEC JTC 1/SC 29/WG3 MPEG Systems, and ITU SG12, as well as enabling new revenue models for the consortium.

Main achievements/ results: The OPEN-DASH-PC project developed and implemented the Ultra Low Latency Dynamic Adaptive Streaming over HTTP for Point Cloud content (ULL-DASH-PC), an open-source transport protocol designed to overcome the scalability issues of existing real-time immersive communication. Key achievements include the open-source implementation and integration of ULL-DASH-PC into the SPIRIT 5G testbed, enabling multi-quality, multi-user real-time communication of volumetric data. The protocol demonstrated high performance, achieving an impressive end-to-end delay of less than 250ms , while supporting essential features like real-time point cloud capturing and quality adaptation. This work provides a valuable benchmark and a new transport protocol component for the SPIRIT platform, directly contributing to standardization efforts for immersive content delivery.

4.1.3.7 REDIA (REMOTE, DIGITAL ASSISTANT AND TRAINING SYSTEM):

Short description: With REDIA, we have the plan to connect the virtual simulator and digital assistant solutions in a new all-in-one concept to use the same tool for training, virtual experiences and operative purpose. We use the concept ‘train as operate’ and operate as train’.

Submission summary: Skylife is a technology-based company with the purpose of creating a different business model based on knowledge, values and people. The constant efforts in R&D have led us year after year to a growing number of success stories in key sectors such as Aerospace and Naval, and we continue to innovate from the forefront in other areas of different industries. From Skylife, we develop software and hardware solutions to train and guide users for different processes in which it is interesting to reduce time and risks, increase immersion and quality assurance. REDIA project will seeks the evaluation of the importance of a human representation for:

- Digital assistants that support operators in manufacturing processes.

- Virtual simulators which train procedures, gain skill and feel risks from different situations from surgery in a n operating room to large factories, sport events, museums.

Skylife proposes the integration of interesting SPIRIT Platform features such as SplitRendering and Congestion-based rate adaptation to Skylife products and a new Skylife development of algorithm for face and body tracking using only virtual reality kit (glass and controllers).

A new algorithm for face and body tracking recording a human representation (for training or virtual experience) or send it through communication with other users (for assistance or remote support). This new algorithm will be compared with the current capture avatar animation and combined with the SplitRendering library to evaluate is it necessary to generate a 2D image of the 3D object and Congestion-based rate adaptation to ensure a smooth and real time animation. Skylife is fully oriented to SPIRIT's lines of research focused in Human to Human and Human to Machine communication and we will provide the know-how to take this research into lines of interest of leading companies in manufacturing (aerospace, naval, defence), training (energy) and education sector.

Main achievements/ results: The REDIA project developed an all-in-one concept for training, virtual experiences, and operational support, integrating the principles of 'train as operate' and 'operate as train'. The core achievement is the creation of a new proprietary algorithm for face and body tracking , which can recognize facial gestures and body posture using only an Oculus Quest Pro headset and controllers. This technology enables a highly realistic virtual avatar

Co-funded by the European Union
Project funded by

representation for remote experts, enhancing both virtual simulators (Ultimate) and digital assistants (Infinity). Although the component is currently limited in its connection to the main SPIRIT components, the project successfully defined the full integration plan with SPIRIT features like SplitRendering and Congestion-based rate adaptation to ensure smooth, real-time animation.

4.1.3.8 SITE (SIMULATIONS FOR IMMERSIVE TELEPRESENCE ENHANCEMENT):

Short description: SITE pioneers the integration of AI-driven scientific computational methods within an immersive telepresence platform. It enhances remote interactions by reproducing high-resolution, volumetric scientific data and capturing key variables such as velocity, pressure, temperature, or contaminant concentrations in fluids like water and air, or smoke.

Submission summary: Simulations for Immersive Telepresence Enhancement (SITE) introduces an advanced system designed to improve immersive telepresence using scientific computational methods. SITE focuses on enhancing remote interactions by reproducing high-resolution, 3D scientific data, capturing key variables such as velocity, pressure, temperature, and contaminant concentrations in fluids like water, air, and smoke. This capability opens up various applications for both human-to-human (H2H) and human-to-machine (H2M) communications. For H2H interactions, SITE enhances telepresence by simulating environmental factors like temperature, humidity, and airflow in real-time, making it feel as though participants are physically on site. It can replicate environmental effects on avatars or surfaces, which is particularly useful for applications such as thermal comfort or remote training, allowing for a real-world practice environment, for example, surgeons to realistically practice as in an operating room. In H2M communications, SITE's technology is invaluable for the automation industry. It provides machines with enhanced data for better control in remote or autonomous processes, applicable in areas like infrastructure management, manufacturing, energy production, and emergency response planning. The system equips remote users with quantifiable and accurately represented data in XR, video, or haptic interfaces, facilitating predictive capabilities essential for the remote control of critical infrastructures. Utilizing computational fluid dynamics (CFD), machine learning (ML), and our cloud API, SITE dynamically predicts, processes, and visualizes complex fluid dynamics in real-time, accurately mirroring real-world conditions. Our cloud-based technology achieves rapid inference of turbulent fluid flows within milliseconds and features a scalable API that optimizes inference and postprocessing processes, adaptable to varying bandwidths. This technology integrates seamlessly with the SPIRIT platform, facilitating rigorous testing of fluid dynamics features KPIs in immersive telepresence. For a practical demonstration, we propose using an edge server and the Husky Robot for H2M interactions, where decision-making relies on CFD-ML results for either manual or automated commands.

Main achievements/ results: The Simulations for Immersive Telepresence Enhancement (SITE) project pioneered the integration of AI-driven scientific computational methods within an immersive telepresence platform. The core achievement is the development of a system that uses Computational Fluid Dynamics (CFD) and Machine Learning (ML) to dynamically predict, process, and visualize complex volumetric scientific data in real-time . This capability enables the reproduction of key environmental variables like velocity, pressure, and temperature in fluids (air, water, smoke) to enhance realism in immersive settings. This technology significantly improves Human-to-Human (H2H) telepresence by simulating environmental factors like airflow for applications such as thermal comfort, and enhances Human-to-Machine (H2M) communication by providing remote machines (like the Husky Robot) with quantifiable, predictive data for improved automated or manual control and decision-making in critical infrastructures.

4.1.3.9 SNAP (SCALABLE NEURAL ARTICULATED REPRESENTATIONS):

Co-funded by the European Union

Short description: SNAP goal is to explore the possibilities of the intersection between markerless motion capture and modern view synthesis. This will allow us to demonstrate innovative interactive experiences and scratch the surface of future communication mediums.

Submission summary: SNAP will develop and deliver a novel representation that will disrupt the telepresence experience in terms of quality and resources, contributing directly to the main objective of SPIRIT for scalable delivery of media content. In particular, MOVERSE (MOV) will introduce and improve its preliminary work (TRL 4) on the so-called neural articulated radiance fields (NARF), an implicit representation that lies between the animatable static representations and the textured meshes/point clouds in terms of bandwidth and quality, delivering much higher fidelity renders from the former while using significantly less bandwidth than the latter. When combined with MOV's markerless motion capture technology and the network components of the SPIRIT platform, SNAP will be a novel and challenging use case for SPIRIT that will create new requirements and provide valuable feedback to both entities. Through the integration with the SPIRIT platform, SNAP will be designed to be compatible and leverage widely used network, cloud, and rendering components provided by other telepresence platforms, contributing directly to the development of the relevant product of MOV. It will also constitute a truly versatile solution in the next generation of remote communication as it can be used in various environments and scenarios, from small-scale projects to large productions due to the ability of NARF to produce high-quality results with only a few input images. This will significantly broaden the relevant market segments that could exploit this alternative representation, as well as its impact by increasing stakeholder adoption. The developed solution (TRL 6) and its interoperability with the SPIRIT platform will be carefully validated in collaboration with SPIRIT project experts and will be disseminated through MOV's participation in relevant events and scientific conferences.

Main achievements/ results: The SNAP project explored the intersection of markerless motion capture and modern view synthesis, developing a highly scalable solution for next-generation immersive communication. The core achievement is the advancement and deployment of Neural Articulated Radiance Fields (NARF) , a novel implicit representation that delivers significantly higher rendering fidelity than animatable static representations while using substantially less bandwidth than textured meshes or point clouds. SNAP designed and deployed the NARF pipeline on its portal, and the development of a compatible client application allowed for testing and validation within the SPIRIT platform to assess its performance, contributing valuable feedback and a versatile, disruptive representation for remote telepresence.

4.1.3.10 STREAM (SCALABLE TELEPRESENCE WITH REAL-TIME ENHANCED MULTIMEDIA):

Short description: STREAM focuses on reducing bandwidth usage without compromising 4K resolution and quality in the SPIRIT project. One of the key innovations is the integration of GStreamer with WebAssembly (WASM), enabling a wide toolbox of multimedia tools and features directly within web browsers, setting the foundation for the next generation of communication applications.

Submission summary: Fluendo specializes in providing advanced multimedia codecs and middleware for the Desktop as a Service (DaaS) and Virtual Desktop Infrastructure (VDI) sectors. Our focus is on developing solutions that ensure high-quality, low-latency, low bitrate, and interoperable multimedia experiences. We aim to create a truly future-proof, multi-platform environment that supports various clients and systems seamlessly. This initiative is critical to meeting the growing demand for high-performance telepresence applications, enhancing user experiences, empowering the hybrid workforce, and maintaining our competitive edge in the industry. The SPIRIT project offers an ideal opportunity to develop these tools. Fluendo's proposal addresses key technological challenges in multimedia data processing, specifically

Co-funded by the European Union
Project funded by

targeting bandwidth reduction and the implementation of alpha and depth channels. By integrating Versatile Video Coding (VVC) with GStreamer, enabling VVC support on web browsers through WebAssembly (WASM), and incorporating alpha and depth channel support within the VVC codec, we enhance the performance and interoperability of telepresence applications. Our objectives are clear and targeted. First, we aim to reduce bandwidth usage without compromising 4K resolution and quality. This aligns with SPIRIT's goal of optimizing bandwidth usage for high-quality experiences. Second, we will integrate VVC with GStreamer to improve multimedia processing efficiency, supporting real-time 4K streaming. Third, we will enable VVC support on web browsers by porting GStreamer to WASM, ensuring cross-platform compatibility and performance. Fourth, we will develop a WebRTC-based communication system using GStreamer and VVC decoding to ensure interoperability across major web browsers. Finally, we will implement alpha and depth channel support in VVC-encoded streams to enhance the realism and interactivity of telepresence applications. This project will significantly enhance our product offerings, allowing us to enter new markets and set us apart from competitors. Our active contributions to open-source projects and participation in industry events will establish Fluendo as a leader in multimedia innovation, fostering industry collaboration and setting benchmarks for future research. This experiment will not only bolster Fluendo's competitive position and growth but also contribute significantly to the broader scientific community and ensure sustainable benefits for the SPIRIT project.

Main achievements/ results: The STREAM project tackled the challenge of delivering high-quality, 4K resolution telepresence with significantly reduced bandwidth usage by developing a next-generation, browser-compatible multimedia pipeline. A core innovation was the integration of the Versatile Video Coding (VVC/H.266) advanced video codec into the GStreamer framework, achieving a bandwidth reduction of over 50% compared to traditional H.264 encoding. Furthermore, the project pioneered the porting of GStreamer to WebAssembly (WASM) , creating a fully browser-compatible multimedia toolbox that ensures cross-platform interoperability without extra installations. This new architecture also implemented alpha and depth channel support within VVC-encoded streams, which enhances the realism and interactivity of telepresence and avatar-based use cases.

4.1.3.11 TENeMP (TELEPRESENCE-ENHANCED NETWORK MUSIC PERFORMANCE):

Short description: The TENeMP project will use the SPIRIT infrastructure to conduct experiments with NMP applications over 5G and immersive telepresence. NMP can be a great showcase for both 5G and telepresence: its stringent latency requirements can only be supported by ultra-low latency 5G links and the availability of nearby edge computing resources to host multiparty communication servers.

Submission summary: The Telepresence-Enhanced Network Music Performance (TENeMP) project will use the SPIRIT infrastructure to conduct experiments with Network Music Performance (NMP) applications over a 5G network, supporting immersive telepresence equipment and services such as holographic communications and avatar-based presence. NMP can be a great showcase for both 5G and telepresence technologies. Its stringent latency requirements can only be supported by ultra-low latency 5G links and the availability of nearby edge computing resources to host multiparty communication servers. The real-life presence which is essential for both live music performance and for music teaching can only be met by exploiting immersive telepresence technologies that allow the participants to hear and see each other from multiple vantage points as part of a 3D scene, rather than as flat images captured on a video camera. TENeMP will evaluate the feasibility of different NMP scenarios and topologies over pure 5G and mixed 5G networks, explore different ways of supporting multiparty scenarios by exploiting edge computing resources, and will integrate future telepresence technologies such as holographic communications and avatar-based presence with audio-based NMP tools, to provide a unified presence experience for NMP-based performance and education. The project will exploit many of the components of the SPIRIT

Co-funded by the European Union
Project funded by

testbeds, from 5G connectivity, via telepresence enablers, to edge computing resources, providing a showcase for the SPIRIT platform and its capabilities. At the same time, it will not only try to assess the feasibility of NMP over the advanced facilities offered by the SPIRIT platform, it will actively enhance existing NMP tools with immersive telepresence, providing everyone with access to music performance and education, regardless of their location and mobility constraints.

Main achievements/ results: The TENeMP project evaluated the feasibility of Network Music Performance (NMP) applications over advanced 5G networks, integrating them with immersive telepresence technologies. A core achievement was the assessment of different NMP scenarios, confirming that ultra-low latency 5G links and nearby edge computing are critical to meet the stringent delay requirements (<30 ms) for musical synchronization. The project actively integrated future telepresence techniques—such as holographic and avatar-based communications—with existing NMP audio tools to provide a unified, highly realistic presence experience for remote performance and education. This research not only validated the SPIRIT platform's capabilities as an enabler for low-latency, real-time applications but also demonstrated the use of a Selective Forwarding Unit (SFU) at the edge to achieve scalability for multi-party scenarios.

4.2 OPEN CALL 2 IN NUMBERS

The objective of Open Call 2 (OC2) was to allocate a total budget of €1,500,000 to support at least 15 Third-Party Projects, each selected project eligible for a maximum funding allocation of €100,000. Both single entities as well as consortia (maximum 3 participants) were eligible. The projects funded under OC2 were expected to be completed within a duration of 8 months, fostering innovation and enabling significant advancements in the relevant fields. Detailed information for participation and submission are available on D5.1 Open Call toolkit as well as on the dedicated web page https://spirit-project.eu/open-call-2/

TABLE 7 OC2 CHARACTERISTICS

Opens Call number	Max funding per project [€]	Projects Duration [months]	Number of projects funded	Total funding [€]
SPIRIT-OC2	100,000	8	15 (at least)	1,500,000

4.2.1 Overview on Applications

SPIRIT Open Call 2 was launched with the objective of identifying and supporting innovative applications that advance the state of the art in real-time immersive telepresence. The call attracted a total of **60 proposals**, demonstrating a strong interest from the research and innovation community in the SPIRIT platform and its technological potential.

The submitted proposals covered a broad range of application domains, including healthcare, education, entertainment, tourism, manufacturing, and other emerging sectors, highlighting the versatility and cross-sector relevance of immersive telepresence technologies. Following the assessment, **37 proposals were deemed eligible and technically feasible**, reflecting the overall high quality, maturity, and alignment of the submissions with the objectives and capabilities of the SPIRIT infrastructure.

Co-funded by the European Union

The applicant pool comprised a balanced mix of **academic institutions, research and scientific organisations, and small and medium-sized enterprises (SMEs)**, illustrating the diversity of expertise and perspectives engaged through the Open Call. Overall, the strong participation and quality of submissions confirm the growing recognition of immersive telepresence as a key enabling technology with significant potential to support future digital collaboration, interaction, and innovation across multiple domains.

The total requested funding was approximately €6.0 million, with an average funding request of €96,400 and a minimum request of €91,750.

The majority of applicants for Open Call 2 came from Europe, with Spain contributing the greatest number of proposals.

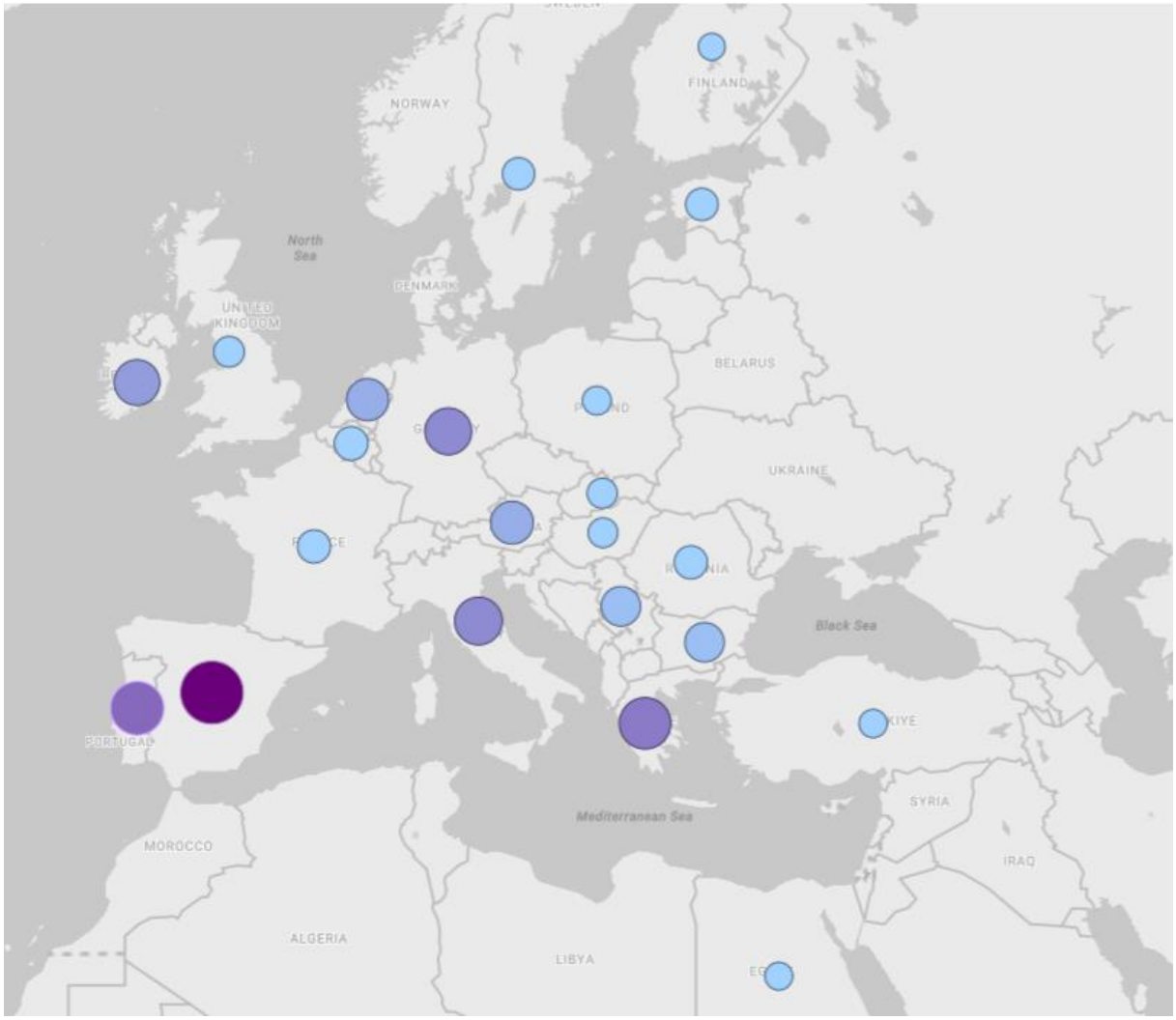

FIGURE 11SUBMITTED PROPOSALS PER COUNTRY THA DIAMETER OF THE BUBBLE IS DIRECTLY PROPORTIONAL TO NUMBERS OF PROPOSALS

The participation was diverse, encompassing SMEs, Academia, and Research centres, with a balanced structure of both single entities and consortia submitting proposals. As observed already for OC1 the majority of SMEs applied independently.

Co-funded by the European Union
Project funded by

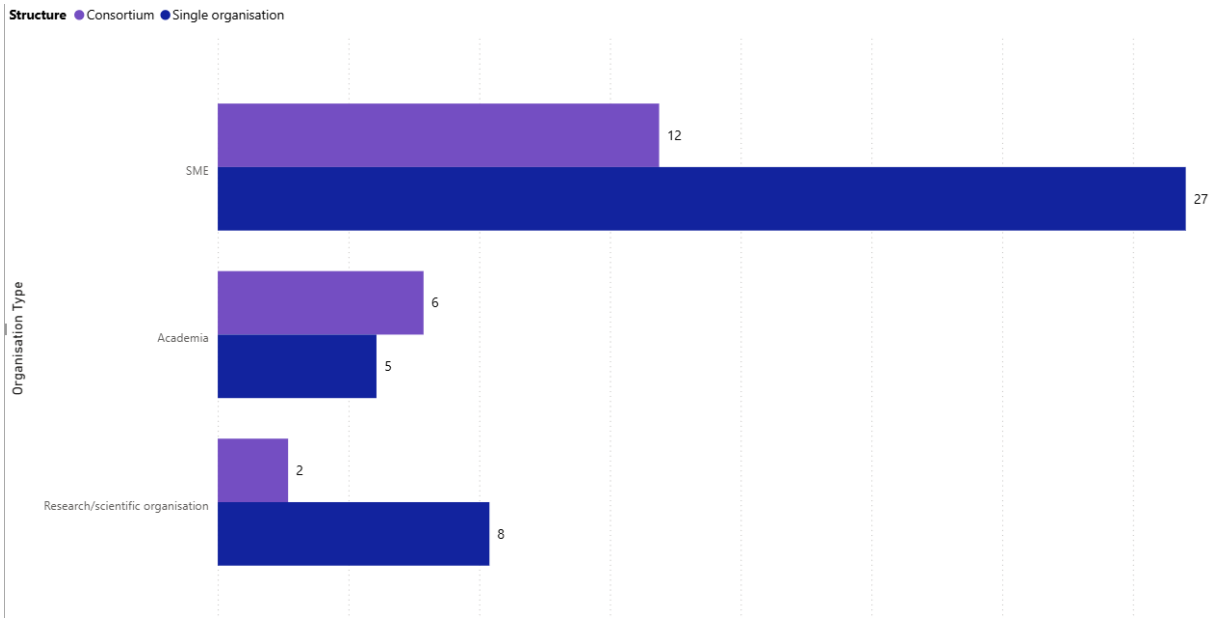

FIGURE 12 PROPOSALS PER TYPE OF ORGANIZATION AND STRUCTURE (SINGLE ENTITY VS CONSORTIUM)

The most represented vertical sector among the proposals was Healthcare, followed closely by Entertainment, and Education (FIG. 13).

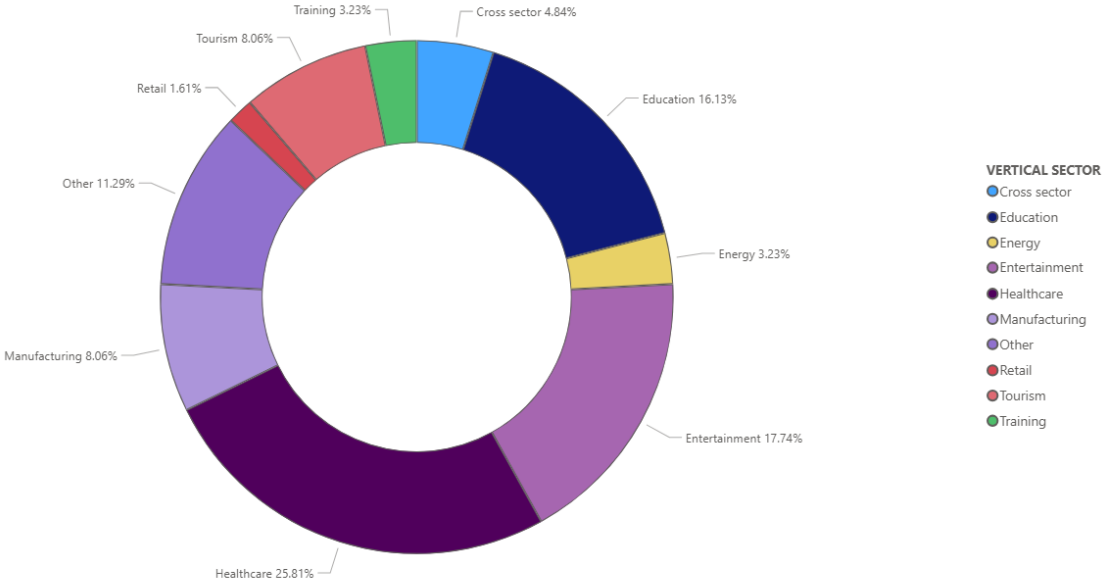

FIGURE 13 PERCENTAGE OF PROPOSALS PER VERTICAL SECTORS

Co-funded by the European Union

4.2.2 OPEN CALL 2 awarded projects

Out of the 37 eligible proposals, a total of 16 projects were awarded (See table 8 below and table 9 for a comprehensive summary).

TABLE 8 OC2 PROJECTS RANKING

RANK	Proposal ID	REVIEWERS SCORE	SME POINTS	FINAL SCORE	Budget total	Budget to SMEs
1	160	64.5	5	69.5	€ 100,000.00	€ 100,000.00
2	163	63	5	68	€ 91,750.00	€ 91,750.00
3	102	62.5	5	67.5	€ 100,000.00	€ 100,000.00
4	149	62.5	2	64.5	€ 100,000.00	€ 25,000.00
5	165	59.5	5	64.5	€ 100,000.00	€ 100,000.00
6	122	64	0	64	€ 94,125.00	€ -
7	111	59	5	64	€ 100,000.00	€ 100,000.00
8	115	58.5	5	63.5	€ 100,000.00	€ 100,000.00
9	132	58.5	5	63.5	€ 100,000.00	€ 100,000.00
10	117	62.5	0	62.5	€ 100,000.00	€ -
~~11~~	~~136~~	~~60.5~~	~~2~~	~~62.5~~	~~€ 100,000.00~~	~~€ 32,000.00~~
12	148	59.5	3	62.5	€ 100,000.00	€ 70,000.00
13	107	61.5	0	61.5	€ 99,919.00	€ -
14	105	60	0	60	€ 100,000.00	€ -
15	137	60	0	60	€ 100,000.00	€ -
16	101	54.5	5	59.5	€ 99,770.00	€ 99,770.00
17	140	57	2	59	€ 99,815.00	€ 26,000.00
18	121	59	0	59	reserve list	reserve list
19	150	58	0	58	reserve list	reserve list
20	143	57.5	0	57.5	reserve list	reserve list
21	151	57.5	0	57.5	reserve list	reserve list
22	162	55.5	2	57.5	reserve list	reserve list
23	144	55	2	57	reserve list	reserve list
24	113	55	0	55	reserve list	reserve list
					€ 1,585,379.00	€ 912,520.00

The selected projects covered a range of vertical sectors, with Education leading the way with 5 projects, followed by Tourism and Entertainment with 3 projects each (FIG 14).

The 16 awarded projects collectively requested approximately €1.6 million in funding. The maximum funding granted to a single project was €100,000, while the minimum request was €91,750 (FIG. 15). Each of these projects duration was 8 months, with a completion date targeted for November 2025.

Out of the total awarded budget of €1.58 million, €912,520 has been allocated to SMEs, either as individual participants or as part of a consortium. This is in line with the SPIRIT initial plan of assigning at least 50% of the grants to SMEs.

It is to note that the project ranked in position 11 with ID136 decided to decline the offer of funding due to a company reorganization. Therefore, project ID 140 (rank 17) was selected for funding.

Figure 16 and 17 are representative of the type of organization (SMEs, Research organization, Academia) leading the projects and the structure either as a single entity or consortium. Each awarded project was assigned to a Patron (FIG. 18)

Co-funded by the European Union

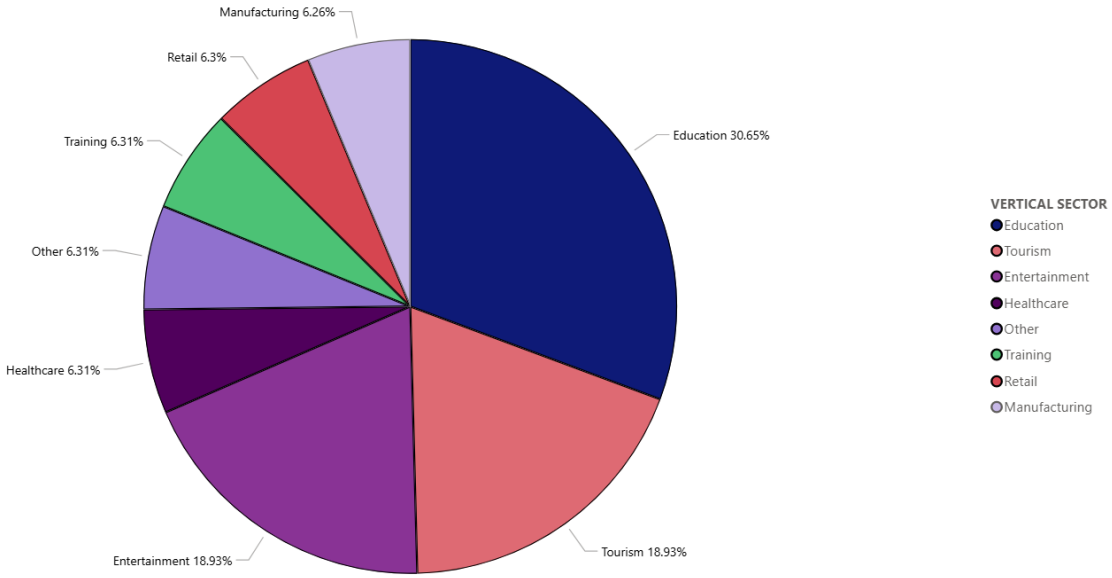

FIGURE 14 OC2 AWARDED PROJECTS' VERTICAL SECTOR

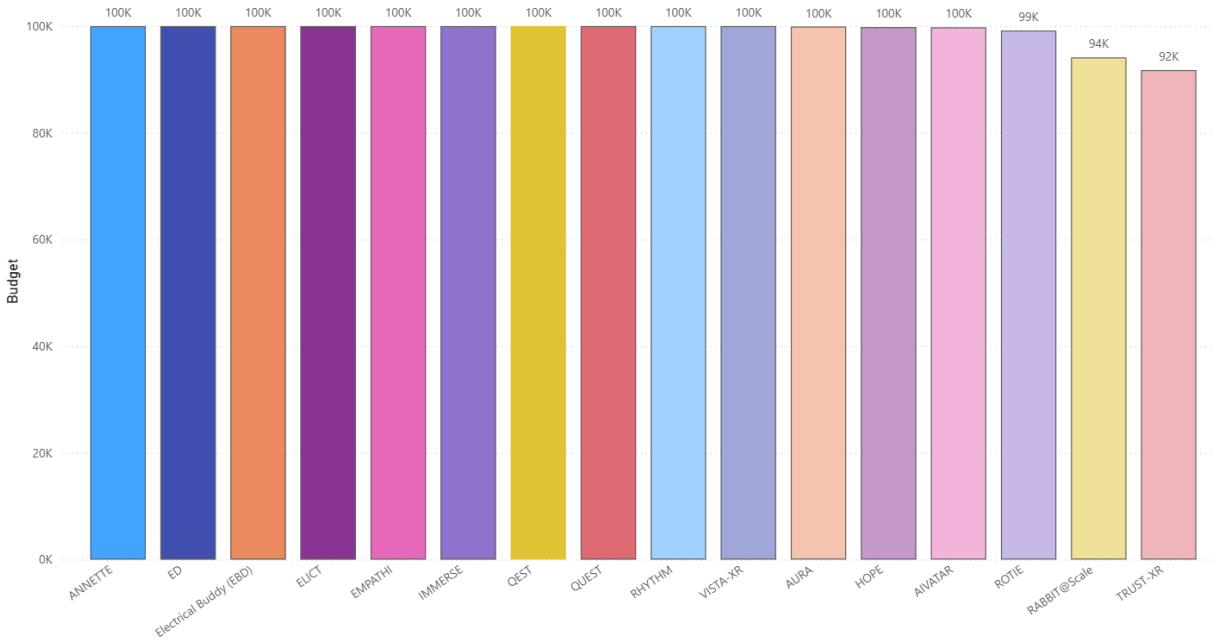

FIGURE 15 BUDGET AWARDED TO EACH PROJECT

Co-funded by the European Union
Project funded by

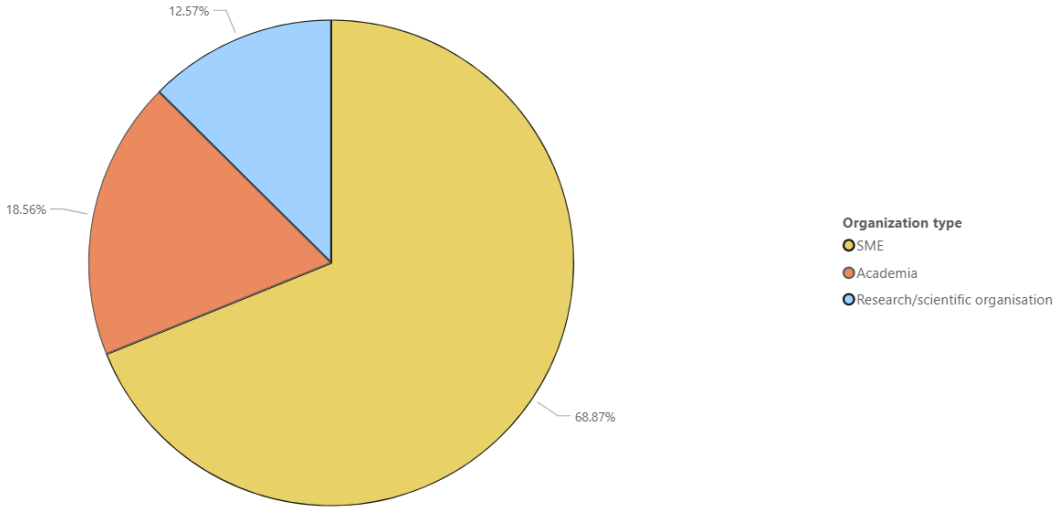

FIGURE 16 TYPE OF ORGANIZATION LEADINGTHE AWARDED PROJECT

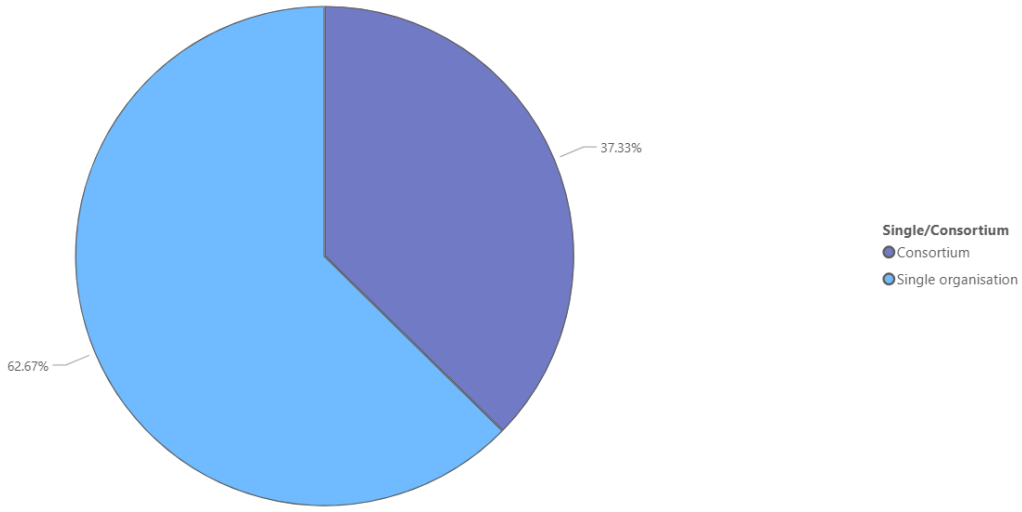

FIGURE 17 TYPE OF STRUCTURE SINGLE ENTITY VS CONSORTIUM

Co-funded by the European Union
Project funded by

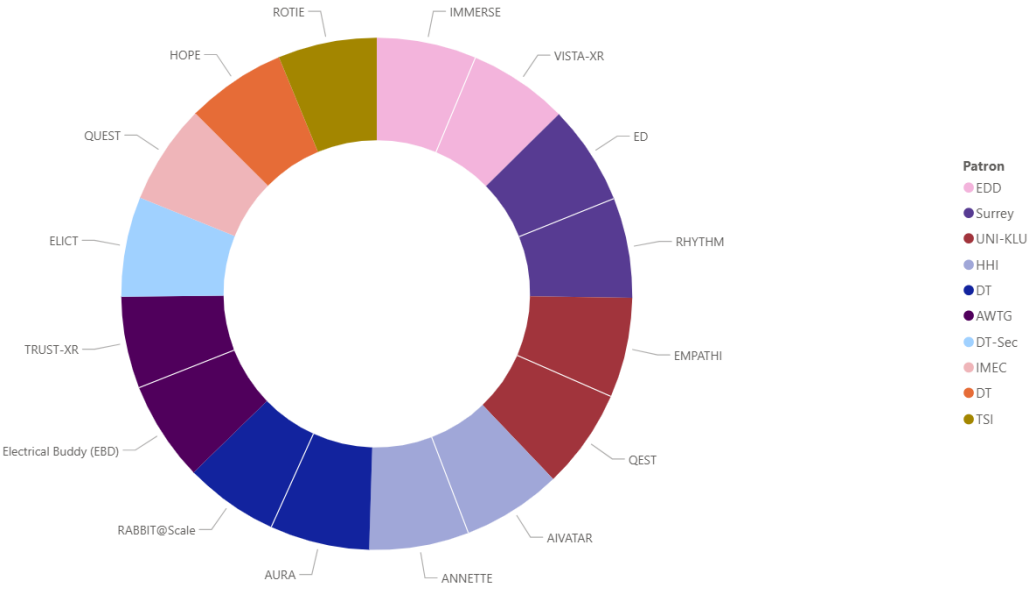

FIGURE 18 PROJECT ASSIGNED TO EACH PATRON

The winners are geographically spread across Europe, with 5 projects from Greece, 3 from Italy, 2 from Spain. Other countries represented with 1 project each 1 are the Netherlands, Germany, Poland, Finland, Hungary and Portugal (FIG. 19).

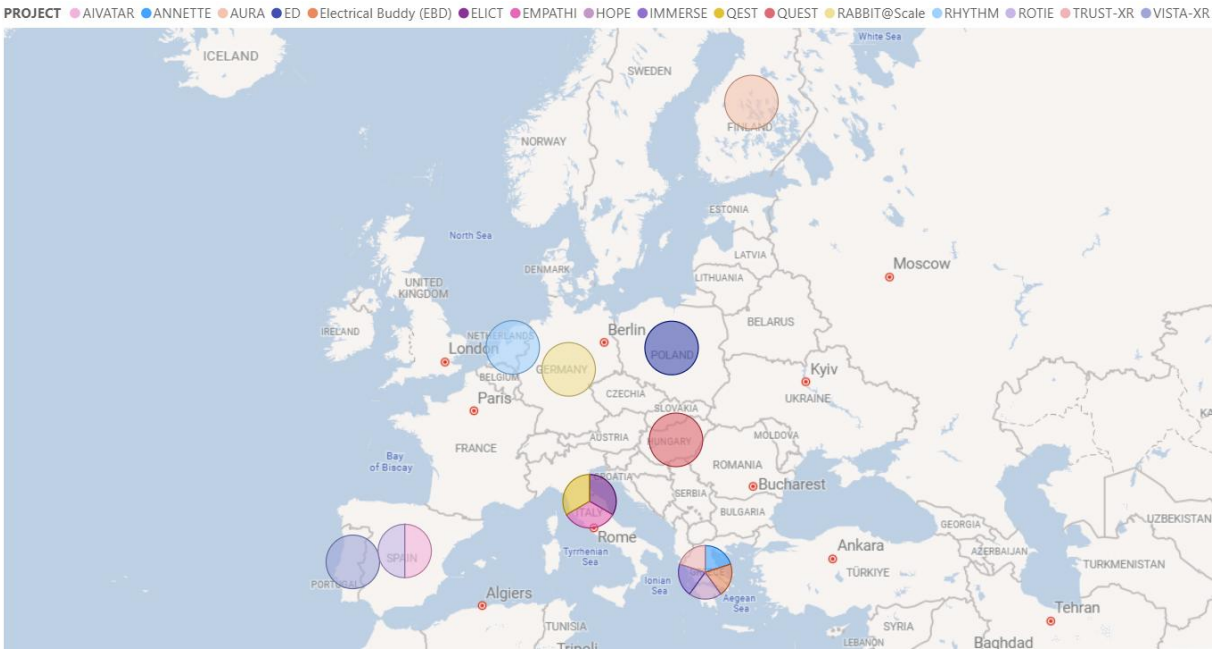

FIGURE 19 DISTRIBUTION OF AWARDED PROJECT PER COUNTRY

Co-funded by the European Union

TABLE 9 OC2 AWARDED PROJECTS COMPREHENSIVE TABLE

	Project	Country	Leading	Total Budget	Budget to SMEs	Single/Consortium	Vertical Sector	PATRON	TEST BED
OC 2	**ANNETTE**	Greece	SME	**100,000.00 €**	100,000.00 €	Consortium	Tourism	HHI	Bristol
OC 2	**TRUST-XR**	Greece	SME	**91,750.00 €**	91,750.00 €	Consortium	Education	AWTG	Bristol
OC 2	**IMMERSE**	Greece	Research/scientif	**100,000.00 €**	- €	Single organisation	Education	EDD	Berlin
OC 2	**QEST**	Italy	Academia	**100,000.00 €**	25,000.00 €	Consortium	Tourism	UNI-Klu	Bristol
OC 2	**Electrical Buddy**	Greece	SME	**100,000.00 €**	100,000.00 €	Single organisation	Training	AWTG	Berlin
OC 2	**RABBIT@Scale**	Germany	Academia	**94,125.00 €**	- €	Single organisation	Education	DT	imec
OC 2	**ED**	Poland	SME	**100,000.00 €**	100,000.00 €	Single organisation	Education	Surrey	Bristol
OC 2	**RHYTHM**	Netherlands	SME	**100,000.00 €**	100,000.00 €	Single organisation	Entertainment	Surrey	Bristol
OC 2	**VISTA-XR**	Portugal	SME	**100,000.00 €**	100,000.00 €	Single organisation	Tourism	EDD	Bristol
OC 2	**QUEST**	Hungary	Research/scientif	**100,000.00 €**	- €	Single organisation	Entertainment	imec	imec
OC 2	**EMPATHI**	Italy	SME	**100,000.00 €**	70,000.00 €	Consortium	Other	UNI-Klu	Berlin
OC 2	**AURA**	Finland	Academia	**99,919.00 €**	- €	Single organisation	Entertainment	DT	None
OC 2	**ELICT**	Italy	SME	**100,000.00 €**	100,000.00 €	Consortium	Healthcare	DT-Sec	Berlin
OC 2	**AIVATAR**	Spain	SME	**99,770.00 €**	99,770.00 €	Single organisation	Education	Fraunhofer, HHI	Berlin
OC 2	**HOPE**	Greece	SME	**99,815.00 €**	26,000.00 €	Consortium	Retail	DT	Bristol
OC 2	**ROTIE**	Spain	Research/scientif	**100,000.00 €**	- €	Single organisation	Manufacturing	TSI	Berlin
				OC2 total budget	**OC2 total budget to SMEs**				
				1,585,379.00 €	**912,520.00 €**				

4.2.3 Awarded projects short summary and results

The individual winning projects are described below in alphabetical order:

4.2.3.1 AIVATAR:

Short description: AIVATAR (Artificial Intelligence and Video Codec Enhancements for Realistic Avatar Telepresence), introduces dual enhancement solutions—codec-based and AI-based—to improve the quality, efficiency, and realism of real-time immersive telepresence. We integrate MPEG-5 Part 2 LCEVC as an enhancement layer over AVC, achieving up to 20% BD-rate reduction, sub-200 ms latency, and full backward compatibility with existing codecs and infrastructure. In parallel, AIVATAR deploys lightweight AI-driven enhancements—focused on up sampling, artifact suppression, and colour fidelity—at the endpoint. These enhancements run without altering current streaming pipelines or requiring server-side changes. These innovations form a hybrid solution that adapts to varying network conditions and resource-constrained XR devices, offering a scalable and high-quality telepresence experience.

Submission summary: Fluendo proposes harnessing its expertise in advanced video codecs, AI-driven multimedia enhancements, and real-time video processing to contribute towards immersive learning within the SPIRIT platform. Building on its innovative products—Fluendo Codec Pack, Fluendo AI Plugins, and Raven AI—Fluendo offers a proven track record in scalable, resource-efficient solutions for multimedia content delivery.

The Experiment objectives include:

1. Integrate LCEVC as an enhancement layer: Implement LCEVC as an enhancement layer, designed to enhance the performance of any base codec. For this experiment, LCEVC will be applied on top of AVC (H.264), achieving up to a 20% BD-Rate reduction. This approach demonstrates the scalability and adaptability of LCEVC, tailored to real-world bandwidth constraints and enhancing the efficiency of video transmission.

2. Develop AI-Driven Visual Enhancements:

○ Sharpness Recovery: Enhance fine details in avatars, including facial expressions and textures, to improve visual clarity.

○ Artifact Suppression: Eliminate compression-induced distortions, ensuring smooth and realistic motion.

Co-funded by the European Union
Project funded by

○ Color Fidelity: Improve the accuracy of skin tones, clothing, and environmental details to create a lifelike experience.

3. Demonstrate Real-Time Integration: Utilize pre-trained, lightweight AI models optimized for resource-constrained endpoint devices, ensuring minimal latency (<200 ms) and seamless operation within SPIRIT's "Real-Time Animation and Streaming of Realistic Avatars" use case.

4. Benchmark Against Existing Solutions: Conduct empirical performance evaluations to validate LCEVC's enhancements over standard implementations and assess the impact of AI-driven improvements on realism and user experience. This experiment directly supports SPIRIT OC2's objectives of validating third-party applications and enhancing the platform with scalable and innovative functionalities. This proposal shift focus from SPIRIT Open Call 1 (OC1) STREAM project introducing novel elements. While OC1 explored VVC and GStreamer integration with WebAssembly for ultra-high resolutions and browser interoperability, this Experiment for OC2 targets on scalable, low-latency enhancements with LCEVC and AI tailored for immersive telepresence use cases.

Main achievements/ results: The AIVATAR project introduced a dual-enhancement hybrid solution to dramatically improve the quality, efficiency, and realism of real-time avatar telepresence streaming. A primary achievement was the integration of MPEG-5 Part 2 LCEVC (Low Complexity Enhancement Video Coding) as an enhancement layer over AVC, which resulted in a significant BD-rate reduction of up to 20% while maintaining full backward compatibility and sub-200 ms latency. In parallel, the project developed and deployed lightweight AI-driven enhancements at the endpoint, including sharpness recovery, artifact suppression, and improved colour fidelity . This comprehensive system enables reduced bandwidth consumption and enhanced resolution on video-based XR applications, ensuring a scalable and high-quality experience on resource-constrained devices.

4.2.3.2 ANNETTE (ENHANCING TELEPRESENCE: REAL-TIME AVATARS IN TOURISM AND CULTURE):

Short description: Enhancing Telepresence: Real-Time Avatars in Tourism and culture - ANNETTE - validates SPIRIT capabilities through the integration and demonstration of two cutting-edge telepresence tourism and culture applications. WINGS will leverage on the wi.LIVE Culture platform which allows the 3D digitalisation of museums (indoor and outdoor areas, objects), the use of QR points for receiving further information about the exhibits, VR tours, and more.

DOTSOFT will contribute by implementing a compelling cultural use case centered around its Oracle Dodona virtual tour scenario. Both applications (wi.LIVE and Oracle Dodona) will be enhanced through SPIRIT's advanced functionalities, including real-time animation and streaming of lifelike avatars, split rendering for dynamic load distribution between server and client, and server-side 3D reconstruction enabling seamless synchronisation of user perspectives with real-time animations.

These integrations will allow ANNETTE partners to provide their feedback on the SPIRIT components and support its objectives for multi-domain applications and collaborative telepresence systems, offering transformative potential for scalable applications across diverse sectors.

Submission summary: ANNETE will validate the SPIRIT platform through the integration and demonstration of two cutting-edge telepresence tourism and culture applications, which will take advantage of the offered SPIRIT capabilities. DOTSOFT will focus on adapting its Knossos Palace – Crete AR mobile app to deliver virtual tours of cultural heritage sites, utilizing photorealistic avatars and server-side 3D reconstruction to synchronize user perspectives

Co-funded by the European Union
Project funded by

seamlessly with real-time animations. WINGS will leverage on the wi.LIVE Culture platform which allows the 3D digitalization of museums (indoor and outdoor areas, objects), the use of QR points for receiving further information about the exhibits displayed on the visitor's mobile screen and/or narration, VR navigation and interaction, virtual tour on archaeological sites and multiplayer functions between the VR users. wi.LIVE Culture platform will benefit from the integration with SPIRIT capabilities such as real-time animation and streaming of realistic avatars, split rendering for flexible sharing of rendering process load between the server and the receiver client, etc. The complementarity of Knossos Palace app and wi.LIVE culture platform is envisioned to enhance the accessibility from the public to Greek culture and heritage and promote them through immersive reality experiences. Both applications will be tested within the SPIRIT testbeds, which integrate 5G connectivity and edge-cloud computing, ensuring scalability, reliability, and operational performance. This will uncover insights into the platform's limitations, propose enhancements, and demonstrate the replicability of the solutions, contributing to standardization efforts. The project will employ structured testing procedures and practical demonstrations to showcase real-world utility. Key outcomes include evaluating the SPIRIT capabilities in integrating photorealistic avatars with real-time rendering and streaming, identifying opportunities for further development, and contributing actionable insights for improving telepresence technologies. The initiative aligns with SPIRIT's objectives to support multi-domain applications and advance collaborative telepresence systems, offering transformative potential for scalable applications across diverse sectors.

Main achievements/ results: The ANNETTE project validated the SPIRIT platform by integrating and demonstrating two high-TRL telepresence applications for tourism and culture: the wi.LIVE Culture platform and the Knossos Palace AR app. Key achievements include the successful inclusion of real-time-animated, photorealistic avatars within these applications, significantly enhancing the immersive experience of cultural heritage site exploration. The project leveraged SPIRIT's advanced functionalities, such as Split Rendering and server-side 3D reconstruction, to ensure smooth performance, achieving a low server-to-client latency of less than 50ms. This demonstration effectively showcased the benefits of integrating the avatar use case into existing, high-TRL applications, promoting greater accessibility to Greek culture and heritage through immersive reality experiences.

4.2.3.3 AURA (AUDIO RENDERING FOR AUGMENTED REALITY TELEPRESENCE):

Short description: The AURA (Audio Rendering for Augmented Reality Telepresence) project aims to address the challenge of binaural audio rendering in real-time holographic telepresence application. The challenge is tackled by implementing a complete dynamic, room-adaptive spatial audio rendering system that complements visual holographic calling technology. Moreover, we examine the room acoustic estimation and rendering accuracy requirements to ensure perceived audiovisual congruence between the audio rendering and the visual hologram. Finally, we demonstrate the overall impact on the quality of experience of binaural rendering in general and room adaptive acoustic rendering in particular. We will conduct our experiments with the following topics:

- Implementation of blind room acoustic identification and spatial audio rendering software
- Spatial congruence of acoustic and visual rendering depending on room estimation accuracy
- Quality of experience evaluation based on a real-time, two-way holographic calling system

Submission summary: In the real world, humans perceive the direction of a sound source, such as a conversation partner, using dynamic spatial cues provided by both ears. Moreover, room acoustic cues, unique to each space, lead us to perceive a source's distance and help us understand whether the sources are present in the same space. In an ideal real-time

Co-funded by the European Union
Project funded by

holographic telepresence application, remote interlocutors should appear as if they are physically present with the user, occupying a specific spot in the space in which the user is located. Acoustically, this requires binaural audio rendering that adapts both to the user's head orientation and the room acoustics of the user's space. The latter is especially challenging in practice, as room acoustic properties can only be estimated blindly without performing dedicated measurements.

The AURA project aims to address this challenge by implementing a complete dynamic, room-adaptive spatial audio rendering system that complements visual holographic calling technology. Moreover, we examine the room acoustic estimation and rendering accuracy requirements to ensure perceived audiovisual congruence between the audio rendering and the visual hologram. Finally, we demonstrate the overall impact on the quality of experience of binaural rendering in general and room adaptive acoustic rendering in particular. We propose to conduct our experiments within three 6-month master thesis projects with the following topics:

I. Implementation of blind room acoustic identification and spatial audio rendering software

II. Spatial congruence of acoustic and visual rendering depending on room estimation accuracy

III. Quality of experience evaluation based on a real-time, two-way holographic calling system

All in all, building on the proposer's prior work [1], [2], [3], [4], [5], [6], the expertise of the Aalto Acoustics Lab, and leveraging hardware from the Artemis project—a soon-to-be spin-off associated with the lab—AURA aims to augment SPIRIT with state-of-the-art AR audio rendering technology.

Main achievements/ results: The AURA project addressed the challenge of binaural audio rendering in real-time holographic telepresence by implementing a complete dynamic, room-adaptive spatial audio rendering system. A key achievement was the development and testing of a novel software solution for blind room acoustic identification, which allows the system to estimate and adapt to the unique acoustic properties of the user's physical space without dedicated measurements. This capability provides more natural audio for video conferences and ensures perceived audiovisual congruence between the dynamically rendered spatial audio and the visual hologram . By conducting a Quality of Experience (QoE) evaluation based on a real-time, two-way holographic calling system, AURA successfully demonstrated the overall significant impact of room-adaptive acoustic rendering on enhancing telepresence realism.

4.2.3.4 ED (EMBODIED DIALOGUE):

Short description: Embodied Dialogue, aims to phenomenologically assess and test SPIRIT, a Scalable Platform for Innovations on Real-time Immersive Telepresence. Our key objective is to develop a testing framework and an embodied presence feedback tool specifically designed for SPIRIT's mesh technology. This will involve collecting user experience data on SPIRIT's ability to simulate physical presence in multi-participant conversations. Innovative aspects include our focus on user-centred evaluations, the integration of embodied methodologies like Systemic Constellations and Social Presencing Theater, and the creation of a modular feedback tool for the SPIRIT ecosystem. By building scalable feedback mechanisms, we aim to help developers, designers and users co-create more authentic, grounded, and empathic virtual interactions.

Submission summary: The Embodied Dialogue project aims to phenomenologically assess and test SPIRIT, a Scalable Platform for Innovations on Real-time Immersive Telepresence, supported by the European Commission's Horizon Europe program. We are a world-leading

Co-funded by the European Union

group of researchers working at the intersection of technology and social systems research. Our goal is to develop a testing framework and an embodied presence feedback tool tailored to SPIRIT's mesh technology. Specifically, we will collect significant user experience data to evaluate whether SPIRIT effectively simulates a sense of physical presence in conversations involving two or more participants. Rather than developing complex new technical capabilities, our project focuses on creating and applying a rigorous testing framework. This framework will result in an embodied presence feedback tool designed to meet the specific needs of the SPIRIT ecosystem. It will be modular, allowing easy integration as a feedback loop between end users and app developers. We will leverage existing application platforms for "Real-time Animation & Streaming of Realistic Avatars" and "Holographic Human-to-Human Communication" to streamline the integration process. This approach minimizes development time and resources, concentrating on the evaluation framework and feedback tool rather than platform construction. The rich dataset we collect will include movement-tracing data and user-generated responses to personalized surveys capturing user experiences. The anonymized tool will maintain user privacy while collecting phenomenologically significant data. It will generate reports for both end users and developers, with explicit user consent for data use. These insights will analyse SPIRIT's potential to enhance non-verbal communication, spatial perception, and relational engagement in virtual spaces. Ultimately, this work can inform the future development of remote learning scenarios, hybrid work environments, and contribute to the broader discourse on telepresence technologies.

Main achievements/ results:

The Embodied Dialogue project leveraged the SPIRIT platform's capabilities, to address the XR-design feedback gap in relation to embodied /social presence and trust, by proposing a user-centred qualitative evaluation tool and framework to assess embodied and social presence and its effects on relational trust in XR-mediated human-to-human conversations and shared activities. A key achievement was the design and validation of a rigorous testing framework for the analysis of immersive telepresence solutions to enhance non-verbal communication, spatial perception, and embodied dialogue, primarily in virtual and mixed reality spaces. Subsequent efforts combined with the subjective results and insight achieved enabled the enhancement of existing QoE techniques and capabilities.

4.2.3.5 EBD (ELECTRICAL BUDDY):

Short description: Electrical Buddy (EBD) is a Mixed Reality training solution designed to guide electrical installers through EV charging station installations and prevent errors. The solution will leverage SPIRIT's 5G testbeds to achieve low latency in camera data feeds. Our objective is to reduce installation errors, improve safety, and set new standards for immersive technical training.

Submission summary: The Electrical Buddy (EBD) project integrates advanced features into a Mixed Reality (MR) system, combining Augmented Reality (AR) and Virtual Reality (VR), to support electrical engineers in the installation and configuration of Electric Vehicle Charging Stations (EVCS). EBD is designed to reduce errors, enhance installer safety, and improve efficiency. The AR app guides installers through step-by- step instructions and provides real-time diagnostics during high-risk installation scenarios. Within the scope of SPIRIT OC2, new features will be added to EBD, including end-to-end security mechanisms and the Diktyo network-aware resource scheduler, to ensure secure and efficient deployment of MR workloads. The application will be thoroughly tested and demonstrated in two 3-day sprints at the Berlin testbed of the SPIRIT platform. This integration will allow real-time MR annotations and IoT data synchronization while mapping containers and applications to the network topology for optimal performance. These features create a secure, immersive experience where IoT data from OCPP-enabled EV chargers is displayed in real time, enabling immediate feedback and reducing risks during live installations. 5G connectivity is critical to EBD's

Co-funded by the European Union
Project funded by

functionality, enabling ultra-low latency for real-time AR overlays and IoT diagnostics. The Berlin testbed will allow EBD to validate low-latency performance, scalability, and secure visual feed transmission using SPIRIT's Confidential Computing tools. This ensures that information from EV chargers and visual feeds from MR devices are transmitted and processed securely, vital for preventing errors and mitigating risks during installations involving live electrical currents. The project's demonstrations at the SPIRIT Berlin testbed will engage stakeholders such as construction firms, facility managers, electrical installers, and EV charge point operators. These groups will test the solution, evaluate its real-world applications, and provide valuable feedback.

Main achievements/ results: The Electrical Buddy (EBD) project integrated a Mixed Reality (MR) training and live guidance system for the installation of Electric Vehicle Charging Stations (EVCS) into the SPIRIT ecosystem. Leveraging the Berlin 5G testbed, EBD achieved ultra-low latency for camera data feeds, enabling real-time AR annotations and IoT diagnostics from OCPP-enabled chargers directly in the installer's field of view. A key achievement was the implementation of secure visual feed transmission using SPIRIT's Confidential Computing tools and the Diktyo network-aware scheduler, ensuring that safety-critical data is processed with high integrity. The project demonstrated a validated workflow for reducing installation errors and improving worker safety, providing reusable open-source modules for immersive technical training in e-mobility sectors.

4.2.3.6 ELICT (ELIGENCE IMMENSIVE COGNITIVE TRAINING):

Short description: The ELICT project integrates XR technologies and real-time telepresence into Eligence, transforming cognitive training through immersive 3D environments where healthcare professionals appear as holographic guides. Key objectives include developing XR-based cognitive training modules, implementing SPIRIT's holographic streaming service, adopting secure data handling through SPIRIT's Confidential Computing framework, and validating the effectiveness of immersive telepresence in cognitive support using -among others- SPIRIT's Quality of Experience evaluation tool.

The project's innovative aspects include:

- Integration of memory and attention games with live professional guidance
- Secure data processing using edge computing and Confidential Computing
- Personalised training adaptation through real-time professional monitoring
- Demonstrating capacity for high-speed real-time streaming using SPIRIT's 5G infrastructure

Unlike existing solutions that lack integrated professional support, ELICT creates a comprehensive system where 3D cognitive tasks are enhanced by real-time guidance, creating an experience that replicates in-person interactions while being accessible remotely.

Submission summary: The ELICT project builds on the VR extension currently under development for Maggioli's successful platform, Eligence. Eligence is a scientifically validated, web-based solution for cognitive training, designed to enhance cognitive functions such as memory, attention, and reasoning through interactive and gamified activities. Widely deployed in healthcare facilities across Greece, this platform is tailored for older adults. By integrating XR (Extended Reality) technologies and leveraging SPIRIT's advanced platform, ELICT will offer an immersive telepresence system, enabling health experts to engage with participants during interactive sessions. The project aims to design and test XR-based cognitive training experiences specifically for individuals who benefit from remote cognitive support. Health professionals, represented as holographic images within the virtual environment, will monitor sessions in real time, offering personalized guidance to ensure the training remains engaging and impactful. SPIRIT's cutting-edge technology ensures low-latency, high-quality

Co-funded by the European Union
Project funded by

communication, enabling secure and data-rich interactions that enhance the overall user experience. Alzheimer Athens plays a pivotal role as a scientific advisor and solution validator, ensuring the cognitive training experiences are scientifically rigorous and effectively address the needs of older individuals. Their expertise will guide the development, implementation, and evaluation of the training, ensuring meaningful outcomes for both participants and healthcare professionals, The ELICT project is expected to validate the feasibility and effectiveness of immersive telepresence in cognitive training, gather insights to refine the platform, and advance the integration of XR technologies into telehealth practices. Through real-world testing and performance analysis, ELICT aims to set new standards for telehealth. It seeks to demonstrate how XR-enhanced cognitive training, incorporating human-human communication, can improve engagement, deliver better outcomes, and drive broader adoption of immersive XR technologies in cognitive and related applications.

Main achievements/ results: The ELICT project transformed cognitive training for older adults by integrating XR technologies and real-time holographic telepresence into the scientifically validated Eligence platform. A core achievement was the creation of a comprehensive system where healthcare professionals appear as holographic guides within immersive 3D environments, providing personalized, live guidance during memory and attention games. By leveraging SPIRIT's 5G infrastructure and Confidential Computing framework, the project demonstrated secure, high-speed streaming and real-time training adaptation based on professional monitoring. The project concluded with a successful real-world validation, proving that immersive telepresence effectively replicates in-person interactions to improve engagement and outcomes in cognitive telehealth.

4.2.3.7 EMPATHI (EMOTION MODELING FOR PERSONALIZED AVATARS TELEPRESENCE IN HERITAGE INTERACTION):

Short description: EMPATHI enhances SPIRIT's Real-Time Avatar Animation by integrating real-time emotional recognition. Using a 3D avatar of Renaissance poet Ludovico Ariosto, the project creates an emotionally adaptive storytelling experience at the "Furiose Interazioni" exhibit in Reggio Emilia. Key innovations include a CNN-based emotion recognition module, real-time bidirectional feedback between the avatar and visitors, and personalised storytelling. The avatar dynamically adapts to users' emotional cues, fostering empathy and engagement in cultural heritage education.

Submission summary: The EMPATHI project, proposed by RE:LAB, EMOJ, and UnivPM1, enhances SPIRIT's Real-Time Animation and Streaming of Realistic Avatars use case by integrating an innovative emotional recognition component. This enhancement enables the avatar to manifest its own emotions and to adapt dynamically to end user emotions, enriching the sense of presence and interaction in immersive environments. The use case of EMPATHI is projected around an emotionally responsive 3D avatar modelled as Ludovico Ariosto, the Renaissance poet, to guide visitors through the "Atelier Furiose Interazioni" technological exhibit at Palazzo del Mauriziano in Italy. This avatar translates in real time, into corresponding emotional representations through an Emotional GUI, the producer's emotions, ensuring a natural and engaging interaction. EMPATHI introduces several key innovations. An integrated emotion recognition system that utilizes a CNN (Convolutional Neural Network) to process video streams in real time within a docker container, seamlessly integrating into SPIRIT's infrastructure. A simplified emotional feedback through a two-way feedback interface: one Consumer GUI allowing visitors to provide simple inputs in real time which are conveyed back on a Producer GUI to let the producer/avatar adjust interactions dynamically. An adaptive storytelling because the avatar modifies its narrative tone based on the emotional dynamics provided by the producer, ensuring an engaging and personalized visitor experience. This project demonstrates the potential of embedding emotion recognition within SPIRIT's Real-Time Avatar framework. It showcases how the producer's real-time emotions can enrich cultural heritage presentations, setting a new standard for personalized storytelling and

Co-funded by the European Union
Project funded by

interaction. The approach's scalability makes it adaptable to applications in education, tourism, and beyond, highlighting its transformative potential.

Main achievements/ results: The EMPATHI project enhanced SPIRIT's Real-Time Avatar Animation framework by integrating an innovative real-time emotional recognition and modelling component, resulting in an emotion-augmented avatar. The core achievement is the deployment of an integrated CNN (Convolutional Neural Network)-based emotion recognition system that processes video streams to detect and model user emotions in real-time within a Docker container. This system was demonstrated through an emotionally adaptive 3D avatar of poet Ludovico Ariosto, which uses a real-time bidirectional feedback interface to allow the producer to dynamically adjust the avatar's narrative tone and emotional output to provide a personalized and highly engaging storytelling experience . This breakthrough sets new requirements for the SPIRIT platform regarding low-latency, synchronized emotional production, significantly enriching cultural heritage interaction and establishing a new standard for personalized digital engagement.

4.2.3.8 HOPE (HOLOGRAPHIC OPTIMIZED PROCESSING ENGINE):

Short description: The HOPE project enhances the SPIRIT platform by advancing real-time holographic communication for retail applications, with a specific focus on real-time teleconference experiences. The project will focus on incorporating semantic, importance-driven compression, resampling, and filtering to highlight essential details, such as facial features, body movements and even points of interest as well as adaptive distance filtering to optimise capture ranges based on the region's size. This not only optimises bandwidth usage but also improves the overall user experience by delivering high-quality visualisations even in bandwidth-constrained environments.

Submission summary: HOPE enhances the SPIRIT platform by advancing real-time holographic communication for retail applications, with a specific focus on real-time sharing try-on experiences. By enabling the capture, processing, and streaming of high-quality 3D representations, HOPE facilitates immersive shopping experiences where customers can try on clothing, accessories, or cosmetics in a lifelike manner and share their appearance with friends for a more interactive and engaging experience. This project will focus on incorporating importance-driven compression, resampling, and filtering to ultimately highlight essential details, such as facial features and points of interest like the products being tried on. Rather than relying on the sensor's uniform sampling, context-aware resampling techniques will be employed to retain points with geometrical significance of higher importance, while discarding insignificant ones in terms of context. This will effectively enhance data transfer efficiency. Advanced mesh compression methods, such as Draco and MeshOpt will ensure optimal data transmission, maintaining high-quality details in bandwidth-constrained environments. The experiment will also focus on a dynamic adjustment mechanism for defining filtering, sampling and compression parameters, depending on the device capabilities and network conditions, contributing to a smooth user experience. Validated in SPIRIT testbeds and supported devices, HOPE aims to deliver practical demonstrations of bandwidth-efficient holographic try-on telepresence, while providing valuable insights to drive further improvements and enhancements to the platform. The consortium, consisting of Phasmatic and AUEB-RC, brings extensive expertise in 3D graphics and geometry processing technologies, along with a strong track record in applying these skills to eCommerce cases, and will lead the development of modular enhancements for the producer and consumer ends to support advanced preprocessing and compression techniques. HOPE positions SPIRIT as a cutting-edge solution for the retail sector, offering personalized and interactive shopping experiences that bridge the gap between online and in-store engagement.

Main achievements/ results: The HOPE project enhanced the SPIRIT platform by developing the Holographic Optimized Processing Engine (HOPE) to advance real-time holographic

Co-funded by the European Union

communication, focusing on immersive retail applications like real-time shared virtual try-on experiences. The core achievement is the implementation of importance-driven compression, resampling, and filtering that highlights essential details, such as facial features and the products being tried on, while discarding insignificant geometrical points. This semantic-aware processing, combined with advanced methods like Draco and MeshOpt, significantly optimized bandwidth usage (resulting in a better compression rate) while ensuring high-quality visualization, even in bandwidth-constrained environments. The project also delivered a dynamic adjustment mechanism for compression parameters that adapts to both device capabilities and network conditions, providing a smoother, personalized, and highly interactive shopping experience.

4.2.3.9 IMMERSE (IDENTITY AND ACCESS MANAGEMENT FOR IMMERSIVE ECOSYSTEMS):

Short description: The IMMERSE project will integrate a cloud-based digital wallet into the SPIRIT platform to enable secure user authentication within immersive systems, with a particular focus on human-to-human, holographic-based communication. By supporting the issuance and presentation of Verifiable Credentials, IMMERSE will enable robust identity verification and authorisation within immersive environments. Aligned with initiatives like the European Digital Identity, which emphasise user sovereignty and privacy, the project will adopt emerging standards from the IETF and OpenID Foundation to deliver a secure, privacy-preserving, and interoperable solution. Key objectives include enabling real-time, privacy-aware authorisation; ensuring conformance with EU regulations and standards; maintaining compatibility with existing identity management frameworks; enhancing user-centric credential management; and implementing efficient credential revocation mechanisms. IMMERSE will offer a secure, resilient, and user-friendly alternative to mobile wallets, improving usability and resistance to system failures.

Submission summary: The proposed work aims to extend the SPIRIT platform to incorporate advanced identity and access management mechanisms designed for immersive telepresence applications. Extending our previous work, which leverages W3C and OpenID standards, we propose the development of a cloud-based wallet for immersive telepresence systems, to provide real-time identity verification and authorization tailored to holographic-based human-to-human interactions. Cloud-hosted modules of our wallet will be provided in the form of an encrypted VM, which will be securely executed leveraging the confidential computing infrastructure of the SPIRIT project. Through a proof-of-concept holographic-based immersive educational system, deployed at DT Testbed in Berlin, we will demonstrate privacy-preserving user authentication and low latency continuous authorization. Our project will align closely with the principles and requirements outlined in the European Digital Identity Framework providing a secure, standards compliant solution that empowers EU citizens and businesses to access immersive services with full control over their personal data. Our solution will provide a secure, immersive authentication experience leveraging modern cryptography, providing a more secure and privacy preserving alternative to the state of the art. Finally, by leveraging SPIRIT's confidential infrastructure it will be one of the first efforts to provide a provably secure cloud-based wallet, allowing trusted, same-device authorization flows following a zero-trust architecture. A key innovation of our solution's authorization flow is its suitability for immersive environments as it allows users to authenticate themselves without interrupting their session (e.g., to use their mobile wallet). Our Proof-of-Concept implementation will demonstrate usability aspects for user authentication and authorization in immersive environments, including user consent, selection of credentials, selection of credential attributes to reveal, and user-to-wallet authentication. Additionally, by deploying verification components at the edge, we will demonstrate performance aspects, including low-latency continuous authorization and fast revocation. Finally, the use of edge resources will allow us to experiment with more computationally- intensive cryptographic primitives that provide additional security, such as Zero-Knowledge Proofs.

Co-funded by the European Union
Project funded by

Main achievements/ results: The IMMERSE project extended the SPIRIT platform by introducing a secure, privacy-preserving identity and access management layer specifically tailored for immersive telepresence and XR applications. A core achievement was the development of the IMMERSE Wallet, a cloud-hosted digital wallet that leverages Verifiable Credentials (VCs) and Confidential Computing to enable real-time, user-centric authentication without interrupting the immersive experience. By executing wallet modules within an encrypted Virtual Machine (cVM) using AMD SEV technology, the project ensured that sensitive cryptographic keys and personal data remain isolated from the host infrastructure. This standards-compliant solution aligns with the European Digital Identity Framework, demonstrating high-assurance identity verification through innovative features like Zero-Knowledge Proofs and low-latency continuous authorization demonstrated in a virtual classroom use case at the Berlin 5G testbed.

4.2.3.10 QEST (QOE EVALUATIONS FOR MULTI-CLOUD STREAMING):

Short description: The QEST project aims to explore the limits of immersive streaming by examining how point cloud compression impacts user experience on two of the most advanced head-mounted displays currently available: the Apple Vision Pro and the Meta Quest 3. To do this, we first extend the SPIRIT testing platform to support these next-generation devices, enabling subjective evaluations of point clouds. In parallel, we introduce an adaptive streaming algorithm designed to handle multiple point clouds in real time within the same 3D scene. By adjusting the Level of Detail for each point cloud according to the user's field of view, network bandwidth, and device capabilities, the algorithm ensures a seamless experience while staying within technical constraints. QEST will also make available a public dataset of 3D tourist sites. Altogether, by combining algorithmic innovation with platform expansion, QEST strengthens the SPIRIT infrastructure's scalability and compatibility.

Submission summary: The aim of the proposed QEST project is to advance in the design and development of novel immersive media applications. In this regard, the contribution to the SPIRIT project is twofold. First, the impact of state-of-the-art point cloud compression (PCC) mechanisms (G-PCC and V-PCC) will be evaluated on two recent and under-investigated head-mounted displays (HMDs), i.e., the Apple Vision Pro and the Meta Quest 3. To this aim, a subjective assessment will be conducted to evaluate the Quality of Experience (QoE) of compressed and uncompressed point clouds (PCs) displayed on these devices. Second, an adaptive algorithm to stream multiple PCs compressed at different levels of details (LoD) will be designed and implemented to address the limitations of current approaches that only consider the streaming of single PCs. To reach this objective, a novel dataset of PCs of tourist points of interest will be collected, which will be used to create 3D scenes including multiple PCs compressed (using G-PCC and V-PCC) at different LoD. The QoE of these 3D scenes, displayed on the two aforementioned HMDs, will be assessed by conducting a second subjective assessment. Based on the achieved subjective results, an adaptive streaming algorithm will be defined, which will be able to select the optimal LoD of each PC present in a 3D scene based on the user's field of view (FoV), the number of PCs in the scene, the network capabilities, and the maximum number of points that can be rendered by the considered HMD.

Main achievements/ results: The QEST project pushed the limits of immersive streaming by expanding the SPIRIT testing platform to support subjective evaluations on next-generation Head-Mounted Displays (HMDs), specifically the Apple Vision Pro and Meta Quest 3. A major achievement was the design and implementation of an adaptive streaming algorithm capable of handling multiple point clouds in real-time within the same 3D scene. This algorithm dynamically adjusts the Level of Detail (LoD) for each point cloud based on parameters like the user's Field of View (FoV) and network/device constraints, ensuring a seamless experience while addressing the new requirement of streaming multiple point clouds under throughput constraints. The project also delivered Quality of Experience (QoE) results comparing the

Co-funded by the European Union
Project funded by

impact of state-of-the-art compression (G-PCC and V-PCC) on these new devices and made available a public dataset of 3D tourist sites for further research.

4.2.3.11 QUEST (QUIC TO ENHANCE SPIRIT'S TELEPRESENCE):

Short description: QUIC is a recently standardised general transmission protocol that has many favourable properties for real-time media transmission over the de-facto WebRTC protocol suite, which is used throughout the SPIRIT project. In resource-constrained situations, for example, when there is a sharp bandwidth drop or right after a client migration event, QUIC can provide better quality by omitting the transmission of less relevant data, compared to randomly dropping data packets. Several proposals exist for achieving prioritisation by distributing the video in QUIC streams. However, finding the best-performing scheduling strategy for telepresence applications requires further research. We'll extend our existing QUIC-based video transmission toolset with multi-streamed video transmission capability; integrate our GStreamer-based sender with the holographic telepresence scenario; study and implement different stream scheduling strategies to improve QoE; extend our existing measurement tool to receive multi-streamed video transmission; conduct measurements in imec's testbed; and disseminate the results.

Submission summary: Telepresence is the next evolutionary step of communication platforms. It is expected to be a technology that will shape the future as it opens new possibilities both in human-to-human and human-to-machine communications. The key idea of telepresence applications is to articulate the presence of communicating peers over large distances by extending the classic multimedia streams with additional stimuli. Common in these applications is that they use numerous concurrent media and stimuli streams and require high throughput, low latency, and loss tolerance. There is an additional requirement, though: mobile collaboration. In most use cases, users and devices are frequently on the move. Unfortunately, current transporting technologies such as WebRTC or LL-DASH cannot meet these requirements. The recently standardized QUIC transport protocol provides novel features that make it a good fit for the transport protocol of telepresence applications. For example, QUIC enables inherent end-to-end security, fate sharing in control and data plane, reduced connection establishment times, improved QoE, etc. QUIC can also migrate client connections between networks such as Wi-Fi and cellular without breaking connections. However, the way QUIC can transmit multi-stream media still needs to be investigated, with many unresolved research questions. In this project, we design and implement QUIC-based real-time media transmission tools for the SPIRIT platform. QUIC enables fine-grained control of transmitting different media and data streams of telepresence applications. We study and implement stream scheduling strategies. We measure and analyse the effect of client mobility on a multi-stream telepresence application in the realistic environment of the imec testbed with the help of the machine learning-based QoE models of the SPIRIT project. We publish our results and release our code and artifacts as open-source. Finally, our contributions also make it possible to create novel telepresence applications involving client mobility.

Main achievements/ results: The QUEST project investigated the use of QUIC (Quick UDP Internet Connections) as an alternative and superior transport protocol to WebRTC for scalable, real-time media transmission in telepresence applications. The core achievement was the design and implementation of QUIC-based real-time media transmission tools, including extending an existing GStreamer-based sender with multi-streamed video transmission capability for holographic telepresence. By studying and implementing different stream scheduling strategies, the project demonstrated that QUIC can significantly improve Quality of Experience (QoE) in resource-constrained situations (like bandwidth drops or client migration) by prioritizing essential data over less relevant streams. The project's findings and open-source artifacts, measured in the imec testbed, establish Media over QUIC (MoQ) as a viable alternative for the SPIRIT platform, enabling novel telepresence applications involving client mobility.

Co-funded by the European Union
Project funded by

4.2.3.12 RABBIT@SCALE (EXPLORING REAL-TIME TRANSCODING OF V-PCC STREAMS AS A SERVICE):

Short description: The project RABBIT@SCALE aims to develop a transcoding service for volumetric dynamic point-cloud streams that are encoded by MPEG-standardised Video-based Point Cloud Compression (V-PCC) and are consumed by adaptive bitrate streaming clients. The transcoding service can be leveraged within an immersive telepresence system to deliver volumetric streams to users with time-varying bitrates over 5G. Given the SPIRIT infrastructure, the project aims to evaluate the scalability of the transcoding service in terms of the number of clients while using multiple configurations and different software and hardware-based techniques. The project will be demonstrated in a real-world environment showcasing scalability for immersive telepresence systems.

Submission summary: This proposal focuses on real-time transcoding aspects of collaborative telepresence applications at scale. We propose RABBIT@Scale, a framework that builds on a previous transcoding-core of ours (RABBIT) which is geared towards real-time transcoding of Video- based Point Cloud Compression (V-PCC) streams. Specifically, we aim to experimentally explore the scalability of real-time transcoding of dynamic volumetric Point Cloud streams. To this end, we propose a transcoding-as-a-service framework that is based on an adaptation of the (sw- and hw-based) transcoding-core of RABBIT. In addition, we aim to link the transcoding service to adaptive bitrate streaming (ABR) clients to explore the scalability of the transcoding service given heterogeneous clients of fluctuating bandwidths. Due to its cloud-based (Kubernetes) architecture we aim to use the SPIRIT DT infrastructure to showcase the transcoding service and to evaluate its scalability with respect to the client workload, as well as the trade-offs in rate-distortion and transcoding real-timeness given different transcoding configurations.

Main achievements/ results: The RABBIT@SCALE project developed and implemented a transcoding-as-a-service framework for volumetric dynamic point cloud streams encoded using the MPEG-standardized Video-based Point Cloud Compression (V-PCC). The core achievement is a novel, cloud-based framework that provides real-time point cloud transcoding and is designed to deliver volumetric streams to Adaptive Bitrate (ABR) streaming clients with time-varying bitrates over 5G. Leveraging the SPIRIT Kubernetes infrastructure, the project evaluated the system's scalability across different software and hardware-based configurations with respect to the client workload, successfully demonstrating the trade-offs between rate-distortion and transcoding real-timeness for heterogeneous and fluctuating bandwidth environments.

4.2.3.13 RHYTHM (REAL-TIME HYBRID TEST FOR HARMONIC MUSIC):

Short description: Within the SPIRIT program, we aim to evaluate how our live volumetric video solution compares with SPIRIT's alternative approach of photorealistic avatars paired with motion capture. While our solution operates with a 5-10 second delay, SPIRIT delivers near real-time performance. We aim to show that the interaction provided by SPIRIT delivers enhances the overall immersiveness that people experience. RHTYHM's research focuses on demonstrating that for specific communication contexts—particularly music performances—SPIRIT's solution offers an ideal platform for innovative artistic expression. We intend to prove that the advantage of real-time interaction versus our 5-10 second delay creates a significantly enhanced experience for both performers and audiences in immersive environments.

Submission summary: Lifelike, video-realistic avatars are essential for creating meaningful connections between artists and audiences in the music industry. The RHYTHM experiment leverages SPIRIT's advanced platform to explore how varying levels of visual fidelity impact fan engagement in immersive hybrid concerts. By comparing pre-recorded volumetric video, mesh-based streaming, and point cloud streaming, RHYTHM aims to determine the optimal balance between visual quality and interactivity. Prioritizing interactivity as a key driver of

Co-funded by the European Union
Project funded by

engagement, the project seeks to develop an accessible hybrid concert model that delivers faster, (near-)live experiences while maintaining presence and immersion. Three-time Grammy winner and rock legend Steve Vai brings artistic credibility and technical insight to the project. His mentorship ensures that WITT's performance reaches the highest creative and immersive standards, demonstrating the full potential of SPIRIT's tools. The innovative Belgian band WITT, known for their augmented reality performances, will redesign their song 'Insomnia' to showcase SPIRIT's live volumetric streaming and interactive audience features, drawing on their success from the CORTEX2 program. SPIRIT's point cloud streaming technology is central to enabling real-time concert simulations with immediate user interactions. This technology supports immersive, low-latency environments while integrating spatial audio for enhanced realism and engagement. These capabilities expand SPIRIT's applicability to diverse entertainment use cases. To measure fan satisfaction, RHYTHM utilizes SPIRIT's QoE tools alongside ITC-SOPI benchmarks, providing actionable feedback for refining SPIRIT's tools. Additionally, SPIRIT's testbeds in Berlin and Surrey will enable cross-location scalability testing, assessing performance under large-scale, multi-user conditions. These insights will guide the optimization of SPIRIT's platform to ensure reliable, low-latency streaming for wide-scale virtual concerts.

Main achievements/ results: The RHYTHM project leveraged the SPIRIT platform to conduct a Real-time Hybrid Test for Harmonic Music, evaluating the impact of low-latency, real-time interaction on fan engagement in immersive hybrid concerts. A key achievement was the comparison of different streaming methods—including pre-recorded volumetric video, mesh-based, and SPIRIT's point cloud streaming—to demonstrate that the advantage of real-time interaction significantly enhances the overall experience for both performers and audiences over solutions with a 5-10 second delay. The project utilized the Belgian band WITT's performance and the mentorship of Steve Vai to create a high-quality, live concert simulation, generating valuable Quality of Experience (QoE) results and a new QoE questionnaire that provided subjective insights into the optimal balance between visual fidelity and interactivity for wide-scale virtual concerts.

4.2.3.14 ROTIE (ROBOT TELEOPERATION THROUGH IMMERSIVE ENVIRONMENTS):

Short description: ROTIE aims to transform human-to-machine and machine-to-machine interactions by developing new HID (Human Interface Devices) to remotely operate robots, recreating the physical space where the robot is in, so the remote worker is perfectly aware of the environment and can operate the robot to perform specific tasks avoiding possible risks at the real environment. Combining robots and immersive technologies seems the step forward to transform human-to-machine interactions, both in physical and virtual environments. Simultaneously, ROTIE can also be used to regenerate scenes and develop digital twins. The virtual scene would be displayed in quasi real time applications running on different devices. The remote operator will be able to run the equipment using different types of controls related to HID. Our proposal includes the acquisition of 2D and 3D images and spatial sounds on the environment, to enrich the perception that is offered to the end user.

Submission summary: ROTIE is a distributed and fully containerization-compatible platform conceived to allow robot operators to monitor and drive their mobile robots or manipulators through immersive interfaces working in bi-directional mode. The framework will offer APIs for advanced Human Interaction Devices that are used to facilitate user-intention-based robot control. And, on the other way round, the user will be virtually tele-transported to the robot environment through the use and fusion of sensorial data including principally 2D/3D images and spatial sound. Besides, the platform is designed to allow also the development of digital twins that can extend the performance of robot operations for pre-operation planning and post-operation analysis. This platform consists of dedicated modules for each layer of human-machine interaction: HID API, XR Service, Robot Motion and Sensor APIs, Robot Operation Engine, Scene Reconstruction Engine and Virtual Scene Rendering Engine. It is conceived as

Co-funded by the European Union
Project funded by

a block- structure, which will allow different types of robots and HID devices to be integrated easily with the platform interfaces. In combination with the ROTIE services, it will contribute to the standardization of robot tele-operation interfaces. Considering the restrictions and possible dangers of remote control of robots, security and data access control layers must be included. In addition, low latency in communications is necessary to allow reliable control of the robots. The ROTIE platform would be integrated with the different layers of the SPIRIT architecture at different levels, in order to test the reliability and precision of control using immersive devices.

Main achievements/ results: The ROTIE project developed a distributed, containerized platform for the immersive teleoperation of mobile robots and manipulators using advanced Human Interface Devices (HID). A core achievement was the implementation of manual robot navigation (including the Husky robot) via XR glasses, achieving a responsive latency of 200–300 ms for camera-controlled movement. The project also pioneered the creation of high-fidelity Digital Twins and Gaussian Splats of remote environments, allowing operators to virtually "tele-transport" into 3D scenes enriched with spatial audio and stereoscopic vision. These innovations contribute to the standardization of robot teleoperation interfaces and validate the SPIRIT platform's ability to support reliable, low-latency human-machine interaction in hazardous or complex industrial settings.

4.2.3.15 TRUST-XR (THERAPY-BASED REDUCTION OF UNCOMFORTABLE EXPERIENCES SAFELY IN EXTENDED REALITY SPACES):

Short description: TRUST-XR proposal aims to deliver immersive, adaptive XR scenarios for therapeutic use. It empowers individuals to safely confront fears, such as claustrophobia or social anxiety, through controlled XR environments, guided in real-time by therapists using holographic telepresence. TRUST-XR integrates cutting-edge personalisation and cognitive-behavioural therapy principles into SPIRIT's low-latency infrastructure. Innovations include real-time context and environment adaptation based on user responses, therapist holograms for emotional support, and performance metrics to track therapeutic outcomes. Through these capabilities, the project validates SPIRIT's potential to support impactful, multi-user, multi-modal, and real-time XR applications while addressing critical societal mental health needs.

Submission summary: Uncomfortable experiences, like anxieties and fears, can significantly impact individuals' quality of life*, limiting their ability to engage in everyday activities or confront specific challenges. The Therapy-based Reduction of Uncomfortable Experiences Safely in Extended Reality Spaces (TR*UST-XR) project aims to provide an innovative solution by leveraging Extended Reality (XR) technologies to create safe, controlled, and adaptive virtual environments for exposure therapy. This approach progressively empowers users to confront their uncomfortable experiences, encouraging resilience and emotional well-being. The project implements immersive XR scenarios tailored to address uncomfortable experiences, such as claustrophobia, social anxiety, and acrophobia. For example, users with claustrophobia can experience a gradual transition from a spacious lobby to an enclosed elevator, with adjustable parameters such as elevator size, duration, and calming visual and auditory cues. These scenarios are personalized to match individual user needs, ensuring safety and effectiveness. The TRUST-XR project aligns seamlessly with the objectives of SPIRIT Open Call 2 (OC #2) by demonstrating the capabilities of immersive telepresence technologies in a real-world therapeutic context. Utilizing SPIRIT's interconnected testbeds and advanced platforms, TRUST-XR will employ low-latency streaming, real-time rendering, and adaptive content delivery to design and test therapy-focused XR environments. These controlled experiments will measure anxiety reduction, user engagement, and the impact of personalization features, contributing to SPIRIT's goals of validating innovative, high-impact use cases. Through its experiment-driven approach, TRUST-XR demonstrates the transformative potential of SPIRIT-enabled applications while contributing to mental health and well-being. It advances SPIRIT's mission by illustrating how immersive telepresence can serve practical, impactful purposes, bridging cutting-edge technology with pressing societal needs.

Co-funded by the European Union
Project funded by

Main achievements/ results: The TRUST-XR project developed and validated an innovative system for delivering immersive, adaptive Extended Reality (XR) scenarios for therapeutic use, focusing on safe exposure therapy for conditions like claustrophobia and social anxiety. The core achievement is the implementation of real-time context and environment adaptation that modulates therapeutic scenarios (e.g., elevator size or duration) based on the user's immediate emotional response. This is powerfully augmented by therapist holographic telepresence integrated via SPIRIT's low-latency infrastructure, providing real-time guidance and emotional support. The project validates SPIRIT's ability to support impactful, multi-user, multi-modal, and Quality of Experience (QoE)-sensitive healthcare scenarios, demonstrating a transformative application for mental health and well-being.

4.2.3.16 VISTA-XR (VIRTUAL IMMERSIVE SOLUTIONS FOR TOURISM AND ARCHITECTURE IN EXTENDED REALITY):

Short description: VISTA-XR is our winning proposal aimed at transforming how people experience cultural heritage using real-time holographic telepresence and collaborative XR environments. Visitors can explore highly detailed 3D reconstructions of architectural landmarks through immersive headsets like the Meta Quest, guided live by holographic avatars.

Key objectives:

- Enable live holographic tours with cultural experts using SPIRIT's WebRTC tools and 5G connectivity.
- Facilitate multi-user collaboration within XR environments for shared exploration and storytelling.
- Optimise high-fidelity 3D reconstructions for cultural sites using point cloud streaming and edge computing.
- Enhance accessibility and engagement for users worldwide, even in remote or underserved regions.

Our innovations build on SCIPLANT, our earlier XR urban planning platform, extending it into the tourism sector. Using SPIRIT's advanced tech stack (multi-source synchronisation, edge rendering, low-latency WebRTC), we bridge immersive storytelling with collaborative interaction.

Submission summary: VISTA-XR (Virtual Immersive Solutions for Tourism and Architecture in Extended Reality) reimagines cultural heritage exploration by integrating real-time holographic telepresence and collaborative XR environments. Using SPIRIT's cutting-edge infrastructure, VISTA-XR enables visitors, experts, and stakeholders to interact with high-fidelity 3D reconstructions of historical landmarks in a way never seen before. At its core, VISTA-XR addresses two critical challenges in cultural tourism:

- Accessibility: Many historical sites are inaccessible due to physical, geographic, or economic barriers.
- Engagement: Existing virtual solutions are static, failing to deliver meaningful interaction or real-time collaboration.

Leveraging SPIRIT's point cloud rendering, multi-source synchronization, and edge computing resources, VISTA-XR introduces a live, immersive experience where:

- Experts appear as holographic guides, leading interactive virtual tours of meticulously reconstructed cultural sites.

Co-funded by the European Union
Project funded by

- Multiple users can engage collaboratively in XR environments, fostering shared exploration and discussion.

Through SPIRIT's multi-site testbeds, VISTA-XR will validate:

- • Real-time holographic streaming with ultra-low latency.
- • Seamless multi-user synchronization for interactive XR sessions.
- • Scalable 3D data processing optimized for high-fidelity cultural assets.

By creating a model for accessible, interactive, and sustainable heritage tourism, VISTA-XR will showcase SPIRIT's potential to revolutionize not only tourism but other fields like education and preservation. The VISTA-XR team combines expertise in XR design, data visualization, and architectural storytelling, ensuring a solution that is as technically rigorous as it is culturally impactful. With VISTA-XR, cultural heritage transcends boundaries, blending past and present into an unforgettable, immersive experience powered by SPIRIT.

Main achievements/ results: The VISTA-XR project successfully transformed cultural heritage exploration by integrating real-time holographic telepresence and collaborative XR environments. Utilizing SPIRIT's 5G connectivity and WebRTC tools, the project enabled live tours of high-fidelity 3D reconstructions where cultural experts serve as interactive holographic guides. Technical achievements included the integration of stereo capture into an end-to-end pipeline and the optimization of point cloud streaming via edge computing, resulting in a seamless experience with under 100 ms end-to-end latency. This innovation addresses critical accessibility and engagement barriers in tourism by allowing multiple users to engage in shared, synchronized storytelling within meticulously reconstructed historical landmarks.

4.3 OPEN CALL COMMUNICATION AND DISSEMINATION ACTIVITIES

The SPIRIT project promoted its two Open Calls through a multi-channel strategy that combined dedicated web pages, targeted social media campaigns on LinkedIn and X, and announcements in project newsletters.

Visibility for the winners of OC1 and OC2 was ensured through the publication of individual written interviews on the project website, which highlighted their technical innovations and envisioned impact, alongside a dedicated video showcasing results from all 27 successful proposals. To foster knowledge exchange and integration among the projects, SPIRIT organized 4 internal presentations where each project was able to showcase theirs results as well as problem solving strategies. Notably, SPIRIT actively facilitated synergies by joining the **Beyond-XR cluster**. This collaborative environment allowed experimenters to present their work to related EU initiatives and culminated in a major final event at **EuroXR 2025**. At this conference, OC winners participated in a joint workshop with the CORTEX² project, delivered live demonstrations, and presented posters, 22 of which were officially accepted by the conference. This opportunity provided the OC1 and OC2 winners with high-level exposure to

Co-funded by the European Union
Project funded by

the international XR and telepresence communities. More detailed information can be found on D6.2.[10]

[10] Deliverable D6.2 Communication Dissemination Standardisation and Exploitation Report

Co-funded by the European Union
Project funded by

5 IMPACT OF OPEN CALL PROJECTS ON THE SPIRIT ECOSYSTEM

The Financial Support to Third Parties (FSTP) mechanism, executed through Open Calls 1 and 2, has been a cornerstone in maximizing the scientific and technological impact of the SPIRIT project. By funding a total of 27 external Third-Party Projects (TPPs), 11 in OC1 and 16 in OC2, the SPIRIT platform has been significantly enriched with diverse applications, novel technical components, and cross-border research contributions. The collective impact is categorized into three strategic pillars: **Validation and Testing**, **Provision of New Requirements**, and **Platform Extension**.

5.1 VALIDATION AND TESTING OF SPIRIT CAPABILITIES

Third-party innovators acted as early adopters, providing a rigorous playground to test the performance, scalability, and interoperability of the SPIRIT infrastructure in real-world environments.

Platform Stress Testing: **RABBIT@SCALE** demonstrated the high-capacity scalability of volumetric stream transcoding using SPIRIT's Kubernetes infrastructure. Simultaneously, **DIANE** validated the 5G and WebRTC pipeline by executing low-latency edge-based control of remote robots across international borders (Surrey, UK to Bari, Italy).

Next-Generation Hardware Support: **QEST** expanded the ecosystem's reach by extending testing capabilities to high-end head-mounted displays (HMDs), specifically the Apple Vision Pro and Meta Quest 3, delivering critical Quality of Experience (QoE) benchmarks.

Cross-Domain Utility: Validation spanned vital sectors, including manufacturing (**GENSAVR** for scalable VR safety training) and cultural tourism (**ANNETTE** and **VISTA-XR** for real-time photorealistic avatar and hologram integration).

5.2 PROVISION OF NEW REQUIREMENTS AND FEEDBACK

Technical insights from TPPs directly influenced the iterative development of core SPIRIT components.

Advanced Transport Protocols: **QUEST** pioneered a QUIC-based alternative (Media over QUIC) to traditional WebRTC, identifying new requirements for scalable and resilient media transport during network migration or bandwidth drops.

Multimodal Presence: **AURA**'s work on room-adaptive spatial audio established the necessity of ultra-low latency for natural remote presence. **Embodied Dialogue** further refined this by providing phenomenological QoE insights regarding spatial perception in multi-participant sessions.

Affective Computing: **EMPATHI** introduced the platform requirement for synchronized, low-latency emotional modelling, driving the transition toward emotionally adaptive avatar interactions.

Network and Cloud Scalability: **ETHOS** and **TENeMP** focused on scalable volumetric video transmission through Tiled Multipoint Control Units and Selective Forwarding Units respectively, while **GENSAVR** aimed at VR training through scalable compute orchestration in Kubernetes.

Co-funded by the European Union
Project funded by

5.3 ENHANCEMENT AND EXTENSION OF THE SPIRIT PLATFORM

External participants contributed novel software modules that expanded the platform's technical reach and market readiness.

Optimized Media Delivery: **STREAM** integrated the Versatile Video Coding (VVC) codec and ported GStreamer to WebAssembly (WASM), enabling browser-based 4K streaming with a **50% bandwidth reduction**. **AIVATAR** further improved efficiency through a hybrid LCEVC and AI-driven enhancement solution.

Volumetric Innovation: **OPEN-DASH-PC** delivered an open-source ULL-DASH-PC transport protocol for adaptive point cloud streaming, while **SNAP** introduced **Neural Articulated Radiance Fields (NARF)** to provide higher rendering fidelity at significantly lower bitrates.

Secure and Semantic Interaction: **HOPE** developed semantic-aware compression for retail applications, and **MANTRA** integrated a Mixed Reality (MR) interface with haptic feedback for intuitive robot teleoperation over the 5G testbed.

Co-funded by the European Union
Project funded by

6 LESSONS LEARNED FROM THE OPEN CALL PROCESS

The execution of the FSTP mechanism yielded several key lessons:

Feasibility Assessment Value: The provision of an **optional advisory service** for feasibility assessment proved highly beneficial, allowing applicants to verify the technical suitability of their proposed experiments with the available SPIRIT infrastructure before submitting the final application. This step was strongly recommended and contributed to the overall high quality and alignment of the proposals received in OC1 and OC2.

Patron System Effectiveness: The assignment of a **SPIRIT Patron** (consortium partner) to each winning project was critical to ensure **continuous technical support**, facilitate access to the SPIRIT testbeds and tools, provide **technical guidance** and troubleshooting, and rigorously reviewed the mid-term and final reports, maximizing the impact of the funded experiments.

SME Engagement Success: The FSTP mechanism successfully stimulated innovation across Europe, particularly involving Small and Medium-sized Enterprises (SMEs). The strategic goal of allocating at least 50% of the grants to SMEs was achieved, with €1.869,000 of the total budget of approximately €3.48 million allocated to SMEs as individual participants or part of a consortium.

Rigorous Evaluation Process: The multi-stage evaluation process, involving **independent external experts** and a consensus meeting with **score normalization** ensured impartiality, transparency, and the selection of projects with the highest strategic alignment and potential for long-term impact on the SPIRIT platform.

Co-funded by the European Union

Project funded by