



SPIRIT

2nd Open Call WORKSHOP

Valentina Margaria

DIGITAL FOR PLANET D4P

WORKSHOP

November 04, 2024

www.spirit-project.eu



BEFORE STARTING



- The event is recorded and, together with the slides, it will be published on the [SPiRiT website](https://www.spirit-project.eu).
- Write your question in the Q&A
- opencalls@spirit-project.eu

AGENDA and SPEAKERS



Introduction to SPIRIT project



Peter Van Daele, imec

Open Calls overview



Valentina Margaria, Digital for Planet

Technology Framework



Ning Wang, University of Surrey



Ali El Essaili, Ericsson



Vivien Helmut, Deutsche Telekom

Questions and Answers



Hermann Hellwagner, University of Klagenfurt



Anita Gojanovic, Digital for Planet



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SPIRIT project: mission and vision

Peter Van Daele

IMEC

Workshop Open Call 2

Online, November 04, 2024

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AMBITION

Realise Europe's first **multi-site & interconnected framework** dedicated to supporting the operation of **heterogeneous collaborative telepresence applications at scale** through relevant technology innovation.

SPIRIT IN A NUTSHELL



Addressed call: eXtended Collaborative
Telepresence
HORIZON-CL4-2021-HUMAN-01-25



Outcome: SPIRIT system, a distributed network
and application platform with interconnected sites



Third party experimentation
through 2 dedicated Open Calls



Targeted TRL: from TRL 4 to TRL 7



Duration: 3 years



Consortium:





***Empowering
Innovation
Through
Collaboration***

Cascade Funding _ Open Call

Cascade funding aims to **accelerate, foster and boost the development of innovative projects** through financial vouchers and mentoring by SPIRIT partners.

SPIRIT OPEN CALLS



SPIRIT provides **3.5M EUR** in two waves of Open Calls to financially support the involvement of third parties to **develop and further test their individual applications using the capabilities of the SPIRIT platform.**



*2 waves of
Open Calls*



*3.5M EUR of
total funding*



*Up to 9 months of
testing projects*



*25 funded
project testing*



*SMEs, industries,
research & scientific
organisations*

11 winning proposals stood out for their innovative ideas and potential impact on advancing immersive telepresence technology. [Check out the Open Call 1 winners here.](#)



2nd Open Call: Timeline, Rules and Guidelines

VALENTINA MARGARIA
DIGITAL FOR PLANET, D4P

Workshop Open Call 2
Online, November 04, 2024

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FUNDING and SUPPORT of 2nd OPEN CALL



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

- **Total Budget:**

- OC2 has a total budget of €1,500,000.

- **Number of Projects Funded:**

- Targeted number of Third-Party Projects (TPP) to be selected: 15

- **Funding Allocation:**

- Maximum funding per project: €100,000.

- **Project Duration:**

- Each TPP funded within OC2 is expected to have a max total duration of 8 months.

ELIGIBLE COSTS



All 3 categories covered
100% for all type of
organisation

Personnel expenses

Travel expenses

Overhead (equivalent
to 25% of direct costs)

PAYMENTS



The payment structure consists of two instalments:

- The **first instalment, equivalent to 75%** of the Maximum Grant Amount at M5 following the submission of the mid-term report (1st report).
- The **second instalment** will be processed subsequent to the final review and submission of Final Report.

PATRON



Each selected project will be supervised by a project partner who acts as PATRON

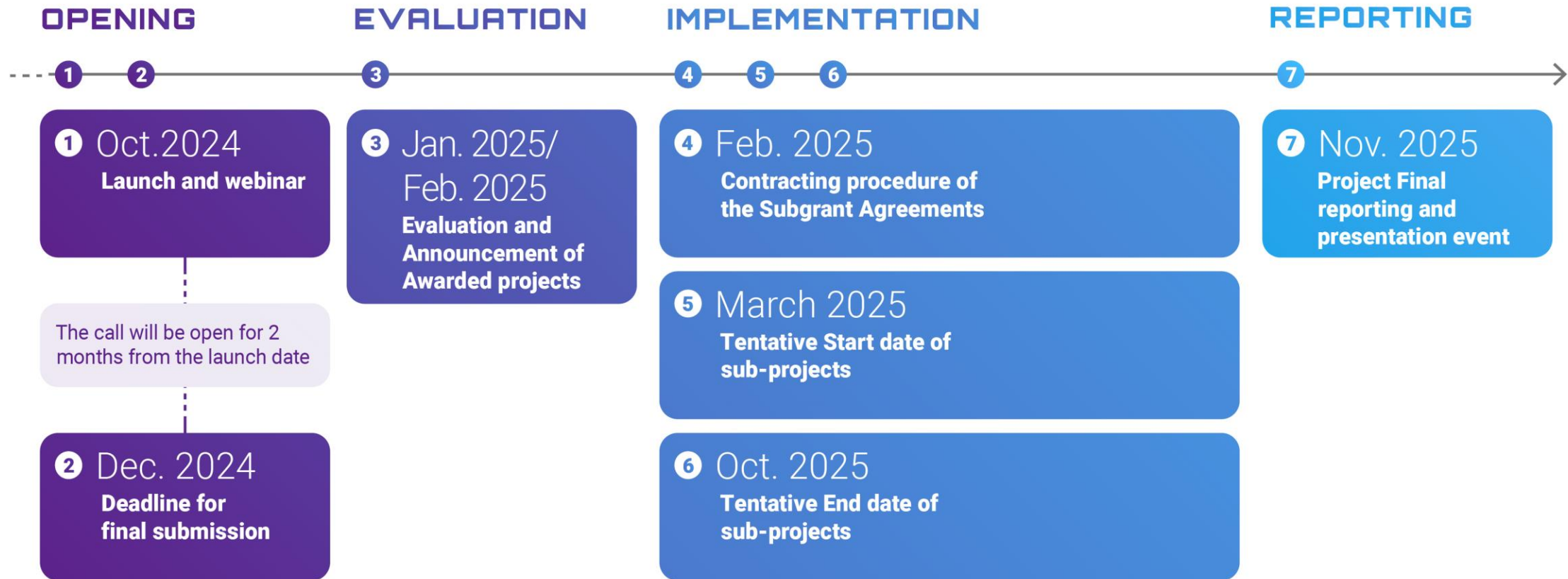


PATRON:

The main point of contact for technical guidance, assisting with project alignment and implementation on the SPIRIT platform.

You can find the list of PATRON on [SPIRIT OPEN CALL 2 dedicated page](#)

TIMELINE



Final Submission Deadline: 19 December 2024, 17:00 CET

IMPORTANT TOOLS



- <https://spirit-project.eu/open-call-2/> is your reference page

OPEN CALL DOCUMENTS:

All documents needed for submission

OVERVIEW

SPIRIT reports explaining technological framework

Be sure to use the documents linked below when preparing and submitting your proposal.

- Proposal Template (.docx) ↓
- Declaration of Honour ↓
- SME Self-Declaration ↓

- D2.2 Use Case Requirements, System Architecture and Interface Definition ↓
- D3.2 Innovation Platform Enablers ↓
- D4.2 Spirit Platform ↓



ELIGIBILITY CRITERIA: WHO

- Targeted organisation:
 - (i) SMEs; (ii) Industry; (iii) Research/scientific organisation; (iv) Academia.
- Both individual organisations and consortia may participate.
- Consortia must consist of a maximum of three organisations.
- The applicant (single organisation or consortium) is eligible for participation in the Horizon Europe programme.
- **IMPORTANT:** As the SPIRIT project was funded within the HORIZON-CL4-2021-HUMAN-01 call, the list of [eligible countries](#) is the one applied to this specific call.
- The applicant **is not affiliated to any of the consortium partners of the SPIRIT project** *

*According to the definition outlined in the Horizon Europe program, an affiliated entity is characterised by having a legal or capital connection with one of the project partners. Specifically, an affiliated entity encompasses any legal entity that is under direct or indirect control of a project partner, shares the same direct or indirect control as the project partners, or directly or indirectly controls the project partners.

ELIGIBILITY CRITERIA: WHAT



Type of Activities Qualified for Financial Support:

Activities that, in line with SPIRIT project goals, aim to support the advancement and validation of collaborative telepresence applications on the SPIRIT platform, as well as the development and enhancement of the platform itself (complete description **OC2 OBJECTIVES**)

- **Validating and testing third-party applications on the SPIRIT platform.**
- **Complementing and enhancing the SPIRIT platform with additional functionalities.**
- **Defining requirements and strategic goals for future developments.**



**ANSWER
THE POLL!**

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FEASIBILITY ADVISORY



SPIRIT consortium offers **an optional advisory service to evaluate project feasibility**. This step is highly recommended and involves submitting a condensed version of the proposal template for feasibility verification.

Submission deadline to take advantage of Feasibility Advisory is **25 November 2024, 17:00 CET**. **Feasibility requests will be processed as soon as they are received, so the sooner you send them in, the sooner you will get feedback and have more time to redefine the final proposal.**

IMPORTANT: undergoing a feasibility advisory does not guarantee the selection of the proposal and does not imply any commitment to move forward with the proposal. It is also important to note that submitting a partial proposal for the ‘Feasibility Advisory’ is an optional preliminary step which is not considered as a final submission.

PROPOSAL SUBMISSION



- Proposals must be submitted in English through the official Open Call Submission Tool on the [SPiRiT website](#).

OPEN CALL 2 IS NOW OPEN!

The second SPiRiT Open Call (OC2) is now open to a wide range of third-party contributors to validate and test their applications on the SPiRiT platform, Europe's first multi-site and interconnected platform for real-time immersive telepresence applications.

[Submit your proposal →](#)

OPEN CALL 2 IS NOW OPEN!

- [Open Call documents](#)
- [Overview](#)

PROPOSAL SUBMISSION: FEASIBILITY ADVISORY or FINAL SUBMISSION



SPIRIT OPEN CALL 2 – Submission

Date

30/10/2024

Stage *

Feasibility Advisory Final Submission

Full Title of the Proposal *

Acronym of the Proposal *

PROPOSAL SUBMISSION: FEASIBILITY



- **Submission Procedure:**

- Select feasibility advisory
- Complete the submission form on the SPIRIT website, ensuring all mandatory fields are filled

- **Documents Required:**

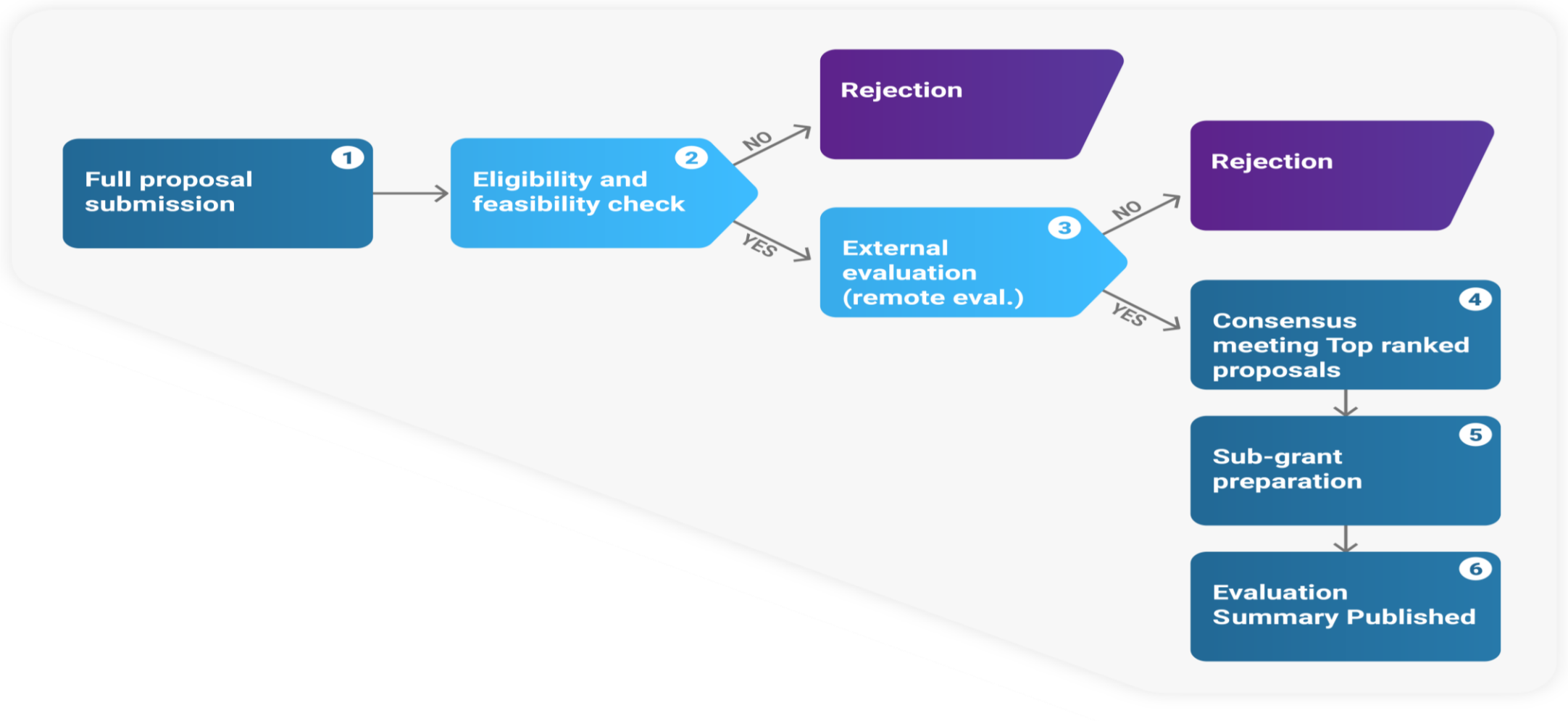
- Upload the Proposal Template in pdf: at least sections A, B, C and H of the proposal template should be fully completed
- Upload Declaration of honour and SMEs checklist if applicable
- Submission for Feasibility Advisory: **the sooner the better with deadline 25 November 2024, 17:00 CET**

PROPOSAL SUBMISSION: FINAL



- **Submission Procedure:**
 - Select Final Submission stage
 - Complete the submission form on the SPIRIT website, ensuring all mandatory fields are filled
- **Documents Required:**
 - Proposal Template fully completed
 - Declaration of Honour
 - SME Self-Declaration (if applicable)
 - Submission deadline for Final Submission: **19 December 2024, 17:00 CET**
 - Late proposals will not be admitted

EVALUATION PROCESS



EVALUATION PROCESS: EXTERNAL EVALUATORS



- The proposals deemed eligible will be reviewed by at least **2 external experts** (NDA is signed)
- **External experts** cannot be part of the consortium
- **External experts** cannot evaluate proposals where a conflict of interest can be identified
- The ranking will be based on 10 Criteria (next slide)
- Consensus meetings involving all reviewing experts and partner's representative will be held to agree on a common opinion and rating for each proposal
- **Final results will be communicated by end of January / February 2025**

EVALUATION CRITERIA and SCORE



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





SPIRIT

WP2

Requirements and Platform Architecture Definition

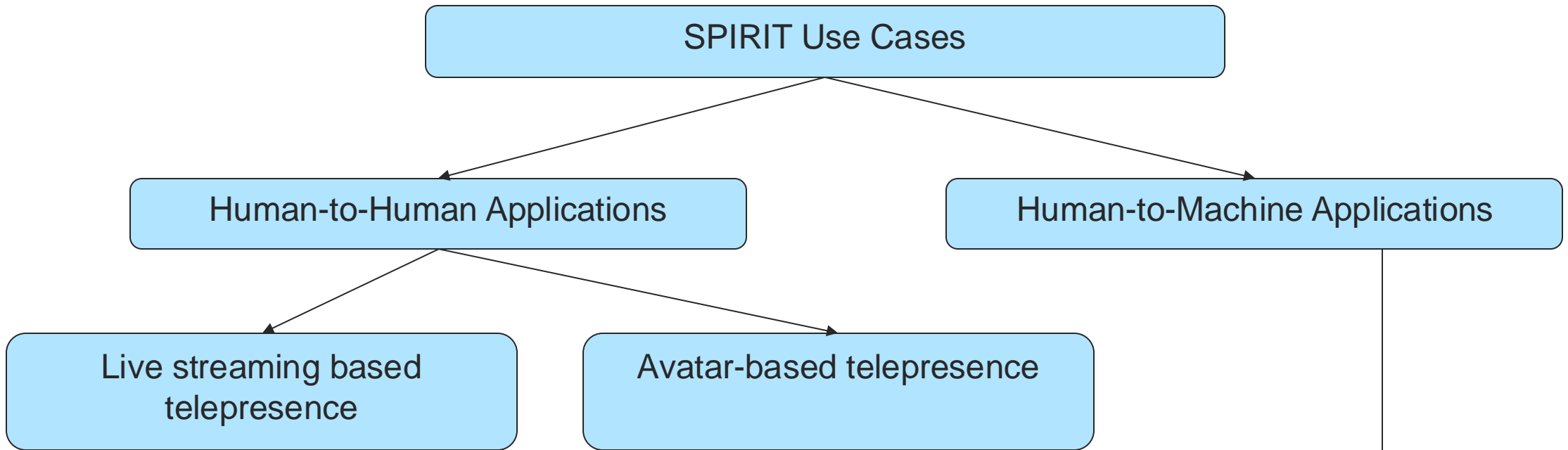
Ning Wang

University of Surrey

Workshop Open Call 2

Online, November 04, 2024

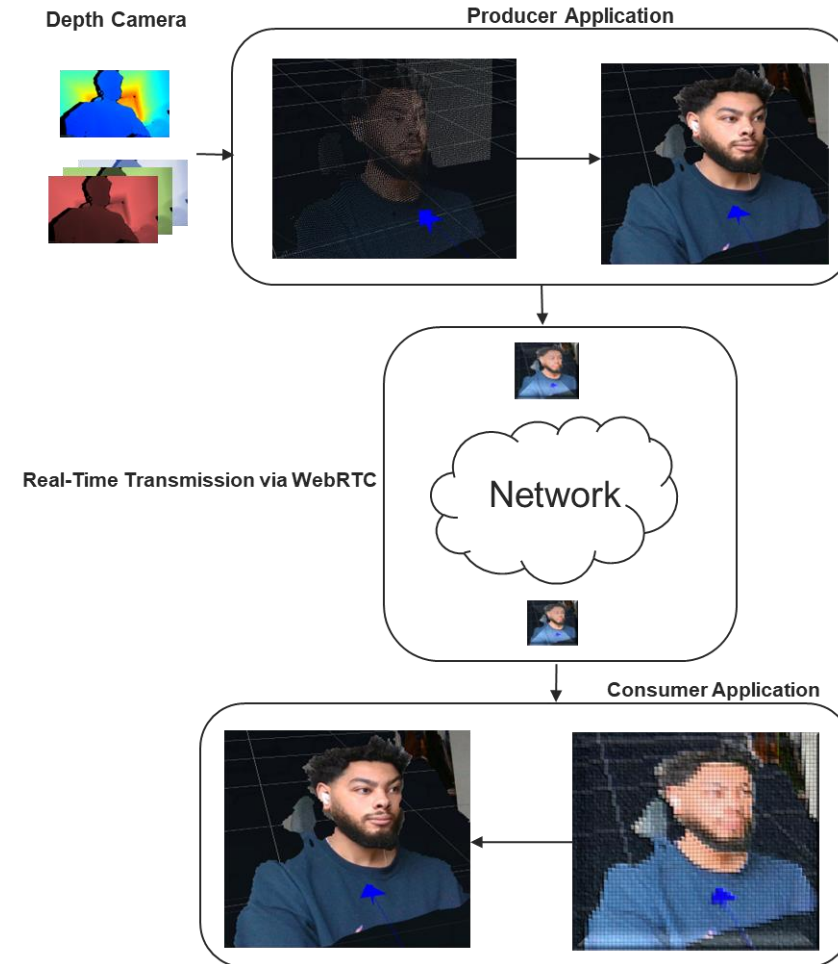
WP2 Use Cases





Live Streaming based telepresence

- Live capture, modeling, and streaming of 3D human representations using Web Real-Time Communication (WebRTC) as underlying streaming mechanism.
- A participant takes the role of the producer streaming processed data that includes a 3D human model obtained through a depth camera connected to a PC/cloud.
- A participant takes the role of the consumer receiving the data stream from the producer through a mobile phone. The decoded and rendered human 3D representation of the producer participant is displayed on AR glasses in real-time.



Multi-source support

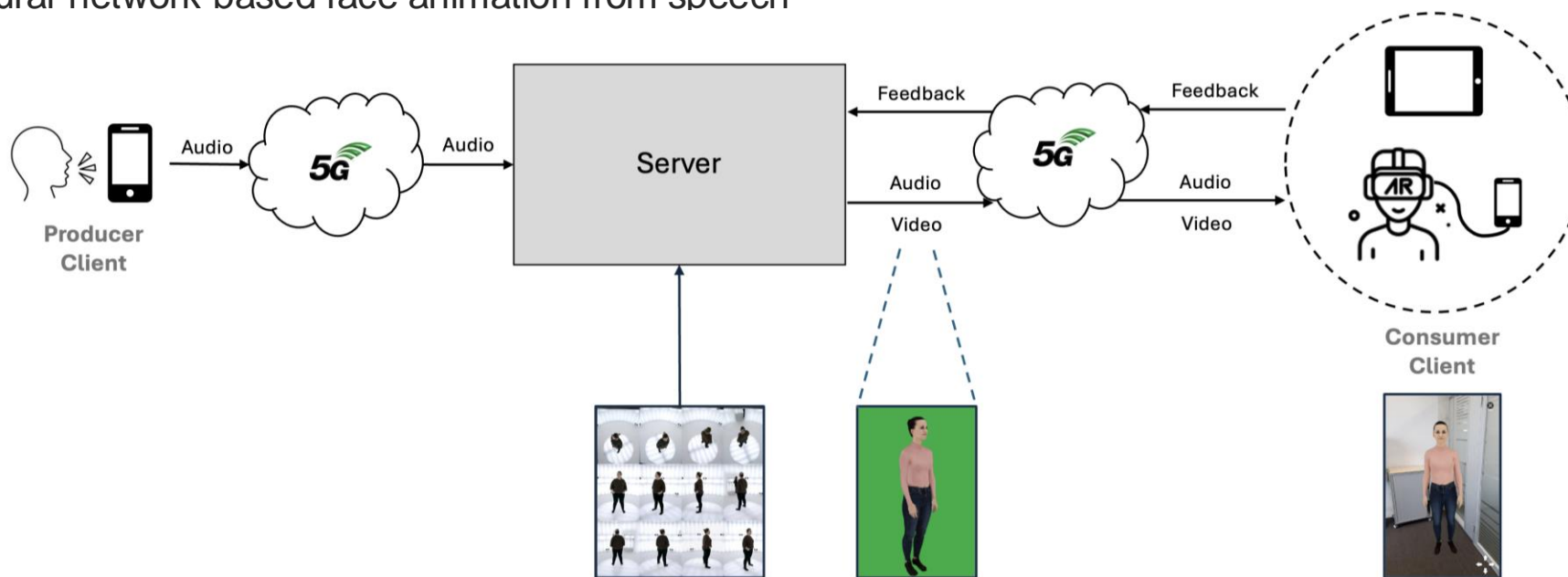


- Simultaneous streaming objects/people at different remote locations to the same virtual space for interaction
- Applications: virtual interaction, distributed performances etc.
- Technical challenges
 - Synchronisation of frames originated from different sources for assured user QoE



Avatar Based Telepresence

- Real-Time animation and streaming of a photorealistic avatar
 - Split Rendering approach -> Lower bandwidth required
 - The 3D object is rendered in the server -> Only 2D video is streamed
 - The consumer client performs the integration of the video in the scene
 - User viewpoint synchronised between client and server
 - Neural-network-based face animation from speech



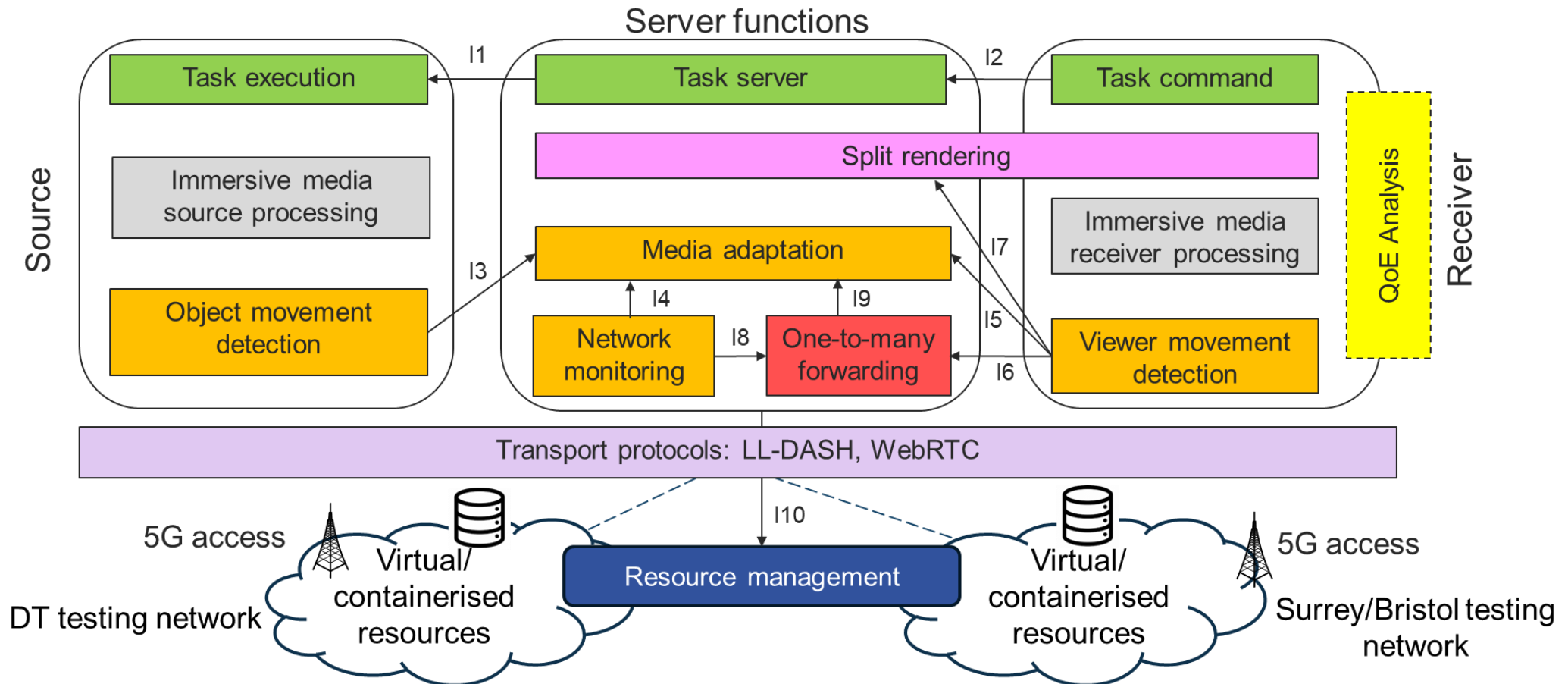


Human-to-machine Based Telepresence

- Manual & autonomous driving capabilities
 - Transport goods from A to B
 - Observation tasks
 - Switch between manual and autonomous driving
 - Intervene manually to solve problems (Notifications in certain scenarios)
- Teleoperation made possible via Video streams
- Centralised steering of devices (using an edge server)
 - Quickly "teleport" between multiple devices
 - Use multiple different devices to steer from the same network (e.g. workstations or handheld devices)



SPIRIT Architecture





SPIRIT



WP3 PLATFORM INNOVATIONS

Nick Turay, Ali El Essaili
Ericsson (EDD)

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Live Holographic Communication Platform (Ericsson)



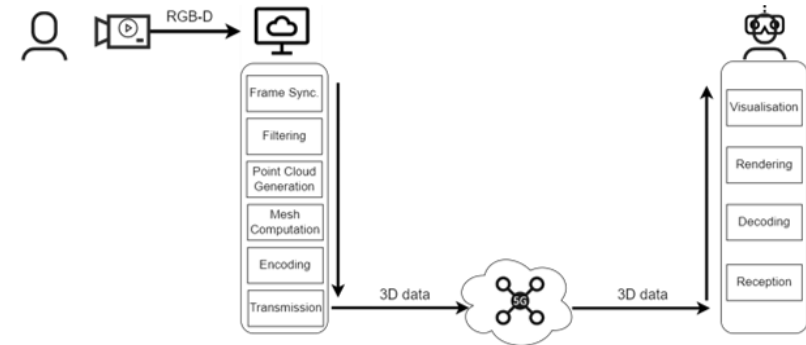
3D human representation generated from a live capture

Client producer application

- Acquisition of RGB and depth frames
- Filtering
- Computation of point clouds and meshes
- Compression
- Real-time transmission of encoded data via WebRTC

Client consumer application

- Real-time reception of encoded data via WebRTC
- Decoding and rendering
- Visualisation of the producer user hologram through AR glasses



Real-Time Animation and Streaming of Realistic Avatars Platform (Fraunhofer HHI)



Photorealistic avatar generated from 16 multi-view videos

- Extraction of a parametric representation of the body movements and facial expressions
- Audio-based face animation

Client capture application

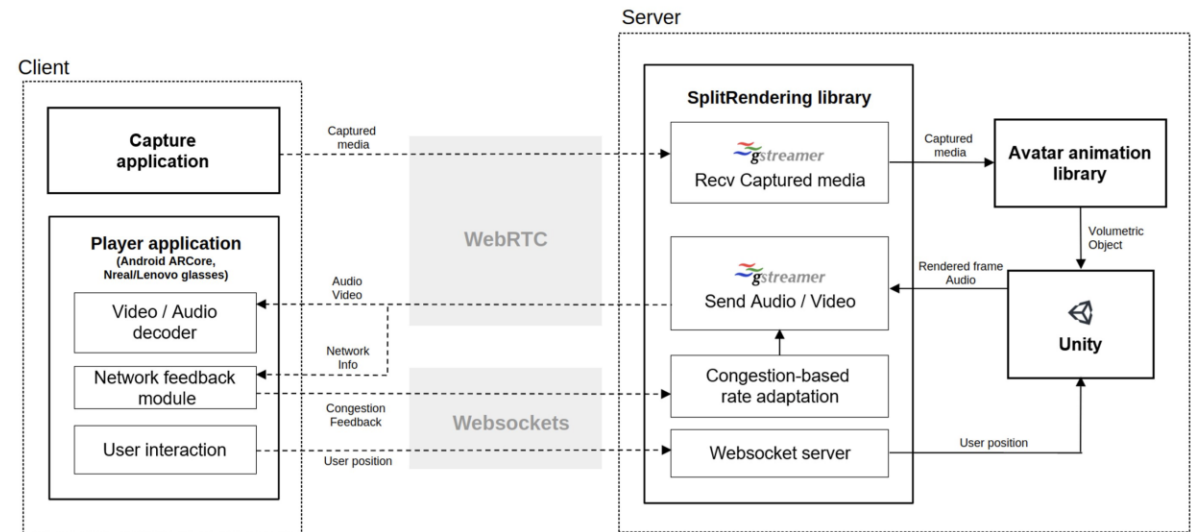
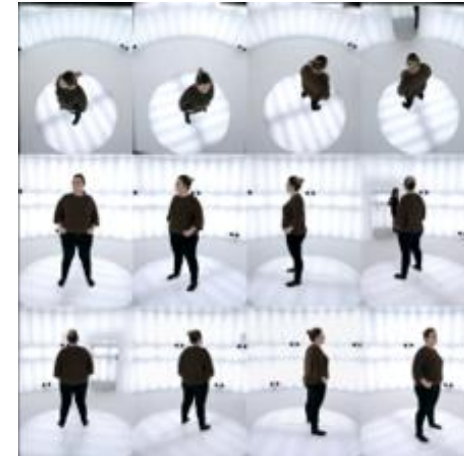
- Capture and streaming of media with WebRTC

Server animation, rendering, and streaming application

- Connection management
- Decoding and processing of incoming media streams
- Real-time NN-based animation of the avatar
- Synchronisation of user viewpoint – virtual cameras
- Rendering of 2D views of the avatar
- Streaming of 2D video and audio

Client player application

- Android tablet/phone or Mixed Reality glasses
- Integration of the avatar in the scene
- User interaction

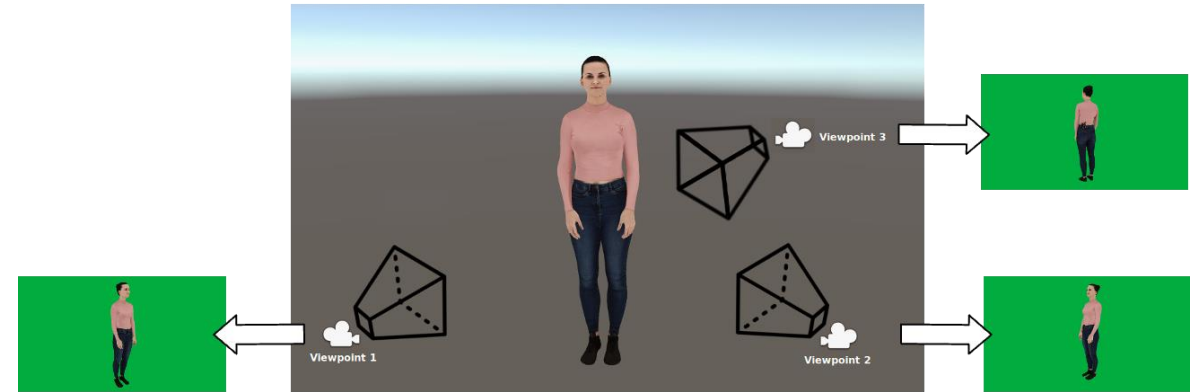


Real-Time Animation and Streaming of Realistic Avatars Platform (Fraunhofer HHI)



HHI: Split Rendering

- Object pool
- Continuous feedback
- Virtual camera (Unity)
- Gstreamer pipeline with WebRTC
- Background removal and integration



HHI: User interaction

- Drag & drop, rotation, and scaling

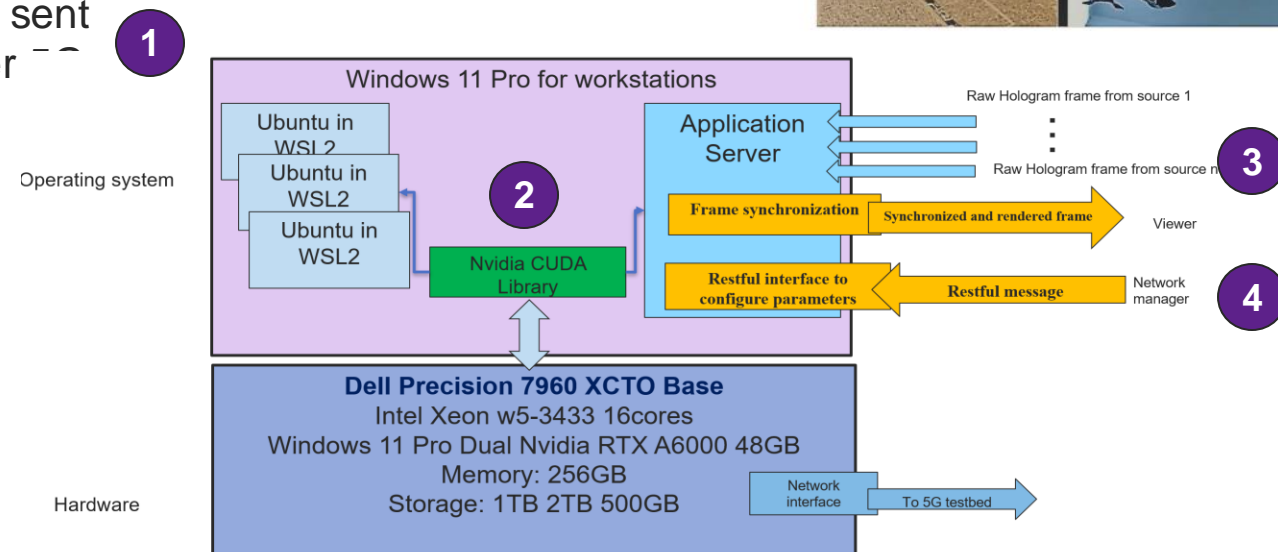


Multi-Source Live Teleportation (University of Surrey)



Teleportation of Real-time Captured Humans

1. Installed on the UoS testbed's Edge, distributed over multiple virtual machines running Ubuntu
2. The hologram server uses Nvidia CUDA to accelerate processing of the 3D video streams
3. The streams are received and sent using simple TCP sockets over ~ 100 ms
4. A RESTful API is available for the management of the hologram server







TESTBEDS INTEGRATION

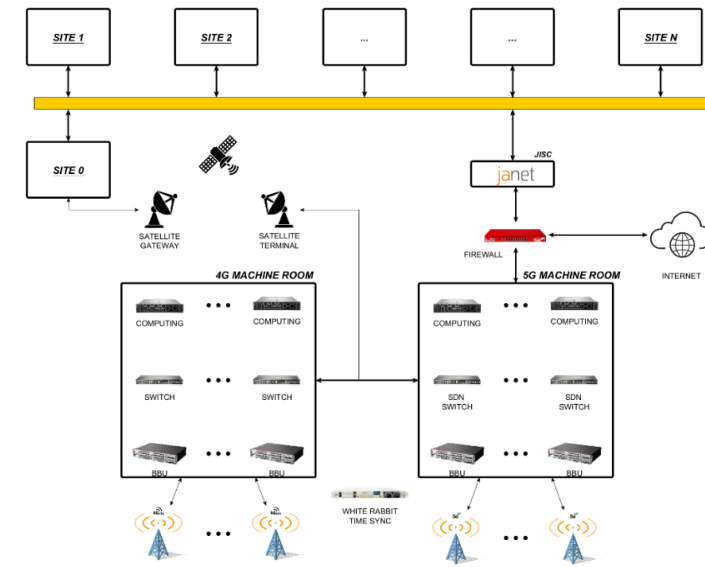
Vivien Helmut
Deutsche Telekom

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Testbed at University of Surrey



- Multi-Radio Access Technology (RAT) network
- Covering the UoS campus, over four square kilometres
- 4G, 5G Stand Alone and 5G Non-Stand Alone
- Virtualised Core network, and fibre external connectivity
- Edge server machine
- Unmanned Aerial Vehicle (UAV) and satellite systems





Testbed at T-Systems

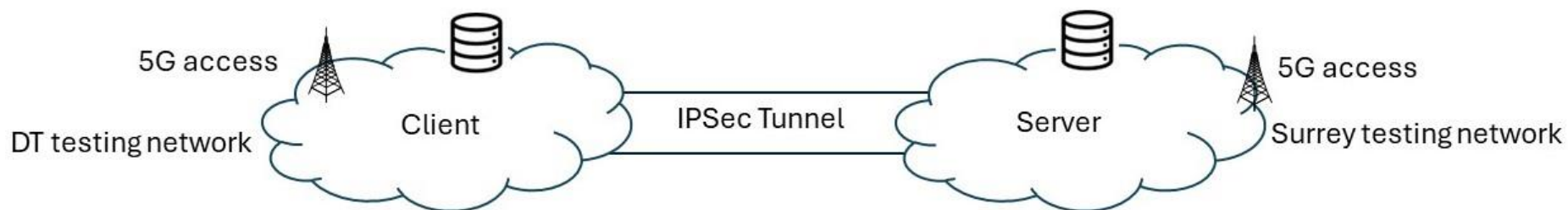
- Located at Berlin Siemensstadt
- Old manufacturing plant for dynamos, now future factory
- 5G Stand Alone Network
 - Supplemented by WiFi and ethernet for access
- Indoor and Outdoor 5G Coverage
- 500 m² outdoor space and 1000 m² indoor space
- Edge Server
 - Kubernetes for Containerised Applications
 - Virtual Machines
- Holograms , Avatar and Robot Use case available





Multi-site Testbed

- The testbed at T-Systems and the testbed at the University of Surrey are interconnected.
- The interconnected test beds allow the testing and validation of telepresence applications that are connected via the Internet.
- Both sides provide edge cloud resources that can be integrated into the architecture of the third-party applications.

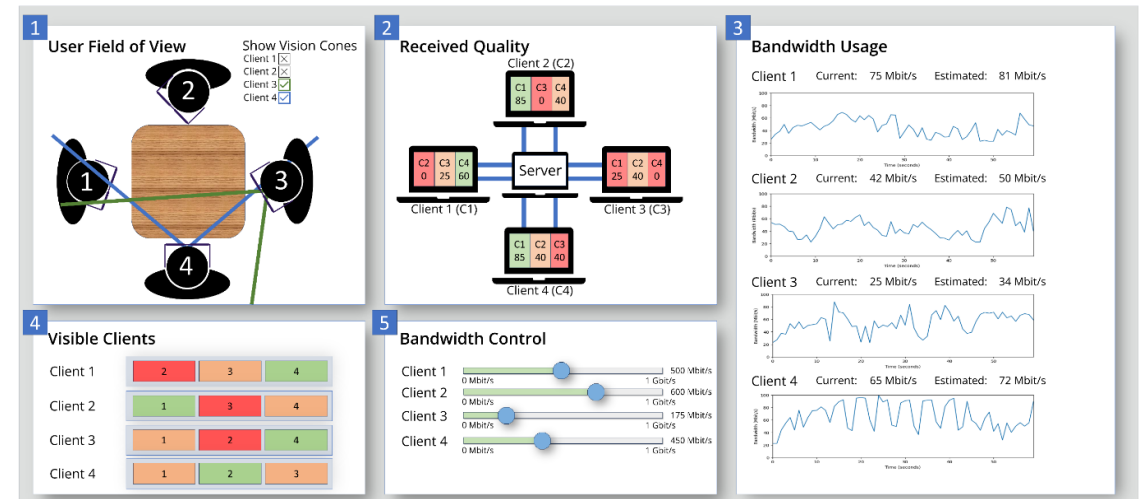
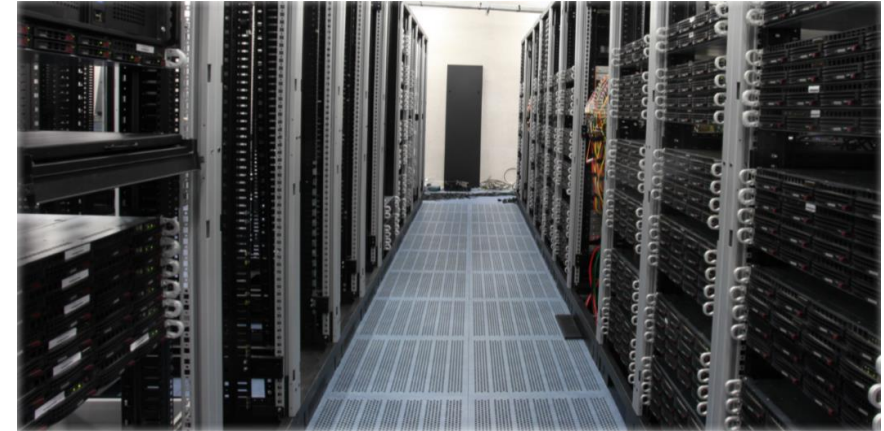


- Test of the Interconnection:
 - The real-time animation and streaming of realistic avatars was integrated to utilise the interconnection. The server was deployed at the Surrey testbed and the client was setup at the Berlin testbed.

Testbed at imec



- "Virtual Wall" facility, located at Ghent University
- Large-scale experimentation facility for advanced networking, distributed software, cloud and big data technologies
- 550+ bare metal and GPU servers, fully configurable
- Part of worldwide federation of testbeds
- SPIRIT Use Case on scalable conferencing available
 - Holographic human-to-human telepresence
 - Scalable many-to-many scenarios

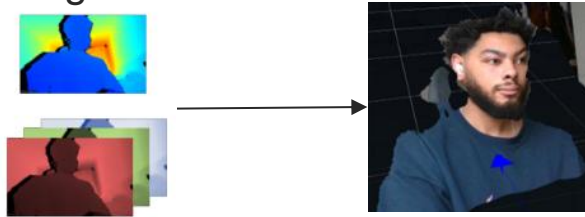


Integration of Application Frameworks



Holographic Human-to-Human Interactions

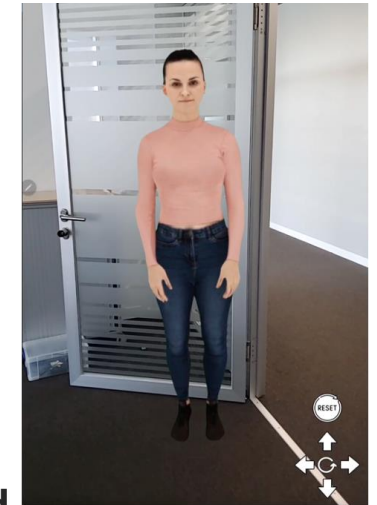
- 3D video conferencing; uses a depth camera on the producer side and an Android phone with connected AR glasses on the consumer side.



- Integration in the **Berlin testbed** is ongoing
- The components are **containerised**
- The camera's USB interface is **extended by a device server** forwarding the RGB-D stream to the Edge
- **Mobile Phone working within the 5G SA** with connected AR glasses
- **Publicly accessible WebRTC signalling server** needed for session initiation

Real-Time Animation and Streaming of Realistic Avatars

- From captured audio stream created visemes are used to animate the avatar.



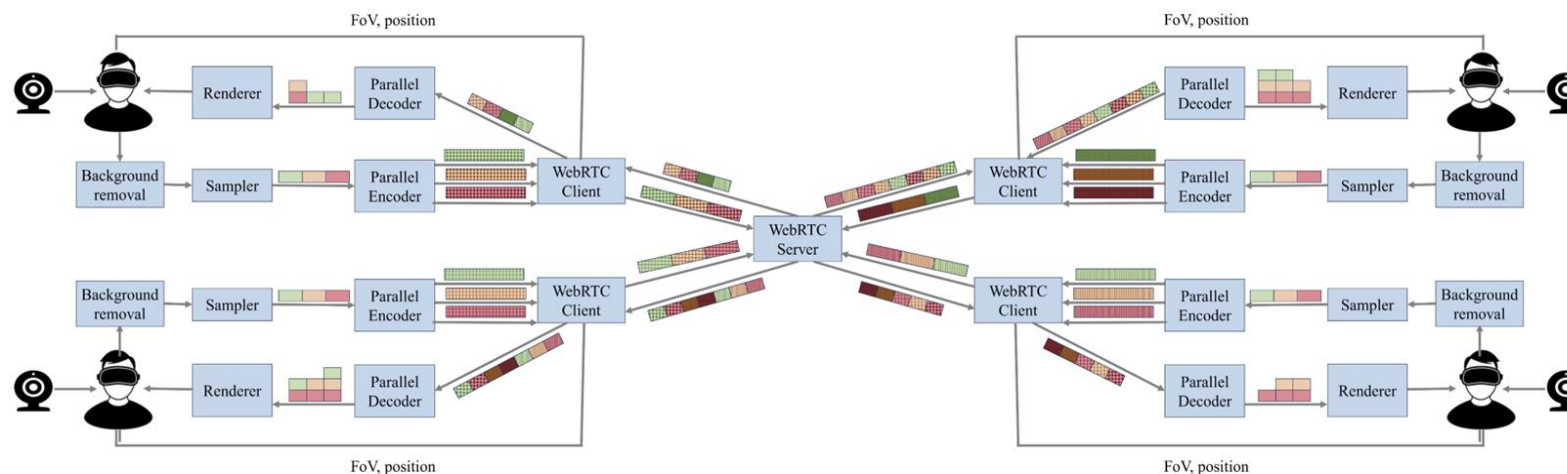
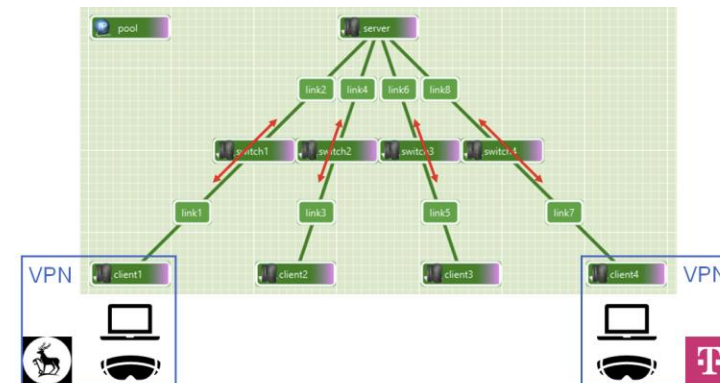
- In the **Berlin testbed** integrated
- The components are **containerised**
- **Mobile Phone working within the 5G SA** with connected AR glasses



Integration of Application Frameworks

Holographic Human-to-Human communication: many-to-many conferencing

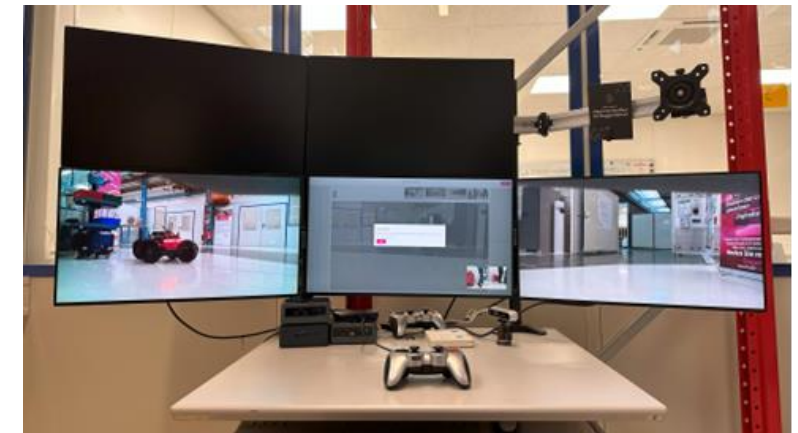
- 3D video conferencing
- Many-to-many scenarios in Virtual Wall testbed in Ghent
- Automated experiment setup
- Public IPv4 addresses, OpenVPN access
- Connection with high-tier machines with HMD
- Network emulation support



Real-Time Human-Machine Interactions



- Driving Platform "Husky" from Clearpath Robotics
- Equipped sensors:
 - 3D Lidar from Ouster
 - 4 x Intel Realsense 435i depth cameras
 - IMU
- Robot Control System running on edge server containerised
 - Robot transmits sensor data to and receives drive commands from the edge server
- Robot is connected via 5G modem
- Multiple Video streams for teleoperation in near real time
- Robots "Control Center" with 3 monitors
 - 4 Views (Front, Left, Right and Backwards), 4th View is displayed as picture in picture
 - Connected to Robot Control System running on the edge via ethernet
- Interaction with the robot via API's:
 - Send manual drive commands
 - Send autonomous drive orders
 - Creation of "Points of interests" to navigate to
 - Creation of "No Go" zones
 - Access to sensor data

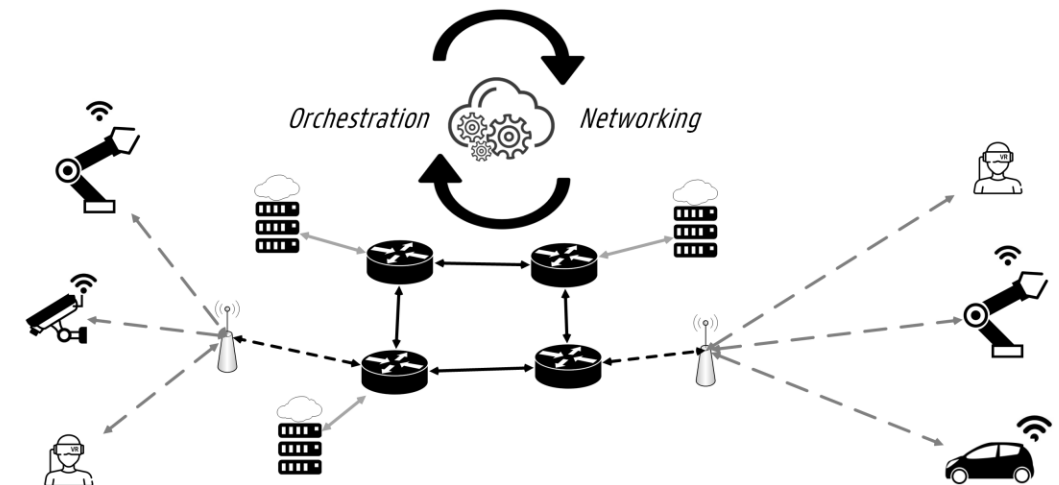


Network-aware Resource Scheduler (Diktyo)



IMEC: Network-Aware Resource Scheduler

- Diktyo from IMEC supports **network-awareness in the scheduling of containers in Kubernetes** (besides RAM and CPU)
- This ensures that end-to-end throughput and latency requirements can be met, which is important in microservice chain deployments for immersive applications
- It keeps track of application dependencies while mapping containers to the topology according to various objectives
- Diktyo has been integrated in CloudNativeLab (imec, open access Kubernetes cluster), in the **Berlin testbed** and in the **UoS testbed**

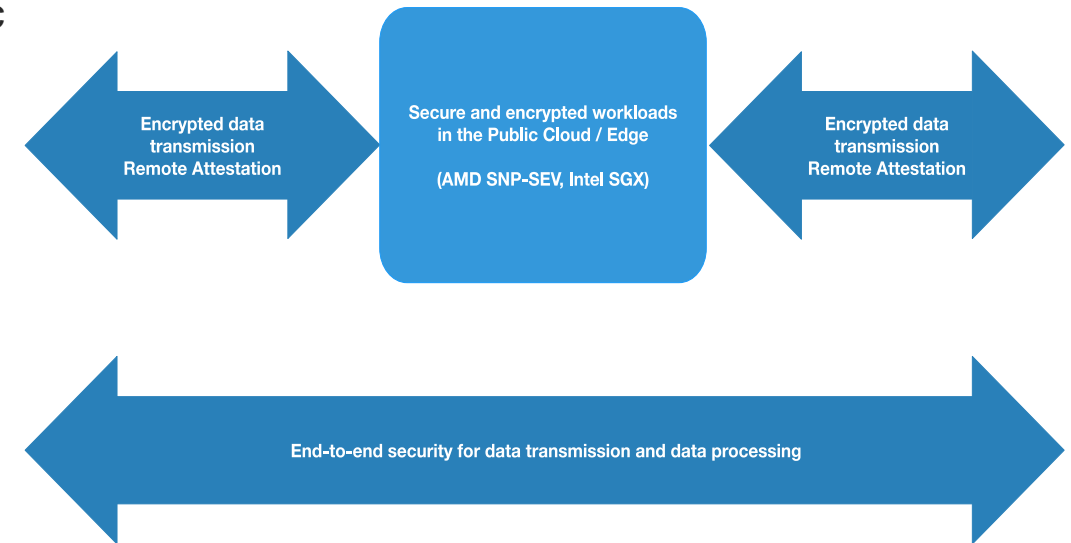


Security (End-to-End)



DT: Confidential Computing to Secure AR/VR Workloads

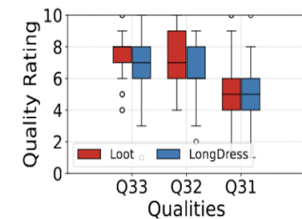
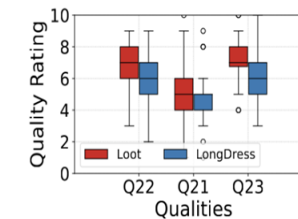
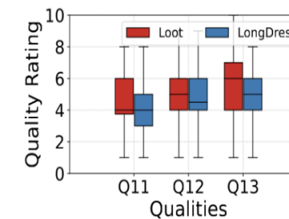
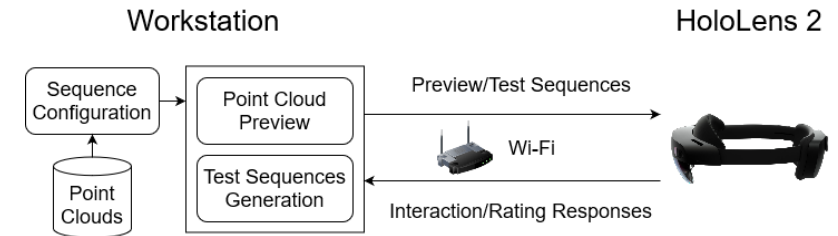
- End-to-end encryption prohibits intermediate cloud processing
 - Mathematical approaches are not feasible, e.g., homomorphic encryption
 - **End-to-end security:** Use of Confidential Computing technologies
 - Allowing processing of data within a cloud
 - Retention of full control by the data owner
1. For the preparation phase T-Sec **developed tools** to locally encrypt an operating system image for a virtual machine, modify it and upload it to the **secure data center operated by T-Sec**
 2. **For operation, scripts are available** that allow to easily launch, connect to and shut down these secured virtual machines



Quality of Experience (QoE) Evaluation



- UNI-KLU and IMEC developed tools for the MS HoloLens 2 to preview point clouds and run subjective QoE tests
- Subjective tests were performed to study the impact of different parameters on the perceived QoE:
 - Compression quality levels and quality switches
 - Viewing distance
 - Content characteristics
- With the results, **a machine-learning based QoE model was developed**
- Also, the ITU P.1203 model for QoE prediction was tuned to also support prediction for 3D point cloud content
- **The software, dataset and QoE model have been made available on GitHub for the open call participants**







OPEN CALL OBJECTIVES AND OUTCOMES

Peter Van Daele

IMEC

Workshop Open Call 2

Online, November 04, 2024

www.spirit-project.eu

OBJECTIVES



- **Validating and testing third-party applications on the SPIRIT platform:**
Conducting experiments with external applications to validate and test their performance on the SPIRIT platform. These experiments focus on integrating third-party solutions into real-world use cases, evaluating their scalability, reliability, and overall contribution to enhancing SPIRIT platform capabilities. The process aims to uncover insights about the platform's limitations and identify opportunities for improvement.
- **Complementing and enhancing the SPIRIT platform with additional functionalities:**
Building on the current SPIRIT platform by integrating and testing new features, services, or components that complement its existing infrastructure. This objective is geared toward enriching the platform, making it more versatile and adaptable to various vertical sectors and use cases.
- **Defining requirements and strategic goals for future developments:**
Identifying new requirements, goals, and visions for the future development of the SPIRIT platform and related projects. By leveraging results from experiments and validations, this objective aims to establish a roadmap for enhancing platform functionalities and ensuring that future iterations align with the broader technological landscape and EU strategic objectives.



Expected OUTCOMES

- **Practical demos in one of the testbeds, validation and test procedures, and actual validations:**

The expected outcome is tangible demonstrations of how third-party applications work within a test environment on the SPIRIT platform. This involves validation through structured testing procedures, ensuring that the applications are functioning correctly and in line with the platform's standards.

- **Contributions to the platform:**

Participants or third-party developers are expected to contribute enhancements, improvements, or new functionalities to the SPIRIT platform as part of the validation and testing process.

- **Reporting of findings, e.g., additional requirements:**

After completing the testing and validation, the outcomes will include detailed reports. These will highlight new requirements, improvements, or issues identified during the testing process, which will guide future development efforts.



Maturity level and vertical sectors

The OC2 use cases are expected to start from TRL4¹ and enhance their maturity at least at TRL6².

Use case applications, encompassing **several vertical sectors**, such as:

- Healthcare
- Retail
- Education
- Training
- Entertainment
- Manufacturing
- Tourism
- Other

1) Technology Readiness Level 4 = technology validated in lab

2) Technology Readiness Level 6 = technology demonstrated in relevant environment



Examples of Activities and Contributions

Use of, or improvement of the following functionality:

- Computational and networking resource monitoring and feedback
- Efficient management and orchestration of computational resources
- Management of stand-alone or container-based applications
- Network resource adaptation
- Transport protocol optimisation
- 5G network connectivity
- Immersive media content capturing, formatting, representation, and adaptation
- Optimisation of application-level algorithms (media encoding, processing, rendering, contextualisation and control)
- Quality of experience testing and model development
- System and network security
- Confidential Computing
- Other



Examples of Activities and Contributions

Extensions to the SPIRIT platform functionality could, for instance, aim at:

- Experiments that provide Research on volumetric data capturing, filtering, and compression techniques including AI algorithms
- Experiment with XR devices such as mobile phones and AR glasses and their provided SDKs
- Manipulate streamed audio and video data to customise the user experience within XR environments
- Test new ways to off-load CPU/GPU heavy computations using an edge cloud solution
- Increase scalability by extending one-to-one communication applications with one-to-many or many-to-many communication capabilities
- Investigate novel (low-latency) transport solutions and protocols not (yet) included in the SPIRIT delivery suite



**ANSWER
THE POLL!**

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QUESTIONS

Hermann Hellwagner, *University of Klagenfurt*

Anita Gojanovic, *Digital for Planet*

Workshop Open Call 2

Online, November 04, 2024



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