



6G_{XR} IMPACT DAY

Advancing Immersive Connectivity for the 6G Era

28 October 2025

5TONIC – IMDEA Networks Institute
Leganés, Spain

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Co-funded by
the European Union

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Project funded by



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Confédération suisse
Confederazione Svizzera
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Swiss Confederation

Federal Department of Economic Affairs,
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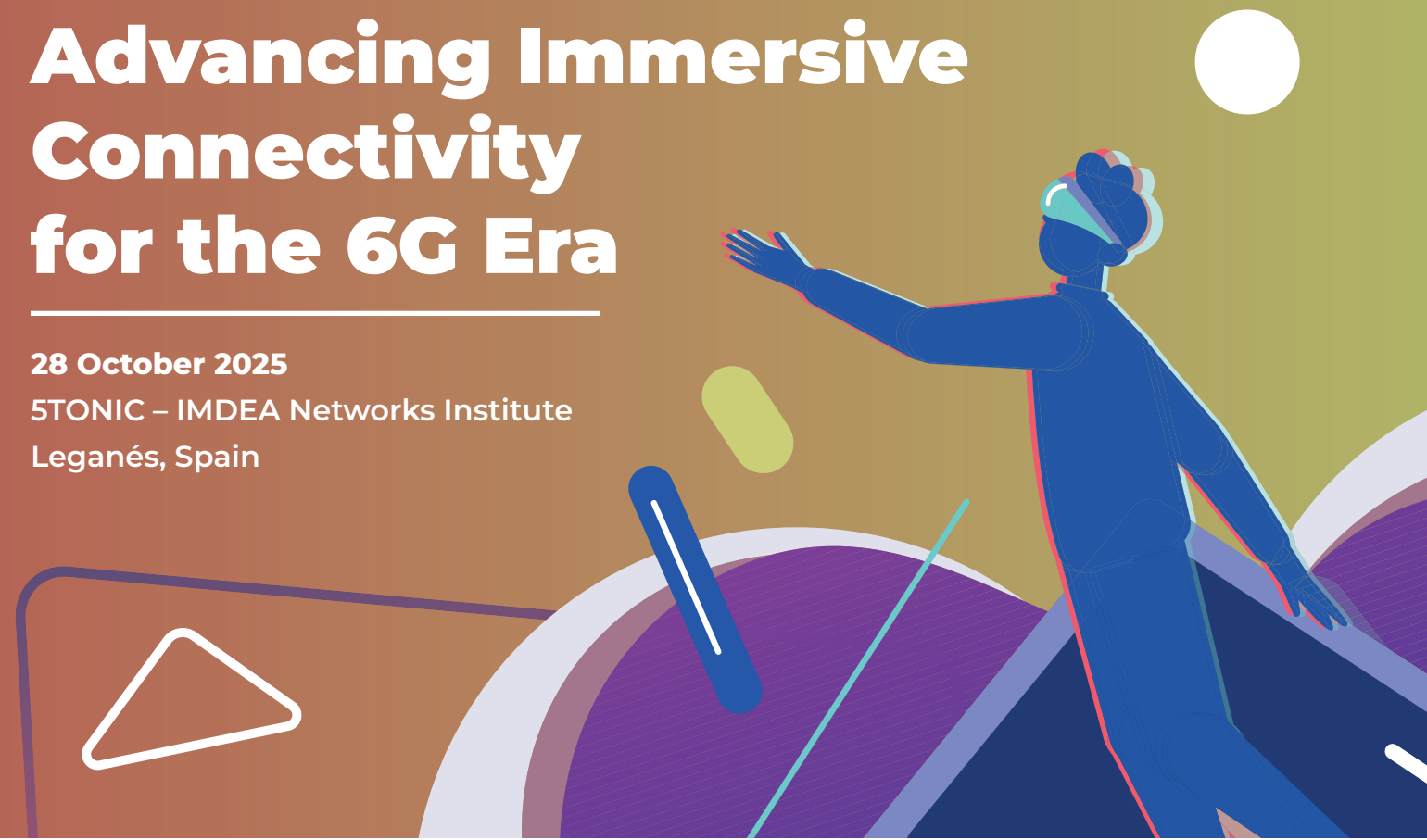


TABLE OF CONTENT

Foreword**03****Demo 1A****04****Demo 1B****06****Demo 2****08****Demo 3****10****Demo 4****12****6G-XR Open Calls****14**

FOREWORD

Welcome to the 6G-XR Impact Day.

As we approach the final months of the 6G-XR project, today's event marks a moment to reflect on what we've achieved and to open the conversation about what comes next. Over the past three years, 6G-XR has built a European multisite infrastructure for experimentation with immersive and intelligent services over advanced 5G and emerging 6G networks.

Funded by the Smart Networks and Services Joint Undertaking (SNS JU) under the first Horizon Europe call for experimental infrastructures, our project was designed to support collaborative, cross-domain validation of key enablers for 6G — including real-time holographic communication, energy-aware XR delivery, collaborative 3D digital twin environments, and AI-driven orchestration. We've supported 30 third-party cascading actions through three Open Calls, enabling researchers, SMEs, and developers to push the boundaries of what's possible across verticals, also beyond XR, such as health, media, mobility, and manufacturing.

The demonstrations you'll see today showcase how immersive applications can operate at scale on federated testbeds, and how XR, AI, and advanced connectivity can converge into powerful, real-world solutions. But beyond technology, this day is also about people, about bringing together those who will shape the next wave of European digital infrastructure.

I would like to extend my warmest thanks to 5TONIC and our South Node partners for hosting this final event here in Madrid. Your support has been crucial in making this a truly collaborative and inspiring meeting point.

Thank you for being part of the 6G-XR community. I hope this event sparks new connections and ideas, and that together we can continue driving forward a more immersive, sustainable, and intelligent future.

Warm regards,

Dr. Jussi Haapola

*University of Oulu, Finland
Project Coordinator of 6G-XR*

DEMO 1A

Optimizing immersive XR experiences with automated network congestion detection in 6G



Use Case 1: Resolution Adaptation or Quality on Demand for Real-Time Holographic Communications

This demo will showcase how automated network congestion detection and network-assisted rate recommendation features can enhance the reliability and stability of eXtended Reality (XR) services in 6G environments. The demo will feature a real-time XR holographic communication session between 2 remote users in stable conditions. Then, it will evidence how network performance degradation impacts the quality

of audiovisual communication, and how such undesired conditions can be reliably mitigated by adjusting data rates based on the available resources. Besides, and an AI-assisted congestion detection predictive algorithm implementation will be shown.

Developed by 6G-XR partners: i2CAT, Ericsson and Capgemini

Who benefits?

Mobile Network Operators (MNOs) can leverage the Congestion Detection Function (CDF) to expose intelligent Network-as-a-Service (NaaS) APIs for XR developers.

XR Service Providers gain improved quality of experience, with adaptive bitrate and throughput optimization ensuring smoother, more reliable immersive services.

Step-by-step walkthrough

01

Stable Start – High-Quality Holographic Call

Two users initiate a live holographic XR call: one user is connected via 5G in Barcelona, the other via a wired connection in Madrid. The call starts in optimal conditions, meeting target bitrate, resolution, and QoS metrics.

02

Simulated Network Congestion Begins

A surge in traffic from an eMBB (enhanced Mobile Broadband) user causes Physical Resource Block (PRB) utilization to increase on the 5G cell. XR call quality starts to degrade — resolution and frame rate drop, leading to visible disruptions.

03

Congestion Detected – XR Stream Adjusts

The system's Congestion Detection Function (CDF) detects the issue and notifies the XR orchestrator. The media stream is automatically downshifted (lower resolution / frame rate), stabilizing the experience in real time.

04

Prioritization – XR Traffic Gets Boosted

A network policy engine elevates the QoS priority of the XR call over background traffic. The media bitrate partially recovers, even while congestion persists, ensuring smooth interaction.

05

Recovery – Back to Full Quality

Once the eMBB traffic ends, the CDF sends a “congestion cleared” signal. The XR app ramps back up to full resolution and frame rate, restoring high-quality holographic communication.



DEMO 1B

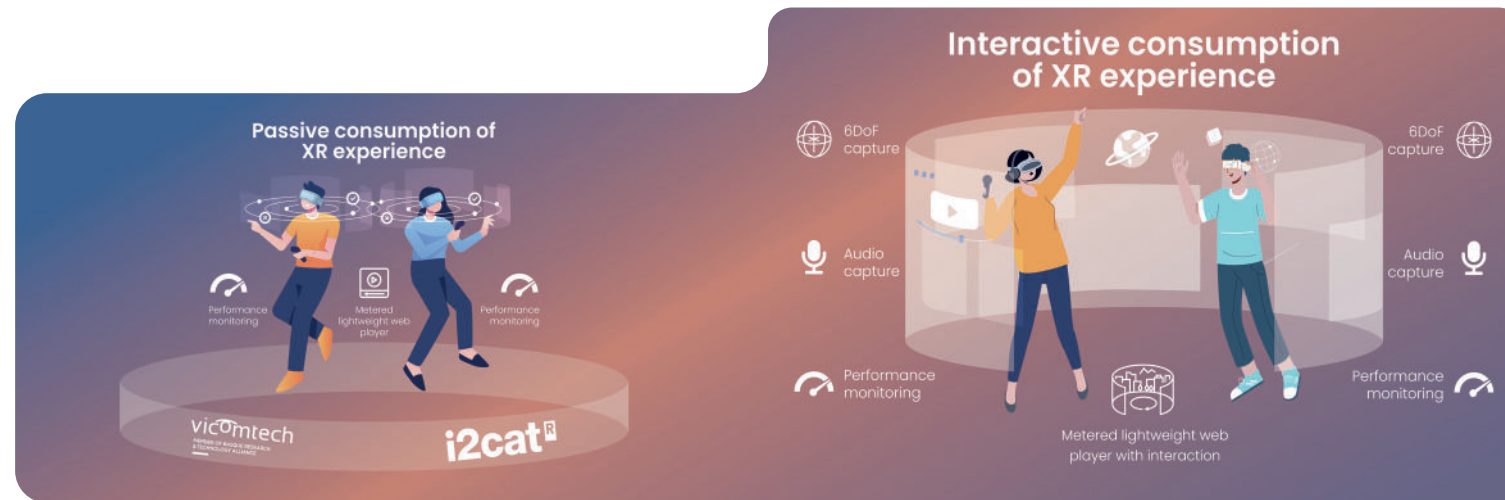
Optimizing immersive XR experiences with automated edge resources allocation in 6G



Use Case 2: Routing to the Best Edge for Real-Time Holographic Communications

This demo will showcase how dynamic edge computing resources allocation helps to enhance the performance and contributes to interoperability in eXtended Reality (XR) services, in particular in a holo-portation service. The service will be able to make use of different Edge nodes for XR processing offloading and for managing the multi-user communications. The automated selection of the optimal Edge will be based on specific goals, like minimizing delays. In particular this demo will show two main features: i) dynamic selection of the optimal Edge location, .e.g. cloudlet to mitigate network degradation across distributed edge nodes in multiple administrative domains, ii) instantiation of Interactive Remote Rendering functions at the Edge allowing the participation of lightweight client devices in resource-intensive XR services.

Developed by 6G-XR partners: i2CAT, Capgemini, Vicomtech, Ericsson



Who benefits?

Mobile Network Operators (MNOs) can enhance their Network-as-a-Service (NaaS) offerings by enabling automated selection of the optimal edge node for XR services, improving efficiency and service differentiation.

XR Service Providers gain lower latency and higher service quality through intelligent, network-assisted edge resource allocation, ensuring smoother, more responsive immersive experiences.

Step-by-step walkthrough

01

Session Initialization

A native Holo client in Barcelona requests the Holo Orchestrator to initiate a real-time holographic communication session.

02

Remote Rendering Offload – First User

An XR user in Madrid, using a lightweight web client, joins the session. Due to limited device capabilities, rendering is offloaded to a Remote Renderer deployed in Barcelona.

03

Edge Discovery – Second User

A second XR user in Madrid, also on a lightweight client, attempts to join. The Holo Orchestrator queries the Edge Discovery API (provided by IEAP) to determine the optimal edge node based on the user's geographic location and network conditions.

04

Dynamic Edge Assignment

Based on the API response, the Holo Orchestrator assigns a Madrid-based Remote Renderer to the second user—bringing compute resources closer to the client and reducing latency.

05

Performance Comparison

The session quality of both Madrid users is compared. Results show improved latency, responsiveness, and user experience for the user connected via the dynamically selected local edge node, demonstrating the effectiveness of 6G-XR's Edge Discovery and resource allocation capabilities.



DEMO 2

Holographic Call via IMS Data Channel - Native Dialer Integration for Real-Time 3D Communication



Use Case 3: Control Plane Optimizations for Real-Time Holographic Communications

This demonstration showcases real-time 3D holographic calling directly integrated into a smartphone's native dialer. It enables a one-way hologram of a person with synchronized two-way audio, transmitted over a standards-based IMS Data Channel. The cloud-based technology performs real-time hologram reconstruction from a single-camera video feed using AI-enhanced processing. The demo highlights seamless integration into existing telecom infrastructure without additional applications, paving the way for immersive, next-generation 5G/6G communication services.

Developed by 6G-XR partners: MATSUKO, Telefónica, Ericsson

Who benefits?

Mobile Network Operators (MNOs) leverage IMS Data Channel and native service integration to enrich their offerings with immersive 3D communication, while maintaining control over QoS and infrastructure.

Service Providers & Developers benefit from a standards-based, interoperable platform to build and deploy real-time holographic applications without the need for proprietary apps.

Standards & Research Communities gain a working proof-of-concept demonstrating how existing telecom infrastructure (IMS, Data Channels) can support low-latency, real-time XR services, thereby informing future standards and R&D.

Enterprises & Professionals unlock new modes of remote collaboration, client interaction, and immersive training, especially in sectors like media, design, education, and telepresence.

Step-by-step walkthrough

- 01

Call Initiation
The caller uses the iPhone's native dialer to place a holographic call via the IMS (IP Multimedia Subsystem) Data Channel—no third-party apps required.
- 02

Session Setup
The IMS core handles signaling and establishes the session between devices, dynamically connecting them to the most optimal cloud or edge server for real-time processing.
- 03

Capture & Reconstruction
The iPhone captures a live video of the caller (face and upper body), which is sent to the cloud/edge where AI-based volumetric reconstruction generates a 3D hologram on the fly.
- 04

Hologram Reception
On the receiving end, the Android user answers the call via their native dialer. The reconstructed 3D hologram appears in real time, while audio is transmitted through standard IMS voice.



DEMO 3

Co-creative Cyber Studio in a Sliced 5G O-RAN Network



Use Case 4: Collaborative 3D Digital Twin-like Environment

This demonstration introduces a novel remote Fabrication Lab (Fab Lab) concept using XR and 3D digital twins over a private 5G network. It enables multi-user collaboration and real-time control of R&D and manufacturing processes in immersive virtual environments. Built on O-RAN with URLLC and network slicing, the setup ensures low-latency performance. A live comparison of eMBB and

URLLC slices under congestion, combined with user QoE feedback, confirmed high usability and minimal latency—validating the feasibility of XR-based digital twins for remote industrial collaboration in cyber-physical systems.

Developed by 6G-XR partner University of Oulu.

Step-by-step walkthrough

01

5G-Connected VR Setup

Two users join via VR headsets connected to laptops with 5G modems, accessing a sliced private 5G O-RAN network via the OAIBOX platform for low-latency performance.

02

Remote Collaboration Roles

One user acts as Fab Lab instructor, the other as remote operator. Both access the same 3D digital twin workspace from different locations.

03

Hands-On Virtual Interaction

Upon login, avatars and 3D models appear. Users interact with the models using hand tracking and communicate via voice and gestures.

04

Real-Time Equipment Control

The user inserts the design into the virtual printer, triggering the corresponding real 3D printer in the Fab Lab—fully synchronized with the digital twin.

Who benefits?

XR Service Providers gain a new model for immersive remote collaboration powered by 3D digital twins and VR.

Education, Training & Healthcare Providers can deliver hands-on, remote learning and simulation experiences in immersive environments.

Mobile Network Operators (MNOs) can showcase differentiated services through private 5G slicing and URLLC capabilities.

Enterprises, Industrial Designers & Manufacturers benefit from real-time co-creation, remote operation of physical equipment like 3D printers, and enhanced productivity.

Standards & Research Communities can explore integration best practices across XR, network slicing, and digital twin technologies for cyber-physical systems.

05

Immersive Monitoring

A live video feed from the real printer is overlaid onto the virtual one, allowing users to monitor the fabrication process directly within the XR environment.

DEMO 4

E2E application and 5G RAN Optimization Based on Green Energy Availability



Use Case 5: Energy Measurement Framework for Energy Sustainability

Demonstration of an autonomous, energy-efficient, and sustainable communication solution incorporating green energy forecasting along with AI/ML-optimized control of energy consumption for RAN and video applications. The demonstration built at VTT Oulu uses an accurate energy measurement framework to dynamically adjust the RAN and video application based on green energy availability. AI/ML is used in decision-making at a centralized controller to optimize QoS for video users and the use of RAN energy saving features within the limits of energy budget.

Developed by 6G-XR partner VTT.

Who benefits?

Private Network Operators reduce operational costs, grid dependency, and CO₂ emissions by dynamically aligning RAN and application behaviour with green energy availability.

Public Network Operators scale energy-aware optimization across large infrastructures to lower carbon footprint while maintaining QoS.

Mobile Users benefit from reduced device energy consumption and extended battery life via adaptive video quality based on energy constraints.

Enterprises & Video Service Providers optimize energy usage and application performance, contributing to greener video delivery in energy-constrained contexts.

Sustainability & Research Communities gain insight into real-world, AI-driven strategies for sustainable networking and measurable CO₂ reduction.

Step-by-step walkthrough

01

Forecast Energy Budget

Using solar energy forecasts, electricity prices, and battery charge levels, the system predicts the available green energy budget for the next hour.

02

Optimize Resource Allocation

An AI/ML-driven controller selects the optimal RAN power state and video resolution to stay within the energy budget while maintaining service quality.

03

Apply Energy-Efficient Settings

The RAN configuration and video parameters are dynamically adjusted based on the controller's decision.

04

Monitor in Real-Time

The system continuously tracks energy consumption and key network KPIs to detect any unexpected behavior or inefficiencies.

05

Adapt for QoE

If the Quality of Experience (QoE) drops below acceptable thresholds, the system automatically adjusts video resolution to improve user experience without breaching the energy budget.



6G-XR OPEN CALLS

€1.8M awarded to 30 ground-breaking XR and 6G projects across Europe

The 6G-XR Open Calls have been instrumental in extending our experimental infrastructure and catalysing novel XR applications over Beyond-5G / 6G networks. Three waves, we have funded 30 high-potential projects, supporting a diverse mix of SMEs, academia, research organisations and industry to drive innovation in immersive connectivity, energy efficiency, and vertical sector use cases.



OC1

Platform & Network Enablers

Eight projects were selected to fill foundational gaps in the 6G-XR architecture. Areas covered included XR streaming, RAN slicing, digital twin environments, QoS APIs, and energy measurement tools. These early enablers laid the groundwork to extend infrastructure capabilities and support ambitious experimentation in future calls.

OC2

Stream B Enablers

Ten projects concentrated on advanced enablers such as reconfigurable intelligent surfaces (RIS), energy monitoring, slicing techniques, and AI-based load balancing. OC2 built upon OC1's foundational work, pushing forward performance and adaptability.

OC3

Vertical Replicability Enablers

Twelve projects were awarded in OC3 to deploy and validate XR use cases across real-world vertical sectors—healthcare, broadcast media, mobility, and energy. This Call focused on real-time holography, immersive services, digital twin collaboration, energy measurement frameworks, and AI-driven XR functionality.

Key Impacts

The funded experiments have been conducted on authentic **6G-XR infrastructures**, bridging theory and practice across multiple domains.

SMEs, research labs, universities, and industry across Europe gained access to state-of-the-art testbeds, fostering cross-border collaboration and technology transfer.

Contributions from Open Call projects informed Europe's **6G roadmap** by integrating XR, AI, network slicing, and energy sustainability in next-generation systems.

The Open Calls established a bridge among connectivity, immersive media, and green networking—a foundation for XR that is powerful, responsive, and efficient.