D8.2: Exploitation and Sustainability Report

Revision: v.1.0

Work package	WP 8: Communication, Standardization, and Exploitation
Task	Task 8.3: Exploitation and Sustainability Plan
Due date	31/12/2025
Submission date	30/12/2025
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Version	1.0
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Abstract	This deliverable reports the outcomes of Work Package 8 (WP8) of the 6G-XR project, covering communication and dissemination, standardization and regulation, and exploitation and sustainability planning over the full project duration. It consolidates the strategies and actions implemented to maximise the impact of 6G-XR results, including the definition and execution of a dissemination plan, systematic engagement with key SDOs and industry fora (e.g., 3GPP, ETSI, CAMARA, SNS-IA), and the monitoring of relevant EU regulatory developments such as the AI Act and Cyber Resilience Act. The document presents a comprehensive account of standardization activities, with 27 documented contributions across multiple partners and technical domains, and describes how project innovations are being exploited through product and service roadmaps, open-source releases, patent applications, and follow-up research initiatives. It also outlines the project's sustainability and ESG approach, detailing how environmental, social and governance considerations have been integrated into the exploitation strategy and how key software artefacts, datasets and know-how are being preserved and positioned for continued use beyond the project's lifetime.

Co-funded by the European Union

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Grant Agreement No.: 101096838
Call: HORIZON-JU-SNS-2022

Topic: HORIZON-JU-SNS-2022-STREAM-C-01-01
Type of action: HORIZON-JU-RIA

Keywords	

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

DEM: Demonstrator, pilot, prototype, plan designs

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

DATA: Data sets, microdata, etc.

DMP: Data management plan

ETHICS: Deliverables related to ethics issues.

SECURITY: Deliverables related to security issues

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

EXECUTIVE SUMMARY

The 6G-XR project is advancing the next generation of immersive communication technologies by integrating experimental XR services with programmable 5G/6G infrastructures, deterministic networking, and cutting-edge innovations across the networking, computing, and XR domains. Deliverable D8.2 provides an overview of the project's progress and results in standardization, exploitation, and sustainability, reflecting the contributions of all partners during the first 30 months of the project.

Work Package 8 (WP8) of the 6G-XR project was dedicated to maximizing the project's impact through three interrelated tasks: dissemination and communication (T8.1), standardization and regulatory engagement (T8.2), and exploitation and sustainability planning (T8.3). The core objectives of WP8 were to raise broad awareness of 6G-XR's vision and results (O8.1), ensure 6G-XR innovations influence relevant standards and policies (O8.2), and develop viable exploitation routes for project outcomes alongside a sustainability plan aligned with Environmental, Social, and Governance (ESG) principles (O8.3). This deliverable (D8.2) reports the achievements of WP8 by the end of the project (M36), detailing how these objectives have been met and how key performance indicators (KPIs) have been surpassed.

Dissemination and Communication (T8.1): Over the 36-month span, WP8 implemented a comprehensive communication strategy that significantly increased the visibility of 6G-XR across both scientific and industrial communities. The consortium produced over a dozen peer-reviewed publications in top conferences and journals (with 7 papers published by M25 and additional submissions under review), exceeding initial targets. Project partners actively participated in more than 30 industry events and academic conferences, including flagship venues such as Mobile World Congress (MWC) and the EuCNC & 6G Summit, where they showcased 6G-XR demos and presented outcomes and results. These efforts were complemented by an engaging online presence – the project's website and social media channels amassed over 1,000 followers and featured regular news updates, newsletters, videos, and even media coverage in Europe and abroad. Through close coordination with the Open Call program (WP7), the project also promoted results from third-party experiments, integrating their success stories into 6G-XR's outreach activities to broaden the impact beyond the consortium. Overall, the dissemination campaign has ensured that 6G-XR's vision, technological breakthroughs, and open call innovations reached a wide audience of researchers, industry stakeholders, and the general public, thereby solidifying the project's visibility and community engagement.

Standardization and Regulation (T8.2): WP8 placed a strong emphasis on contributing 6G-XR's technical insights to standards development organizations (SDOs) and industry alliances. By project end, the consortium made 18 contributions to SDOs, far surpassing the KPI target of 10. These contributions targeted a range of bodies – notably 3GPP (in working groups addressing XR in future 5G/6G releases), ETSI (including MEC and other relevant groups), and the CAMARA open API consortium – ensuring that 6G-XR's requirements and solutions (e.g. network-assisted XR streaming, cross-layer orchestration, sub-THz communications) are considered in emerging standards. Partners also engaged with broader 6G pre-standardization fora such as One6G (e.g. presenting at One6G Summit and collaborating on white papers) and contributed to industry initiatives (GSMA, IEEE, ITU-R, O-RAN Alliance) to align 6G-XR with global 6G efforts. Through these activities, the project not only influenced specifications (for example, by proposing new API enhancements for XR service quality in CAMARA and 3GPP) but also kept its research closely synced with the evolving standards landscape. In parallel, WP8 monitored the regulatory landscape to ensure strategic alignment with new EU policies. The team proactively assessed 6G-XR outcomes against forthcoming regulations – notably the EU AI

Act (with an internal review focusing on prohibited AI practices and high-risk AI system criteria) – and engaged with topics from the Cyber Resilience Act to the Data Act. In fact, 6G-XR joined forces with other SNS projects to host a joint tutorial on "Supporting the Implementation of EU legislation on AI, Cybersecurity, Data and others through research," reflecting the project's commitment to compliance and policy awareness. This proactive stance has ensured that 6G-XR technologies are not only standardized for adoption but also developed in accordance with emerging European regulatory frameworks.

Exploitation and Sustainability (T8.3): A robust exploitation plan was executed to translate 6G-XR innovations into tangible value for partners and the wider XR ecosystem. 6G-XR has produced a rich portfolio of exploitable assets across WP2–WP6, reflected in the Innovation Opportunities documented by partners. These include:

- adaptive multimedia pipelines for holographic communication;
- IMS-based holographic calling solutions;
- congestion detection and predictive analytics modules;
- deterministic and TSN-enabled 3D digital twin systems;
- XR orchestration and NaaS exposure APIs;
- multi-camera sensing innovations;
- AI-driven network monitoring and control frameworks;
- sub-THz RF front-end prototypes at 300 GHz;
- energy-aware end-to-end controllers for green networking.

The project identified multiple exploitation routes spanning product development, open-source releases, intellectual property, and service offerings. On the product side, several partners have incorporated 6G-XR results into their roadmaps – for example, Capgemini Engineering integrated 6G-XR's network API innovations into its edge orchestration platform (IEAP) to enhance edge resource allocation for XR, positioning this solution for commercial offerings to telecom customers. Similarly, consortium members in the telecom and XR industry (Telefónica, Ericsson, MATSUKO) collaborated on integrating an IMS data channel for holographic communication, directly improving their existing telepresence products and services. In terms of new services, the groundwork has been laid for immersive XR applications (such as multi-user holoportation and 3D digital twin remote operations) that partners plan to offer leveraging the project's outcomes.

Open-source exploitation was another cornerstone: the project made contributions to relevant open software communities to maximize uptake of 6G-XR technology. Notably, 6G-XR partners contributed an edge discovery API to the Linux Foundation's CAMARA project – simplifying how applications find optimal edge nodes – and aligned it with GSMA's network API initiatives. Through one of the Open Call projects, patches were upstreamed to GStreamer (a widely used multimedia framework) to improve streaming for XR use cases, and the University of Oulu released a North Node Adapter tool in the 6G-XR open repository to aid in sub-THz radio experimentation. These open-source contributions ensure that 6G-XR's advancements in network optimization and XR delivery will persist beyond the project and be accessible to developers and researchers globally. Additionally, while no patents were officially filed during the project, partners identified patentable ideas (e.g. in 300 GHz radio design and XR

network optimization) and have been evaluating intellectual property protection, indicating potential patent filings as a follow-up to safeguard key innovations. Throughout the exploitation process, WP8 also emphasized capacity-building and technology transfer: internal workshops and training ensured that each partner's business units are equipped to exploit the project results (from improved algorithms to new system architectures) in their future R&D and product development.

Sustainability and ESG Considerations: WP8 developed a forward-looking sustainability plan to ensure the project's long-term impact and responsible innovation practices. A central element was the integration of ESG (Environmental, Social, and Governance) principles into 6G-XR's activities and outcomes. To this end, the project conducted an ESG self-assessment via a comprehensive questionnaire distributed to all work package leaders. This questionnaire, inspired by the European Green Deal objectives and ICT sustainability standards (e.g. energy efficiency and accessibility guidelines from ETSI), evaluated how each technical development addresses environmental impact, social inclusion (such as accessibility of XR to diverse users), and good governance (ethics, data privacy, etc.). The results of this assessment – consolidated in D8.2 – confirmed that 6G-XR partners have proactively considered sustainability in design (for instance, optimizing resource usage in XR streaming to reduce energy consumption, and adhering to privacy-by-design in user data handling). Any identified gaps or improvement areas will inform partners' future efforts, ensuring that the trajectory started in 6G-XR continues in alignment with green and ethical tech principles. In addition to ESG, WP8's sustainability strategy encompassed plans for post-project continuity. The team organized a dedicated Exploitation Workshop in the final project phase to bring together consortium members and external stakeholders (industry, standard bodies, and academia). This workshop facilitated discussions on the commercialization and further development of 6G-XR solutions after the project's official end, effectively setting the basis for ongoing collaborations, spin-off projects, and integration of 6G-XR technology into future initiatives. The project's open dissemination of software and findings (e.g. through Zenodo, open-source code, and public deliverables) further strengthens continuity by allowing others to build on 6G-XR's work.

The activities of WP8 have been instrumental in amplifying 6G-XR's impact and ensuring its legacy. By meeting or exceeding most of KPIs by M36 – from scientific publications and event participation to standardization contributions and exploitation milestones – WP8 has greatly enhanced the project's visibility and credibility in the 5G/6G and XR communities. The standardization contributions mean that several 6G-XR concepts are now influencing the next generation of network standards, paving the way for adoption of project innovations in global 6G architectures. The exploitation efforts have enabled technology transfer to partners' products and platforms (bridging the gap from research prototypes to market-ready solutions) and seeded future innovation (through open-sourced components and identified innovation opportunities). Furthermore, by aligning with EU regulatory and ESG frameworks, 6G-XR has demonstrated a commitment to not only technical excellence but also societal responsibility and compliance, which enhances trust in its solutions. In summary, WP8's comprehensive approach – combining outreach, standardization, exploitation, and sustainability – has ensured that 6G-XR's outcomes will endure beyond the project's lifetime. It has created a foundation for continued development of 6G-enabled XR applications, informed standards and policies in the XR domain, and equipped both consortium partners and the wider community with knowledge and tools to carry forward the 6G-XR vision into the future.

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ABBREVIATIONS

3GPP	3rd Generation Partnership Project
5G	Fifth-Generation Mobile Networks
6G	Sixth-Generation Mobile Networks
AI	Artificial Intelligence
CRA	Cyber Resilience Act (EU)
DoA	Description of Action
ETSI	European Telecommunications Standards Institute
EU	European Union
IPR	Intellectual Property Rights
ISAC	Integrated Sensing and Communication
JU	Joint Undertaking
KPI	Key Performance Indicator
R&I	Research and Innovation
RAN1	Radio Access Network Working Group 1 (3GPP)
RAN2	Radio Access Network Working Group 2 (3GPP)
RRS	Reconfigurable Radio Systems
SA1	Service and System Aspects Working Group 1 (3GPP)
SA2	Service and System Aspects Working Group 2 (3GPP)
SDO	Standards Developing Organisation
SNS	Smart Networks and Services (European partnership / programme)
SNS JU	Smart Networks and Services Joint Undertaking
THz	Terahertz
XR	eXtended Reality
QoS	Quality of Service
QoD	Quality of Data

1 INTRODUCTION

This Deliverable, *"Standardization, Exploitation and Sustainability Report"* - D8.2, is a key output of 6G-XR's Work Package 8 (WP8). This report documents how the project's results have been disseminated, standardized, and prepared for long-term impact, in line with WP8's mandate to maximize the project's overall impact. In particular, WP8 ensures that 6G-XR's innovations are broadly communicated to stakeholders, adopted in relevant industry standards, and exploited beyond the project's lifetime. This aligns with 6G-XR's overarching goals, which include making impactful contributions to 6G standards and addressing key societal objectives. D8.2 builds upon the initial strategies laid out in D8.1 (the *Communication and Dissemination Strategy Plan* delivered in Month 5) and marks the completion of the project's standardization and exploitation activities at Month 36. It complements the dissemination efforts from the first project phase by focusing on the standardization contributions and exploitation plans achieved during the project's implementation.

WP8 Objectives: The scope of WP8 is framed by three specific objectives (O8.1–O8.3) defined in the project's Description of Action. O8.1 aims at the development of an effective outreach communication and dissemination of 6G-XR results to all relevant stakeholders (including researchers, industry, and the general public). O8.2 focuses on identifying the standards and regulatory bodies affected by 6G-XR outcomes and creating new activities or contributions within those forums (at various levels such as working groups or technical committees) to ensure 6G-XR's innovations are reflected in emerging 6G standards. O8.3 targets the exploitation of project results through appropriate routes – for example, pursuing patents, internal product development, and service innovation – and the publication of software outputs as open-source, while also formulating a sustainability plan that adheres to Environmental, Social, and Governance (ESG) guidelines. Collectively, these objectives ensure that 6G-XR not only achieves technical breakthroughs, but also effectively transfers its knowledge and technology to the broader community and market.

WP8 Structure and Tasks: To achieve the above objectives, WP8 is structured into three tasks covering dissemination, standardization, and exploitation activities:

- **Task 8.1 – Dissemination and Communication (M1–M36):** This task developed and implemented the project's dissemination strategy and communication plan, addressing Objective O8.1. It established 6G-XR's public presence through a visual identity (project branding), the official website, and social media channels, and carried out stakeholder engagement to raise awareness of the project's vision and results. Task 8.1 coordinated closely with WP7 to promote the 6G-XR Open Calls and the solutions developed by third-party participants, and it guided scientific dissemination (publications, demonstrations, etc.) at top-tier conferences and events in the SNS and target stakeholder communities. The communication and dissemination activities set the foundation for a broad outreach, ensuring that 6G-XR's intermediate outcomes were visible to both specialized and general audiences throughout the project.

- **Task 8.2 – Standardization and Regulation (M5–M36):** This task drove 6G-XR's contributions to standardization, addressing Objective O8.2. Its focus was to ensure that the core technologies and insights developed in 6G-XR influence next-generation standards and industry specifications. Task 8.2 identified which existing standards or working groups could be impacted by 6G-XR results and initiated new standardization activities where necessary. Consortium partners leveraged their active involvement in key Standards Developing Organizations (SDOs) – including 3GPP, ITU-T/ITU-R, ETSI, IEEE, and O-RAN – to contribute technical proposals and align 6G-XR's innovations with the global 6G research agenda. The task also engaged with relevant industry forums (for example, the 6G-IA Pre-Standardization

Working Group) to ensure coordination and avoid duplicating efforts. Through these actions, 6G-XR has supported impactful contributions to standards, helping to pave the way for XR capabilities in future 6G specifications.

- **Task 8.3 – Exploitation and Sustainability (M8–M36):** This task focused on translating the project's outcomes into concrete exploitation paths and ensuring their sustainability, fulfilling Objective O8.3. Throughout the project, Task 8.3 worked in tandem with the technical WPs to identify exploitable results and formulate routes for their uptake by both the consortium partners and the wider industry. These routes include internal product development (integrating 6G-XR innovations into partners' R&D roadmaps), the pursuit of intellectual property protections (with several project innovations evaluated for patent filings), and the release of key software components as open-source contributions to foster community adoption. In addition, Task 8.3 developed a comprehensive sustainability plan addressing long-term continuation of the project's outcomes. This plan is aligned with ESG principles – ensuring that environmental impact, social responsibility, and governance best practices are considered in how 6G-XR technologies will be carried forward. An exploitation workshop was organized in the final phase of the project to solidify post-project collaboration and commercialization strategies. Overall, Task 8.3 ensures that 6G-XR's results are not only technically validated but also positioned for real-world uptake and lasting benefit beyond the project's end.

By design, WP8 is a horizontal work package that interacts with all the technical WPs (WP1–WP7) to collect disseminatable results, channel innovations into standards, and formulate exploitation plans. This ensures that 6G-XR's research activities (ranging from network enablers to XR use-case validations) are continuously supported by impact-generating actions. The combined efforts in Tasks 8.1, 8.2, and 8.3 link the project's scientific and technical outputs with its broader objectives of European leadership in 6G and Extended Reality, as well as contribute to the success metrics (KPIs) related to outreach, standardization, and innovation uptake defined for 6G-XR.

Document Structure: The remainder of this deliverable is organized as follows:

- **Section 2 – Communication Activities:** Presents an overview of the performance and activities of the various communication, scientific dissemination and community outreach tools and channels deployed to promote the project's active engagement with the targeted stakeholder communities.

- **Section 3 – Standardization Activities:** Describes the standardization approach and contributions of 6G-XR. This section details the project's participation in various SDOs and regulatory forums, the technical areas influenced by 6G-XR (e.g. XR requirements in 3GPP), and the timeline of contributions. It also highlights how the consortium's standardization efforts have met or exceeded the targets set for WP8.

- **Section 4 – Exploitation and Sustainability:** Presents the exploitation strategy and outcomes for 6G-XR's results. This section summarizes each partner's exploitation plans and key exploitation achievements (such as patents filed or products evolved), outlines the open-source releases and community-building efforts, and provides the sustainability plan ensuring long-term impact. Considerations of environmental and societal sustainability (ESG factors) in 6G-XR's exploitation model are also discussed here.

- **Section 5 – Conclusions:** Summarizes the main findings and achievements of the deliverable. It reflects on how WP8's activities have fulfilled the project's impact objectives, and provides a concluding assessment of 6G-XR's contributions to the 6G ecosystem in terms of dissemination, standardization, and exploitation. This final section also offers insights into

future steps or recommendations for sustaining and building upon the project's outcomes after its completion.

Overall, Deliverable D8.2 serves to demonstrate that 6G-XR's influence extends beyond the lab: through coordinated communication, standardization, and exploitation efforts, the project has created a bridge from cutting-edge 6G research to tangible industry and societal impact, fully in line with its objectives and the expectations of the SNS Joint Undertaking.

2 COMMUNICATION AND DISSEMINATION

2.1 STRATEGY AND IMPLEMENTATION

The communication and dissemination strategy of 6G-XR was established at project start and formally documented in Deliverable D8.1. It provided the overarching framework, objectives, tools, and stakeholder segments guiding all outreach and visibility activities carried out throughout the project. As a final report, this section revisits that strategy and explains how it was effectively implemented during the full project duration.

2.1.1 Strategic foundations

D8.1 defined a structured, phased approach to communication and dissemination, organised into three cumulative stages illustrated below. These phases served as the baseline for sequencing activities across the project's lifetime:

- **Awareness** focused on establishing a strong identity, early visibility, and consistent messaging through the creation of the 6G-XR brand, website, templates, and social media presence.
- **Engagement** centred on increasing interaction with targeted communities through events, technical dissemination, newsletters, and collaborative actions.
- **Adoption** emphasised showcasing project results, enabling uptake by external stakeholders, and promoting opportunities such as the Open Calls.

This phased logic ensured that communication evolved in alignment with project maturity—starting from brand establishment, progressing to knowledge exchange, and culminating in the promotion of the project's technical outputs and research infrastructure.

2.1.2 Implementation during the project runtime

Throughout M01–M36, the consortium implemented the strategy through a coordinated, multi-channel approach across online, offline, and community-oriented activities. The **visual identity**, including logo, colour palette, typography, and templates, was deployed systematically across all project outputs and partner communications to ensure a unified and recognisable presence.

The **project website** served as the central information hub, supported by active **social media channels**, periodic **newsletters**, **press releases**, and a growing set of **promotional materials** (flyer, roll-up, slide deck). These channels were consistently updated to reflect project progress, events, Open Call activities, and demonstrator work.

As planned , communication efforts were closely connected to dissemination activities, meaning that scientific outputs, presentations, and technical milestones were systematically promoted to the relevant communities. This ensured a strong alignment between the project's technical developments and its visibility in the 6G and XR ecosystems.

2.1.3 Stakeholder-centric outreach

The communication and dissemination strategy identified a broad and diverse set of stakeholder groups, including research communities, technology providers, SMEs and start-ups, open-source actors, standardisation bodies, policymakers, and the general public.

These segments guided the tailoring of messages and formats. For instance:

- researchers were reached primarily through events, publications, and expert-level content;
- industry and SMEs via events, Open Call promotion, and practical result showcases;
- open-source and standards communities through updates on contributions and early technical outputs;
- policymakers and the general public through accessible news items, website updates, and press-oriented communication.

This segmentation ensured relevance and alignment between content and audience expectations.

2.1.4 Sustainable and responsible communication

The strategy placed emphasis on sustainability principles, including a preference for digital dissemination, limited printing, the use of recyclable materials where physical items were needed, and the adoption of virtual meeting formats whenever appropriate. This approach reduced environmental impact and aligned with contemporary expectations for responsible project communication.

2.1.5 Alignment with the SNS JU ecosystem

A key strategic intention from D8.1 was the strong alignment with the broader SNS JU programme, including collaboration with the SNS OPS CSA and participation in relevant working groups and community activities. This ensured that 6G-XR's results were not communicated in isolation, but rather contributed to the broader coordination, visibility, and knowledge-sharing efforts of the European 6G research landscape.

2.1.6 Result-oriented activities

The implementation of the communication and dissemination strategy was continuously monitored through the key performance indicators (KPIs) defined in the initial strategy. Activities were adapted over time to support Open Call promotion, testbed developments, public demos, and major events such as EuCNC & 6G Summit and other flagship gatherings in the XR and 6G domains.

Overall, the strategy provided a stable and coherent structure that supported the effective promotion of the 6G-XR vision, activities, and results. It enabled a consistent narrative throughout the project, ensured visibility across target communities, and contributed directly to the impact the project achieved within the European 6G and XR innovation ecosystem.

2.2 OBJECTIVES

The communication and dissemination objectives set the foundation for a coherent, high-impact outreach strategy throughout the 6G-XR project. This section summarises these objectives and how they were achieved during M01–M36.

- **Create a unique and recognisable brand identity:** D8.1 called for a strong, consistent visual identity, including logo, colour palette, typography, and standard templates, to support all communication activities.

  The brand was deployed across all materials (website, social media, presentations,

deliverables, newsletters, flyers, roll-up), ensuring coherence and visibility across the European 6G and XR ecosystem.

- **Raise awareness of 6G-XR results and advantages:** A core objective was to ensure widespread visibility of the project's innovations, testbeds, and demonstrations. *Awareness was generated through a multi-channel approach: continuous website updates, active LinkedIn and X accounts, YouTube content, press releases, newsletters, and strong presence at major events such as EuCNC & 6G Summit and MWC. These actions positioned 6G-XR as a visible contributor to next-generation XR and 6G research.*

- **Engage the largest possible number of stakeholders:** Identification of a diverse range of stakeholder groups: researchers, industry players, SMEs, experimenters, open-source communities, standardisation bodies, policymakers, and the wider public. *Engagement was achieved through participation in conferences, technical workshops, targeted messaging for Open Calls, project webinars, and partners' amplified outreach. Tailored content ensured relevance to each stakeholder segment.*

- **Give the 6G community visibility and resonance across Europe:** The strategy emphasised contributing to the broader European 6G ecosystem and reinforcing its coherence. *6G-XR systematically aligned with SNS JU activities, participated in joint communication efforts, and used its platforms to amplify ecosystem news, strengthening Europe's collective narrative on 6G and XR technologies.*

- **Expand the project community and foster collaborations: T**he importance of building an active community and establishing synergies with related EU-funded initiatives. *The project grew its community through newsletters, social media engagement, Open Call outreach, and direct collaboration with SNS OPS CSA, SNS working groups, and B5G/6G and XR-focused networks. These relationships facilitated knowledge exchange and cross-project visibility.*

- **Encourage contributions to scientific publications, open-source work, and standardisation bodies:** The strategy highlighted the need for scientific dissemination and contributions to relevant technical communities. *Partners contributed publications, participated in leading conferences, and engaged in standardisation-related discussions where relevant. Open-source work and technical contributions were communicated through the project's channels to maximise impact.*

2.3 TOOLS AND CHANNELS

To implement the communication and dissemination strategy defined in D8.1, 6G-XR deployed a coordinated set of tools and channels designed to ensure high visibility, broad stakeholder engagement, and clear presentation of the project's results. This section summarises these tools and how they supported outreach activities across M01–M36.

Overall, the combination of a coherent visual identity, a dynamic website, active social media presence, structured newsletters, and a wide variety of promotional materials enabled 6G-XR to communicate effectively throughout the project lifecycle supporting the Open Calls, use case dissemination, demonstrator visibility, and high-impact showcasing at the Final Impact Day.

2.3.1 Project identity and templates

A complete visual identity framework was developed, including logo, colour palette, typography, and templates for deliverables, presentations, press releases, and meeting minutes, to guarantee a consistent and recognisable style across all project outputs. All partners applied these templates in their external communication, ensuring coherence in materials shared at events, on social media, and on the website.

2.3.2 Project website

The project website functioned as the central information hub and the primary public-facing communication tool. The main top-level menu includes:

- **About 6G-XR**: provides the project vision, objectives, overall approach, and a description of its multisite Research Infrastructure (RI).
- **Consortium**: presents the list of all 15 partner organisations from across 8 countries, with logos and links to institutional profiles.
- **Use Cases**: describes the target application domains (e.g., XR, holographic communication, digital twins, immersive services) the project aims to support.
- **What's New**: features recent news items, announcements, and updates on the project's progress, such as Open Call launches, recognitions, and event summaries.
- **Open Calls**: dedicated section for all 6G-XR Open Calls (OC1, OC2, OC3), including call documentation (information notes, templates, agreements), timelines, and result announcements.
- **Public Deliverables**: a repository where all publicly available deliverables (reports, specifications, deliverable PDFs) are published and made downloadable.
- **Stay Tuned / Social & Contacts**: provides links to 6G-XR's social media channels and contact information (e-mail for project lead, general contact), as well as subscription to the newsletter.

On the home (landing) page, the website displays a project banner, highlights such as the latest major showcase event (for example, "6G-XR Impact Day"), brief statements of vision, and quick-access features: announcements of ongoing or upcoming Open Calls, "Latest news" teasers, a block for upcoming events, and a "Subscribe to newsletter" form.

Beyond hosting core project information and updates, it played a decisive role in supporting the three Open Calls. A dedicated Open Calls section presented all application documents, instructions,

timelines, FAQs, and promotional material, ensuring applicants and prospective experimenters could easily access the necessary resources.

The *What's New* and *Library* sections were regularly updated with news items, deliverables, use case presentations, public demos, and the full set of communication materials (flyers, posters, slide decks, roll-ups). This ensured that stakeholders could access not only static information but also dynamic updates reflecting the project's maturation and growing set of results.

The site also includes a footer common to all pages: containing the consortium declaration, funding acknowledgements (SNS JU & EU logos), and links to privacy/cookie policies — providing transparency and compliance for visitors.

This structure ensures that all relevant project information, from high-level vision to detailed technical deliverables, from community calls to news, from partner contacts to open calls, is easily discoverable, well organised, and updated in accordance with project developments.

2.3.2.1 Project website performance

The 6G-XR project website demonstrated steady and broad-reaching engagement, attracting 23,592 visits and generating 47,063 pageviews. European countries account for the vast majority of traffic (over 19,000 visits), with Spain, Finland, Greece, and Switzerland forming the top visitor locations from that region. Engagement quality remained strong, with an average visit duration of 1 min 54 s, 2.2 actions per visit, and peaks in traffic aligning with major project activities, open calls, publications, and event announcements. Notably, the site accumulated 578 downloads (500 unique), indicating sustained interest in technical outputs and project documentation.

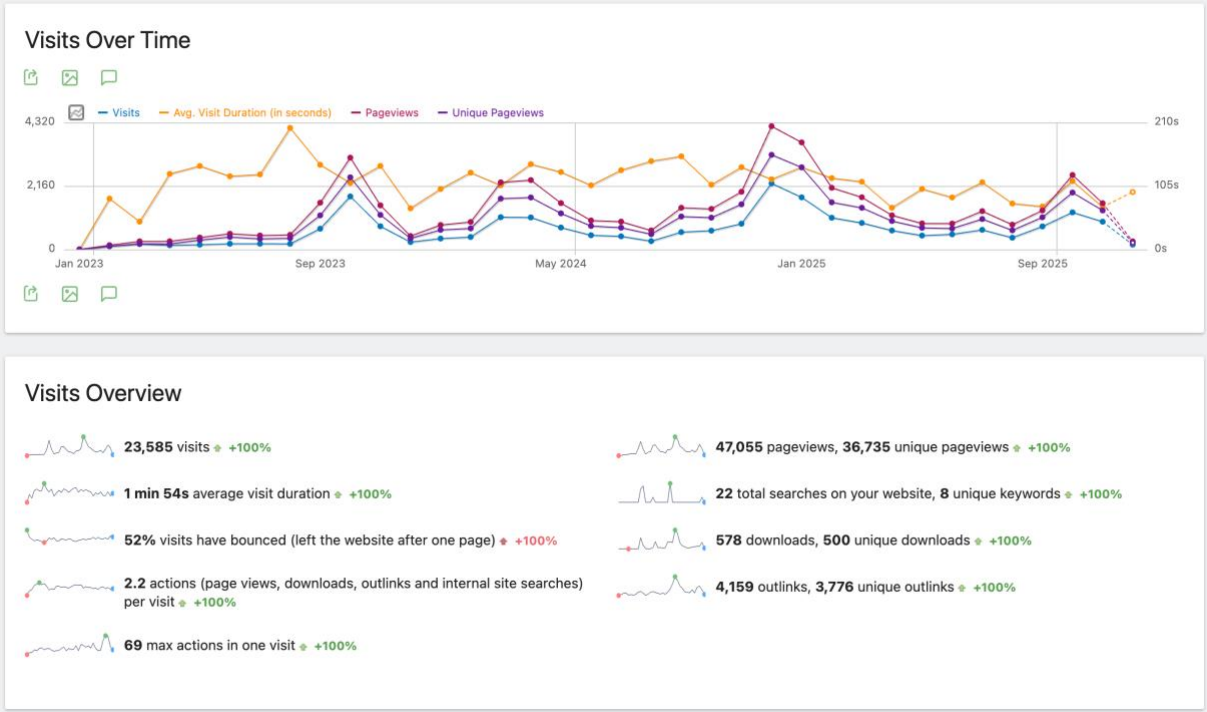

Figure 1: Website analytics with visitor behaviour metrics throughout project duration (M1-M36)

A particularly notable performance driver was the Open Call webpages, which together accumulated more than 17,000 pageviews, ranking among the most visited sections of the entire site. The Open Call

landing page and related informational sub-pages consistently appeared in the top-five most accessed pages, demonstrating high stakeholder interest across Europe in the project's funding opportunities and participation pathways. This strong traffic confirms that the website effectively supports the project's innovation ecosystem, serving as a central access point for potential applicants, researchers, and SMEs engaging with 6G-XR activities.

PAGE TITLE	PAGEVIEWS	▼ UNIQUE PAGEVIEWS	BOUNCE RATE	AVG. TIME ON PAGE	EXIT RATE	AVG. PAGE LOAD TIME
6G-XR	11,709	9,068	42%	00:00:40	55%	4.4s
6G-XR 3rd OPEN CALL	6,192	4,462	61%	00:01:06	88%	6.97s
6G-XR 1st OPEN CALL	4,227	3,164	63%	00:00:49	85%	2.04s
6G-XR 2nd OPEN CALL	3,195	2,289	60%	00:01:00	81%	4.88s
Open calls	2,669	2,041	34%	00:00:42	40%	2.15s
About 6G-XR	2,172	1,774	41%	00:01:02	45%	1.45s
Consortium | 6G-XR	1,741	1,483	52%	00:01:03	49%	1.57s
Deliverables	1,480	1,252	63%	00:01:40	75%	2.09s
6G-XR Impact Day | 6G-XR	1,443	1,026	64%	00:01:07	90%	5.25s
Use Cases	1,104	953	73%	00:01:12	65%	2.86s
6G-XR OPEN CALL 2: facts and figures	768	624	57%	00:01:13	56%	2.56s
6G-XR OPEN CALL 1: facts and figures	772	623	66%	00:01:16	55%	3.49s

Figure 2: Highest performing webpages in (unique) pageviews

2.3.2.2 News articles

During the lifetime of 6G-XR, the project published **more than 25 news articles** on its official "News" channel, covering a wide variety of topics including project milestones, event attendance and organisation, Open Call announcements, and major results.

These articles addressed multiple categories to help users navigate and access information based on their interest:

- **Major Project Updates & Milestones**: such as the recognition of 6G-XR's work among the "Top-10 Key Achievements of 2025" by SNS JU, or the announcement of the Final Impact Day.
- **Open Call Announcements & Results**: for example, the official launch of the third and final Open Call, and a "Meet the Awarded Open Call 3 Projects" feature presenting the successful proposals and promoting uptake.
- **Event Reports**: recaps and summaries after major external conferences or internal consortium meetings, including presence at exhibitions or testbed workshops, giving visibility to 6G-XR contributions to the 6G and XR ecosystems.
- **Demonstrator & Use Case Showcases**: informing the community about technical progress, experimenter outcomes, and demonstration events once demonstrators became available.

Figure 3: Sample of project news items

By structuring the news in this way, 6G-XR ensured that stakeholders, from researchers to industry actors to potential experimenters, could rapidly identify relevant content. The regular cadence of publications reflects the project's commitment to transparency, outreach, and continuous engagement.

This robust news flow significantly contributed to the project's dissemination KPIs, supporting awareness raising, stakeholder engagement, and communication of results to a broad audience.

2.3.3 Social media channels

Social media platforms played a central role in maintaining an active and visible project presence across the European 6G and XR landscapes. LinkedIn, X, and YouTube were used to disseminate updates on project activities, promote participation in events, share videos and interviews, and highlight progress on use cases, demonstrations, and key technical achievements. These channels provided immediacy and reach, enabling the consortium to engage diverse communities, amplify the project's messages, and sustain momentum between major communication milestones.

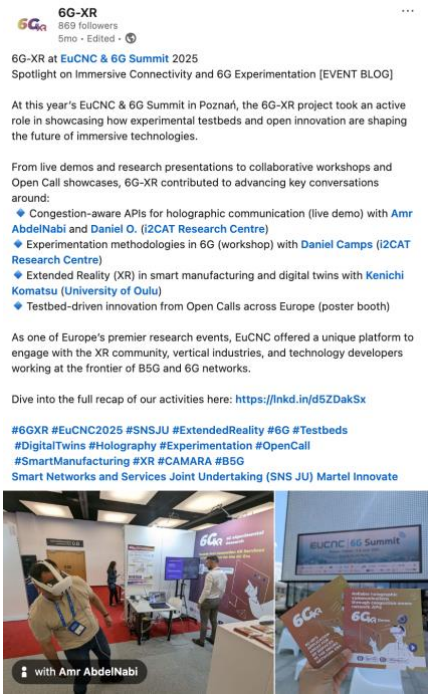

Figure 4: Example LinkedIn post reporting on multiple dissemination activities at EuCNC & 6G Summit 2025, linking to full event report on the project website

Figure 5: Example X post promoting the 6G-XR booth and demo of the Open Call 1 funded REQUIEM project at the European Big Data Value Forum 2024

These channels were used extensively to support the visibility of the three Open Calls, with coordinated campaigns announcing call openings, reminders before deadlines, showcasing selected experimenters, and later disseminating updates on their work within the 6G-XR testbeds.

The 6G-XR Open Call is here. Are you ready to take the next step and get funding for your idea? We... Posted by Kevin Keyaert 12/18/2024 Sponsored from 12/18/2024 to 12/20/2024. View results	Image	All followers	25,300	-	142	0.56%
6G XR | 3rd Open Call Information Webinar Posted by Kevin Keyaert 12/11/2024 Get up to 110,000 more impressions by boosting this post. Boost	Article	All followers	802	-	23	2.87%
Join our session at IEEE GLOBECOM in Cape Town! We are thrilled to announce that Javier... Posted by Kevin Keyaert 12/10/2024 Get up to 110,000 more impressions by boosting this post. Boost	Image	All followers	986	-	52	5.27%
We are at Stereopsia in Brussels! Come and learn about the 6G-XR project and its range of us... Posted by Kevin Keyaert 12/9/2024 Get up to 110,000 more impressions by boosting this post. Boost	Image	All followers	337	-	23	6.82%
The 6G-XR Open Call 3 - Vertical Replicability Enablers is officially live! This is your chance t... Posted by Kevin Keyaert 12/5/2024 This post type can't be boosted. Boost	Video	All followers	1,068	1,275	56	5.24%

Figure 6: Impressions and engagement of LinkedIn posts

2.3.4 Newsletter and press releases

The 6G-XR project maintained a structured and continuous stream of external communication through **periodic newsletters**, **official press releases**, and a curated **press clippings archive** — all publicly accessible on the project website. These channels played a central role in consistently updating the community about project milestones, open calls, demonstrators, and ecosystem recognition.

The **newsletter series**, published at regular intervals from mid-2023 onward, served as a consolidated communication channel to share major developments, upcoming events, Open Call information, and project outcomes. As of July 2025, five full newsletters had been released. Through these newsletters, 6G-XR kept a steady line of contact with stakeholders, ensuring they were informed about technical progress, new opportunities, and strategic events, thereby sustaining engagement beyond isolated press releases or event appearances.

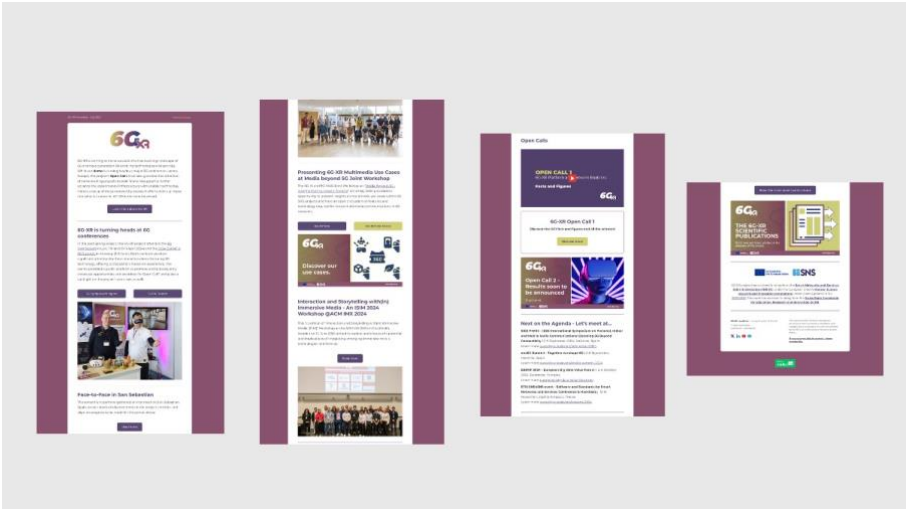

Figure 7: Example 6G-XR newsletter from July 2024

Official **press releases** were used to mark and highlight key project milestones and achievements, often accompanying major announcements or demonstration breakthroughs. The first press release — announcing the project kick-off and the consortium composition — laid the groundwork for external visibility and communicated the project ambition to a broad audience. Subsequent press releases supported the launch of each Open Call providing a public gateway for innovators, SMEs and academic organisations to discover funding and experimentation opportunities on the 6G-XR infrastructure. Further high-visibility announcements have communicated technical achievements. For instance, in September 2024 a press release described the integration of a holographic-call Proof-of-Concept using IMS Data Channel.

Notable examples include:

- **Kick-off (March 2023)**: introduced the project, its objectives, consortium composition, and overall vision for enabling XR services over future 6G infrastructures.
- **1st Open Call Launch (October 2023)**: announced the opening of the first funding window for external experimenters, detailing the scope of experiments supported by the 6G-XR testbeds.
- **IMS Data Channel Holographic Call Demo (September 2024)**: described the successful integration of holographic real-time communication using IMS Data Channel, one of the project's flagship technical achievements.

Figure 8: Examples of key press releases (IMS-integrated holographic calls, Open Call 1 announcement, 6G-XR Impact Day final showcase in Spanish)

Complementing these, the **press clippings archive** documented external media coverage and public recognition of 6G-XR outputs and events. By curating these third-party references, the project strengthened its credibility and broadened its reach beyond the immediate network of research and telecom stakeholders, contributing to broader public visibility of 6G-enabled XR research and use-case relevance.

Noteworthy mentions in external media sources include:

- Coverage of the **IMS Data Channel holographic communication achievement** in September 2024, picked up by innovation and telecom blogs.

- Dissemination of **Open Call announcements** via partner institutional newsletters and national digital-innovation outlets.

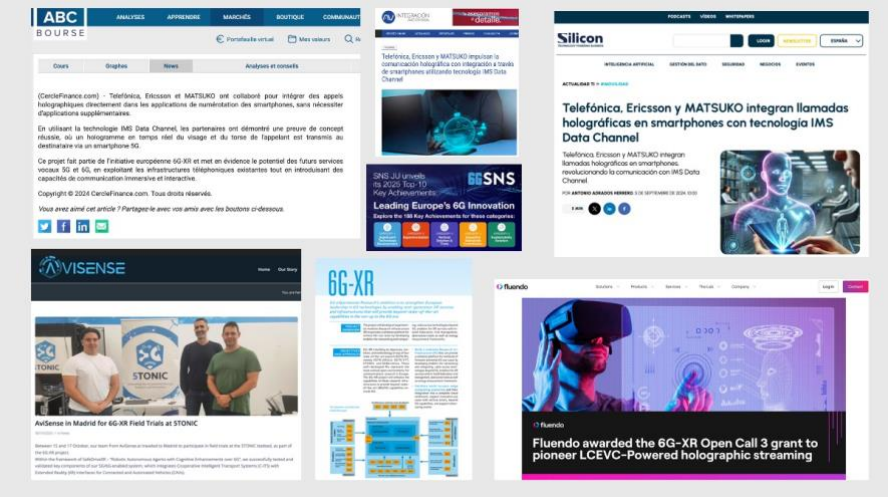

Figure 9: Sample of external media clippings covering 6G-XR

Together, newsletters, press releases, and media clipping tracking formed an integral part of 6G-XR's dissemination infrastructure. They provided a regular cadence of outreach, ensured transparency of project evolution, supported the promotion of open calls and demonstrators, and established a documented public footprint of the project's activities, achievements, and acknowledgments.

2.3.5 Promotional materials

Throughout the project, a comprehensive suite of promotional materials supported communication and dissemination activities. Beyond the core flyer and roll-up banner produced early in the project and available in the *Library* section of the website, additional assets were created to support specific activities:

- **Flyers and information sheets** tailored for the three Open Calls, summarising eligibility, benefits, timelines, and application steps.
- **Posters and roll-ups** presenting the project's testbeds, use cases, and demonstrators, used at conferences and at other major showcase opportunities.
- **A project brochure** providing a concise overview of 6G-XR's vision, architecture, testbed capabilities, and demonstration scenarios.
- **Visual materials for demos and use cases**, including thematic graphics and explanatory panels used during events, workshops, and on the website.

These materials were systematically applied at large-scale events including EuCNC & 6G Summit, MWC, and SNS ecosystem gatherings, as well as at project-organised events and online campaigns.

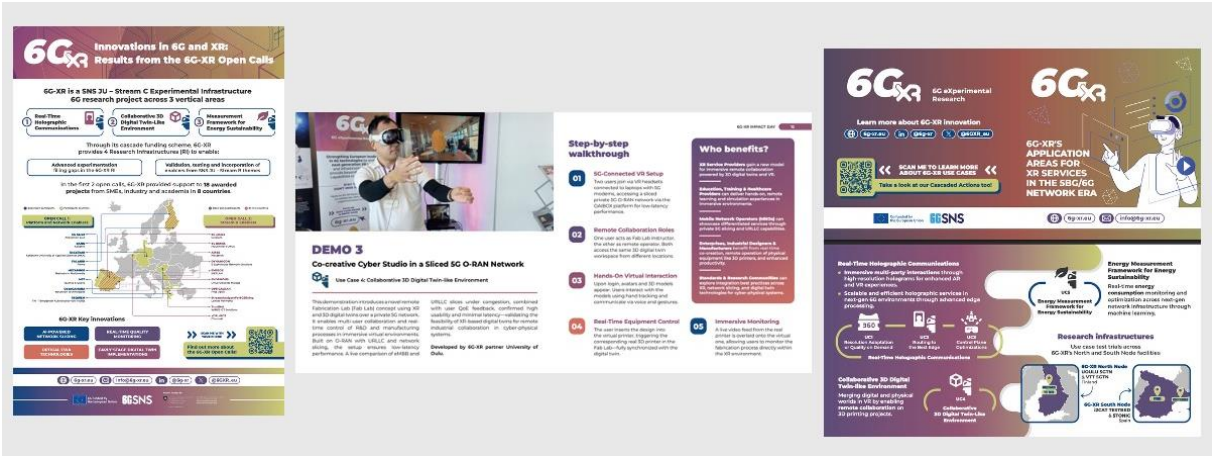

Figure 10: Example of poster, final showcase brochure page, and project use case flyer

2.3.6 Videos

Video dissemination played an important role in communicating 6G-XR's progress, with the project's YouTube channel hosting a diverse set of materials ranging from introductory explainers to technical demonstrations and Open Call content. As of late 2025, the channel features videos that collectively account for over 1800 views views, illustrating sustained interest from the 6G, XR, and research communities. Representative examples include the initial project overview video with Ari Pouttu (185 views), the *"6G-XR 3rd Open Call Information Webinar"* which supported experimenter onboarding (≈ 344 views), the technical demo *"Optimizing immersive XR experiences with automated network congestion detection in 6G"*, and the Open Call 2 experimenter showcase *"6G REMIX | 6G real-time energy monitoring for XR"*. Together, these videos provided accessible, reusable communication assets that complemented written materials, supported recruitment for the Open Calls, showcased multi-site demos, and documented external experimenter results, thereby contributing directly to the project's communication and engagement KPIs.

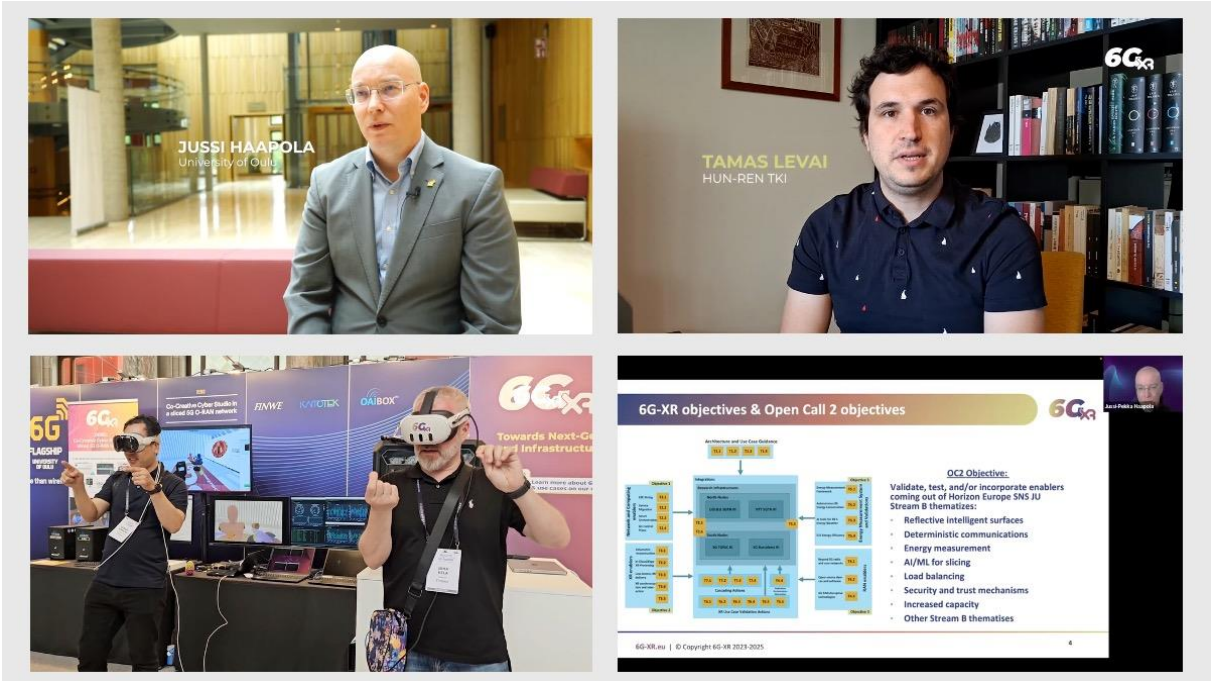

Figure 11: Screenshots of 6G-XR videos (Clockwise: Mid-term project review, OC1 REQUIEM project overview, Demo Co-creative Cyber Studio in a sliced 5G O-RAN network, OC2 information webinar)

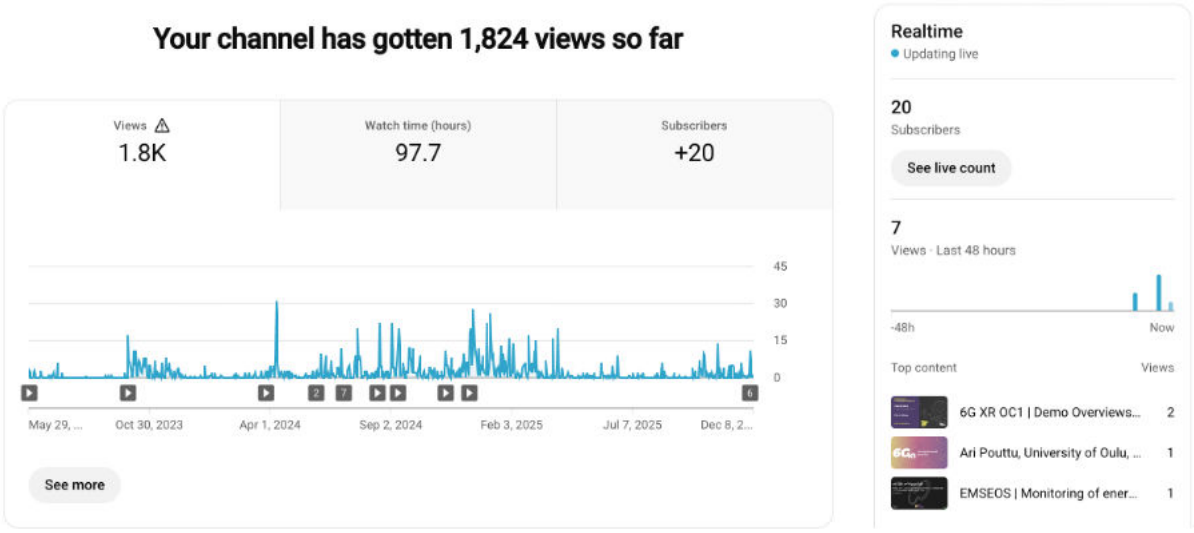

Figure 12: Views metrics of the project YouTube channel throughout the project duration

2.3.7 Internal communication

The consortium relied on the structured internal communication tools outlined in D8.1: the dedicated SharePoint repository for centralised storage of deliverables, presentation templates, graphic resources, and dissemination outputs; and project mailing lists organised by work package and audience type. These tools supported coordination, timely sharing of information, and consistency across all communication and dissemination actions.

2.4 COMMUNITY BUILDING

Community building was a central component of the 6G-XR communication and dissemination strategy, as outlined in D8.1. From the start, the project aimed to foster an active, diverse, and sustainable community around next-generation XR services, 6G testbeds, and experiment-driven research. This community grew steadily throughout the project and ultimately became one of the strongest vectors of impact, connecting researchers, industry stakeholders, SMEs, experimenters, cluster actors, and the broader SNS JU ecosystem.

A major driver of community expansion was the series of **three Open Calls**, which served as structured entry points for external experimenters and SMEs interested in validating XR applications on 6G-XR's distributed research infrastructure. The project dedicated significant communication efforts to the promotion of these calls, including informative online sessions, social media campaigns, targeted outreach to innovation hubs, and the creation of dedicated promotional materials such as Open Call flyers, application guides, and short-format explanatory visuals. Through these efforts, 6G-XR not only attracted a wide pool of applicants but also established an active group of external experimenters who became part of the project's extended innovation community.

In parallel, the project's **use cases and demonstrations** played a key role in community engagement. As the technical work matured, demos were showcased through videos, posters, slide decks, and live presentations at key European events. These materials helped the project communicate its technological ambition and gave external audiences a tangible entry point to understand the value of

the multi-site 6G-XR testbed. The visibility of these demonstrators further encouraged collaboration opportunities, especially with organisations interested in XR, holographic communications, edge computing, and networked media.

Throughout its duration, the project actively engaged with the broader **SNS JU ecosystem**. This included regular participation in SNS workshops, technical clusters, cross-project discussions, and joint promotional actions coordinated by the SNS OPS CSA. By aligning with SNS-wide communication and participating in community events, 6G-XR helped reinforce a shared European narrative around 6G research and ensured that its contributions were visible alongside other flagship initiatives.

The **Final Impact Day**, held at the end of the project, served as the culmination of these community-building efforts. This event brought together project partners, Open Call experimenters, representatives of related R&I initiatives, technical experts, and stakeholders from the XR and telecom sectors. The event programme, posters, demo areas, and promotional materials created specifically for Impact Day provided a structured environment for dialogue, networking, and showcasing the integrated achievements of the project. The event further solidified the community formed around 6G-XR and helped project outcomes reach new audiences.

Digital channels also played a continuous role in sustaining the community. Newsletters offered a curated entry point for ongoing engagement, while social media provided regular touchpoints that kept the evolving community informed of milestones, events, publications, and opportunities. Posts featuring Open Call experimenters, demo walk-throughs, and use case highlights helped maintain momentum and keep the community active throughout the project lifecycle.

By combining structured outreach, open innovation mechanisms, demonstrator visibility, event-driven engagement, and strong alignment with SNS JU activities, 6G-XR succeeded in establishing a vibrant and multi-layered community. This community not only supported the project during its implementation but also ensured that its results, testbed capabilities, and collaboration pathways continue to resonate beyond the project's conclusion.

2.5 SYNERGIES AND LIAISONS

Synergies and liaisons in 6G-XR centred on building strategic, long-term relationships with organisations, research programmes, industrial clusters, and external experimenters whose work aligned with next-generation XR services and 6G experimentation. Rather than being tied to specific events, these collaborations formed a **network of partnerships** that supported technical interoperability, shared community building, and mutual amplification of innovation activities.

A core pillar of synergy was the project's sustained engagement with the **SNS Joint Undertaking and the SNS OPS CSA**, which provided an umbrella framework for collaboration among European 6G research initiatives. Through participation in working sessions, shared communication channels, and programme-level coordination, 6G-XR aligned its messaging and technical narrative with broader SNS objectives. This ensured consistency across the SNS portfolio and strengthened the project's contribution to federated testbeds and immersive application research.

The project also fostered **technical liaisons** with projects and organisations working on experimentation platforms, distributed computing, XR processing workflows, and edge systems. These informal and formal exchanges enabled partners to compare approaches to testbed federation, traffic orchestration, multi-site experimentation, and XR quality of experience. Collaboration with creative media initiatives such as **NEM**, and with XR-focused academic and research groups, strengthened the

project's ability to align infrastructure development with real application and content production needs.

A particularly important synergy mechanism was the **integration of external experimenters through the three Open Calls**. These calls enabled SMEs, start-ups, independent researchers, and technical groups to become part of the 6G-XR ecosystem. Many experimenters participated in parallel research programmes at national or European level, which reinforced cross-project knowledge exchange. Their involvement created a feedback loop that helped refine the project's testbeds, validate its XR workflows, and increase the transferability of results to external communities.

Another layer of synergy developed through **cross-sector interactions** with XR developers, telecom vendors, media technology associations, and network operators. While some of these engagements occurred at events, the synergies themselves matured through ongoing technical discussions, shared exploration of requirements, and interest in piloting or extending 6G-XR concepts. These relationships contributed to ensuring that the project's outcomes were relevant to real deployment environments and aligned with industry expectations.

Across all these collaboration pathways, 6G-XR's synergies and liaisons served a broader purpose: to embed the project within a **cooperative European landscape**, ensuring its results informed, and were informed by, the wider evolution of 6G and immersive technologies.

2.6 PUBLICATIONS

2.6.1 Scientific publications

The 6G-XR consortium demonstrated a steadfast commitment to maximize the public accessibility of its research results. In full adherence to the Open Access guidelines mandated by the Horizon Europe work programme, all scientific publications generated by the project are freely and immediately available to the wider public and interested stakeholders. This commitment ensures the broad and prompt utilization of project findings. A total of 14 papers developed as part of 6G-XR have been successfully published (See Table below). A complete list of all 6G-XR publications is also maintained on the project website and Zenodo.

Table 1: Full list of accepted scientific publications in peer-reviewed journals and/or conference proceedings

Title	Authors	Publication / Journal / Conference	Publication date (month & year)
Resource Allocation for Double IRSs Assisted Wireless Powered NOMA Networks	Z. Xie; X. Li; M. Zeng; D. Deng; J. Zhang; S. Mumtaz; A. Nallanathan	IEEE Wireless Communications Letters	February 2023
Context-Aware Adaptive Prefetching for DASH Streaming over 5G Networks	Juncal Uriol; Inhar Yeregui; Álvaro Gabilondo; Roberto Viola; Pablo Angueira; Jon Montalbán	2023 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB) — conference proceedings	June 2023
Multi-Layer Monitoring at the Edge for Vehicular	Inhar Yeregui; Juncal Uriol; Roberto Viola;	2023 IEEE International Symposium on Broadband	July 2023

Video Streaming: Field Trials	Pablo Angueira; Jasone Astorga; Jon Montalbán	Multimedia Systems and Broadcasting (BMSB) — conference proceedings	
Addressing Scalability for Real-time Multiuser Holo-portation: Introducing and Assessing a Multipoint Control Unit (MCU) for Volumetric Video	S. Fernandez; M. Montagud; D. Rincón; J. Moragues; G. Cernigliaro	31st ACM International Conference on Multimedia — conference proceedings	October 2023
Two Stages Beam Selection Method Using Machine Learning and Peak Finding Algorithm	H. Kim	26th International Symposium on Wireless Personal Multimedia Communications (WPMC 2023) — conference proceedings	November 2023
Characterisation of a D-Band Horn Antenna: Comparison of Near-Field and OTA Measurements	A. Husein; K. Rasilainen; K. Nevala; J. Kallankari; S. Laukkanen; V-M Niemitalo; A. Pärssinen; M. E. Leinonen	2024 18th European Conference on Antennas and Propagation (EuCAP) — conference proceedings	March 2024
Formation and Assertion of Data Unit Groups in 3GPP Networks with TSN and PDU Set Support	S. Robitzsch; C. Sarathchandra; M. Starsinic; X. de Foy	2024 IEEE Wireless Communications and Networking Conference (WCNC) — conference/workshop	April 2024
Edge Rendering Architecture for multiuser XR Experiences and E2E Performance Assessment	I. Yeregui; D. Mejías; G. Pacho; R. Viola; J. Astorga; M. Montagud	2024 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB) — conference proceedings	June 2024
A Hybrid Frequency Offset Estimation Combining Data-Driven Method and Model-Driven Method for 6G OFDMA Systems	H. Kim	2024 IEEE Annual Congress on Artificial Intelligence of Things (AIoT) — conference proceedings	September 2024
MEO: An Enhanced MEC Orchestrator for Federated and Distributed MEC Systems	J. Palomares; E. Coronado; C. Cervelló-Pastor; E. Carmona-Cejudo; S. Siddiqui	2024 IEEE Global Communications Conference (GLOBECOM) — conference proceedings	December 2024
NetXRate: O-RAN enabled network assisted rate control for XR services	A. Lopez Garcia; Amr A. AbdelNabi; D. Camps-Mur; M. Catalan-Cid; M. Montagud	2024 IEEE Global Communications Conference (GLOBECOM) — conference proceedings (upcoming)	December 2024
6G OTA Measurements at Sub-THz Band Using a	A. Husein; K. Rasilainen; Juha-Pekka Mäkelä; A.	2025 19th European Conference on Antennas	March 2025

Compact Robotic System	Pärssinen; M. E. Leinonen	and Propagation (EuCAP) — conference proceedings	
Power calibration methods for frequency extenders aided modulated measurements at sub-THz/THz	S. P. Singh; P. Phukphan; T. Rahkonen; A. Pärssinen; M. E. Leinonen	2025 16th German Microwave Conference (GeMiC) — conference proceedings	March 2025
Inter-Stream Dependencies in Time-Sensitive Networking	H. Chahed; M. Yarvis; F. Frick; A. Kassler	2025 28th Conference on Innovation in Clouds, Internet and Networks (ICIN) — conference proceedings	April 2025
Towards Energy-Aware Video Streaming in 5G/B5G - Application Perspective	Mikko Uitto, Olli Apilo, Jere Koivisto, Nishu Gupta	2025 Joint European Conference on Networks and Communications & 6G Summit (EuCNC/6G Summit)	June 2025
Addressing 3D Digital Twin in XR Remote Fab Lab over Sliced 5G Networks	Komatsu Kenichi, Pauanne Antti, Hänninen Tuomo, Kela Juha, Rantakokko Tapani, Piri Esa, Prokkola Jarmo, Marques Paulo, Alves Tiago, Haapola Jussi and Pouttu Ari	2025 Joint European Conference on Networks and Communications & 6G Summit (EuCNC/6G Summit)	June 2025
Streaming Remote rendering services: Comparison of QUIC-based and WebRTC Protocols	D. Mejías; I. Yeregui; Á. Martín; R. Viola; J. Montalbán; P. Angueira	2025 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB)	June 2025
Leveraging 5G Physical Layer Monitoring for Adaptive Remote Rendering in XR Applications	I. Yeregui; D. Mejías; M. Zorrilla; R. Viola; J. Astorga	2025 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB)	June 2025
Remote Rendering for Virtual Reality: performance comparison of multimedia frameworks and protocols	D. Mejias; I. Yeregui; R. Viola; M. Fernandez; M. Montagud	2025 IEEE International Mediterranean Conference on Communications and Networking (MeditCom)	July 2025
Optimized K-means routing protocol with black-winged kite algorithm for sustainable 5G/6G sensor networks	Nishu Gupta, Mauro Mazzei, Jukka Mäkelä, Mikko Uitto	Internet of Things (Elsevier)	October 2025
Energy consumption assessment of a Virtual Reality Remote	R. Viola; M. Irazola; J. R. Juaréz; M. Nguyen; A. Zoubarev; A. Futasz; L.	2025 IEEE Conference on Network Function Virtualization and Software	November 2025

Rendering application over 5G networks	Bassbouss; A. A. AbdelNabi; J. Fernández Hidalgo	Defined Networks (NFV-SDN)

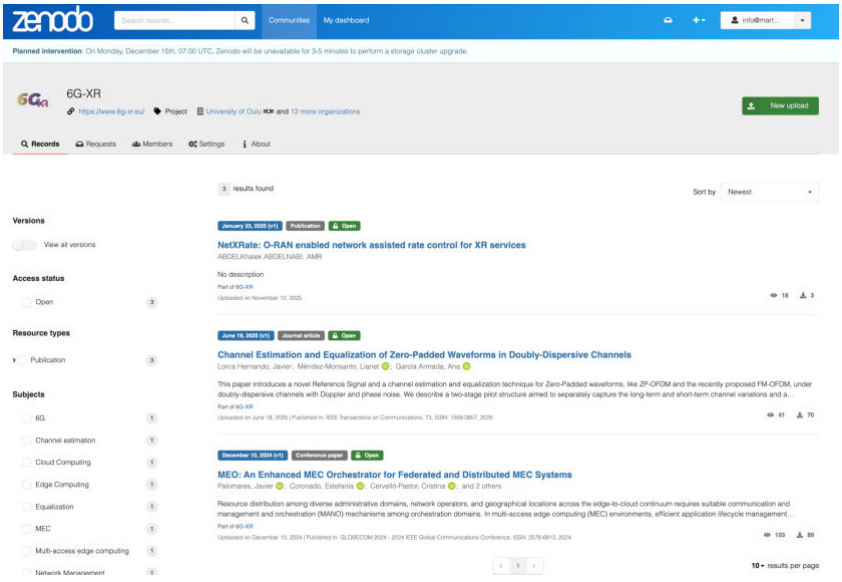

Figure 13: Screenshot of the 6G-XR Zenodo Community Page

2.6.2 White papers

6G-XR has contributed to and/or co-edited the following White Papers:

- ***Emerging 5G and beyond ecosystem business models***: published in Q1 2025 by the 6G-AI association. Through Intel, the participating partner from the 6G-XR consortium in the White Paper drafting team, insights from 6G-XR on emerging business models around virtual worlds and XR applications were incorporated.

- ***AI/ML as a Key Enabler of 6G Networks – Methodology, Approach and AI Mechanisms in SNS JU***: published by the SNS JU Technology Board in Q1 2025 with contributions from IT, MATSUKO, INTEL and UOULU.

- ***6G KPIs – Definitions and Target Values***: published by the SNS JU Test, Measurement, and KPIs Validation (TMV) Working Group in Q1 2025. It was co-edited with partner IT.

- ***Towards 6G Architecture: Key Concepts, Challenges, and Building Blocks:*** published by SNS JU 6G Architecture WG in Q2 2025 with contributions from I2CAT, CAPGEMINI, ERICSSON, VTT, VICOMTECH

- ***Sustainability in SNS JU Projects - Targets, Methodologies, Trade-offs and Implementation Considerations Towards 6G Systems:*** published in Q2 by SNS JU Technology Board – Sustainability TF with contributions from partners IT and MARTEL.

- ***6G for Media and Entertainment – Challenges, Opportunities and Future Outlook:*** *published in Q4 2025 by the SNS JU Technology Board WG and approved by 6G-AI. 6G-XR partners VICOM and i2CAT contributed to the publication*

2.7 PARTICIPATION AND ORGANISATION OF EVENTS

Events served as the primary stage on which 6G-XR presented its testbeds, demonstrations, research outputs, and Open Call opportunities to a wide variety of audiences. While synergies involved ongoing collaboration, events provided **situated, high-visibility moments** where the project engaged with specific communities, showcased results, and amplified communication activities.

Large-scale **industry exhibitions** such as **Mobile World Congress (Barcelona)** enabled partners to reach telecom vendors, operators, and XR solution developers. At these venues, 6G-XR presented its vision for immersive communications over future 6G infrastructures, shared promotional materials such as flyers and roll-ups, and engaged with companies interested in XR streaming, real-time media processing, and distributed edge capabilities.

At research-oriented conferences like **EuCNC & 6G Summit**, the project addressed scientific and technical communities concerned with networked systems, testbeds, and future communications architecture. Here, 6G-XR partners highlighted the multi-site testbed capabilities, demo concepts, and technical approaches, often linking them to Open Call opportunities and experimenter support. These events also provided a platform for the project's scientific publications and testbed presentations.

The project also reached specialised **media and XR communities**, for example through participation in the **NEM Summit**, where immersive media professionals and creative researchers were exposed to 6G-XR use cases and demonstrator plans. These venues supported alignment between XR content creation needs and the emerging capabilities of the 6G-XR infrastructure.

Academic and training events such as the **International Summer School on Extended Reality** allowed partners to engage with early-career researchers, introduce the project's XR work, and discuss experimentation methodologies with an audience directly involved in XR pipeline research and development.

Table 2: Participation in events and conferences for promotional and dissemination purposes

Event Name	Type	Date & Location	Audience	Partner	Contribution	Focus
MWC 2023	Trade Show	27 Feb–2 Mar 2023, Barcelona	Telecom & Consumer Electronics	CE	Participation	General outreach
NEM Summit 2023	Conference	24–25 May 2023, Zagreb	Media & Creative Tech	UOULU & i2CAT	Presentation	XR use cases; Open Call promotion; Talk: *"Toward next-generation holographic communications in 6G Smart Networks"*
EuCNC 2023	Conference	6–9 Jun 2023,	6G SNS Community	UOULU	Presentation	Use case + Open Call promotion;

		Gothenburg				Part of 6G Flagship session
International XR Summer School	Summer School	18–21 Jul 2023, Madrid	Academia & XR Researchers	i2CAT	Presentation	*"Social VR / XR powered with holographic comms"*
Enabling Metaverse Cooperation Workshop	Workshop	29 Aug 2023, Oulu	Academia & Industry	VTT	Presentation	Promotion of use cases & Open Calls
SNS JU Steering Board Meeting	SNS Governing Body	5 Sep 2023, Athens	SNS JU Community	UOULU	Invited Presentation	Promotion of Open Calls & collaboration
6G-IA SME WG Meeting	Working Group	27 Sep 2023, Online	SME Community	UOULU	Presentation	Open Call promotion for SMEs
EBDVF 2023	Conference	25–27 Oct 2023	Industry & Academia	i2CAT, Matsuko, Intel	Sessions, Panel, Presentations	XR, holographic comms; 6G-XR dissemination
Visions for Future Communications Summit	Conference	7–8 Nov 2023, Lisbon	NetWorld Europe	i2CAT, UOULU	Presentation	Research beyond 6G
IEEE Future Networks World Forum	Conference	13–15 Nov 2023, Baltimore	Industry & Academia	VTT	Invited Talk	Promotion of 6G-XR use cases
Erasmus Mundus Master AI	Lecture	Nov 2023	Academia	i2CAT	Talk	AI for volumetric experiences
ETSI AI Conference	Conference	5–7 Feb 2024, Sophia Antipolis	Standardisation, Industry	Intel	Poster	AI standardisation
6G Test Network Finland Workshop	Workshop	9 Feb 2024, Espoo	Academia & Industry	VTT, UOULU	Poster, Roll-ups, Flyers	Use cases & Open Call promotion
MWC 2024	Trade Show	2024, Barcelona	Global Industry	TID, Matsuko, InterDigital	Participation	Dissemination of 6G-XR
SNS JU Software Networks WG	WG Meeting	21 Mar 2024	SNS Participants	ERI, Matsuko, IT	Project Presentation	XR technology +

						core networking
6G Symposium	Conference	9–11 Apr 2024, Levi	Industry & Academia	OULU	Booth + Demo	XR demonstrations
6G-IA & 5G-MAG Joint Workshop	Workshop	13 May 2024, Online	Media & Networking	VICOM	Invited Talk	6G-XR multimedia functions
SNS JU Architecture WG	WG Meeting	24 May 2024, Online	SNS Participants	VTT	Presentation	6G-XR reference architecture
EuCNC & 6G Summit 2024	Conference	3–6 Jun 2024, Antwerp	Academia & Industry	UOULU	Booth + Demo UC4 + Talk	Results + Open Call promotion
ISIM 2024 Workshop @ ACM IMX	Workshop	12 Jun 2024	Research	i2CAT	Presentation	XR and media workflows
GSMA TSG #56	Industry Workshop	14 Jun 2024, Online/China	Global Industry	TID, Matsuko, ERI	Talk + Demo	IMS DC technology, XR control plane
IEEE PIMRC 2024	Conference	2–5 Sep 2024, Valencia	Academia & Industry	VICOM, i2CAT	Demo Exhibition	3 demos (WP3 + OC1)
One6G Summit 2024	Conference	5–6 Sep 2024, Valencia	Industry & Academia	VICOM, i2CAT	Demo Exhibition	XR & 6G demos
AIOTI Days 2024	Conference	24–25 Sep 2024	Industry & Academia	Intel	Invited Talk	6G-XR RI + Open Call 3
6G Test Network Finland Workshop	Workshop	26 Sep 2024, Espoo	Academia & Industry	VTT, UOULU	Demo + Presentation	RI & Open Call 3
SNS JU Stream C/D Collaboration Webinar	Webinar	4 Oct 2024	SNS Participants	VTT	Project Presentation	Test facilities & RI
EBDVF 2024	Conference	4 Oct 2024	Industry & Academia	Intel	Invited Talk, OC1 demo booth	XR services over converged networks
Data Week 2024	Conference	10 Dec 2024	Academia & Industry	Intel	Invited Talk	IIoT + XR
World Cannes AI Festival	Conference	13 Feb 2025	Academia & Industry	Intel	Presentation	Standards for AI
GTI Summit 2025 @ MWC	Workshop	3 Mar 2025	Global Industry	TID	Invited Talk	IMSDC holographic comms

EuCNC & 6G Summit 2025	Conference	3–6 Jun 2025, Poznań	Academia & Industry	VTT/I2CAT	Booth + Demo	Poster presentation, UC5 / UC1 technical demos
GACLM 2025	Conference	18-21 Aug 2025	Academia & Industry	Intel	Keynote	Regulation of Data & AI
Openverse WS	Webinar	01 Oct 2025	Academia & Industry	Intel	Presentation	Technology enablers of virtual worlds
GStreamer Conference 2025	Conference	23–24 Oct 2025	Open-source Community	FLUENDO (OC winner mentored by VICOM/i2CAT	2 Presentations	OC3 results + XR remote renderer
AIOTI webinar	Webinar	26 Nov 2025	Webinar	Intel	Presentation	Ethics and standardization of AI
Mobile Test Summit 2025	Industry Seminar	18 Nov 2025	Global Industry	UOULU	Invited Talk	UC4 Collaborative Digital Twin

In addition to external events, the consortium organised **project-led workshops**, including technical integration sessions and experimenter onboarding meetings. These events were critical for preparing external Open Call participants to run trials on the 6G-XR testbeds and provided a structured forum for exchanging knowledge, aligning requirements, and offering guidance.

The project's event activities culminated in the **6G-XR Impact Day: Advancing Immersive Connectivity for the 6G Era**, a dedicated final showcase event on 28 October 2025 at 5TONIC – IMDEA Networks Institute (now NEXTONIC) in Leganés, Spain designed to demonstrate the project's results comprehensively. This included live and recorded demonstrations, poster sessions, Open Call experimenter showcases, and presentations of the fully integrated testbeds and XR use cases. The event also featured a suite of dedicated promotional materials, final brochure, roll-ups, posters that helped communicate the maturity and coherence of the project's achievements.

Figure 14: Sample of photos from 6G-XR Impact Day, the final showcase event

Across these diverse events, 6G-XR succeeded in reaching industry, academia, SMEs, experimenters, XR communities, and the broader European 6G ecosystem. Each event provided targeted dissemination opportunities, enabling the project to present concrete results, attract new community members, and maintain sustained visibility throughout its runtime.

Table 3: Events organised by the consortium

Event Name	Type	Date & Location	Lead Partner	Purpose	Outputs
6G-XR Technical Workshop (Integration Workshop)	Internal Technical Workshop	Hosted by i2CAT (2023)	i2CAT, all technical WPs	Align testbed architecture, KPIs, XR workflow requirements	Internal presentations, architecture decisions
Open Call Information Sessions	Public Online Sessions	Various dates 2023–2024	Multiple partners	Promote OC1, OC2, OC3; explain eligibility and testbed capabilities	Slides, Q&A, recordings
Experimenter Onboarding Workshops	Hybrid / Online	2023–2024	Testbed partners (OULU, VTT, i2CAT, others)	Support experimenter integration into multi-site testbeds	Technical documentation, recorded tutorials
Cross-Site Testbed	Project Internal	Periodically 2023–2025	Testbed leads (OULU,	Align RI deployment, KPIs,	Logs, configuration docs

Synchronisation Meetings			VTT, UPV, i2CAT…)	monitoring, XR pipeline	
SNS JU Community Co-hosted Sessions	Joint Dissemination Webinars	2023–2025	6G-XR + SNS OPS	Cross-project promotion, RI federation discussions	Short talks, SNS repository updates
6G-XR Impact Day	Flagship Final Event	Hosted in 2025	All partners	Showcase final results, demos, Open Call outputs, XR use cases	Posters, roll-ups, video demos, brochure, slide decks

2.8 IMPACT ASSESSMENT

Across the full project duration, 6G-XR consistently achieved its communication and dissemination KPIs, demonstrating strong visibility, stakeholder engagement, and outreach impact. The project website significantly exceeded expectations, reaching **7,879 unique visitors per year** due to Open Call interest, well above the >2,000 target, while social media channels grew steadily, with **870 LinkedIn followers** and **309 X followers**. Press and media engagement was similarly successful, with **six press releases** published over the project's lifetime, exceeding the KPI. Scientific dissemination also advanced robustly, reaching **14 peer-reviewed publications in total**, with several submitted publications awaiting acceptance notification. All planned **six newsletters** were delivered, and video production far exceeded the baseline KPI with **26 videos** published, primarily in context of Open Call project promotion, and an average of **83 views per video**. The project also performed strongly in community-building activities, organising **five workshops** and participating in **32 external events**, more than tripling the minimum expected engagement. Overall, the KPI achievements confirm that 6G-XR's communication and dissemination strategy was highly effective in amplifying project visibility, strengthening community engagement, and supporting impact creation across Europe and beyond.

Measure	Indicators	KPI	Description	Status at M18	Status at M36
Project website	#unique visitors (average per year)	>2000	News, publications, videos	4728	7879
Social networks	#followers X #followers LinkedIn	>500 >150	Keeping profiles on such networks active via regular moderation	280 516	309 870
Press releases / publications in press	#press releases	>5	Issuing press releases and external media coverage on	4	6

			key project milestones		
Publications	#peer-reviewed publications in journals, conferences, workshops	≥ 8 per year	Articles and papers presented and published in high-quality venues	4 per year, 8 total	6 per year, 14 total
e-Newsletter	#newsletters (published every 6 months)	6	Recording of subscribers to the electronic newsletter	2	6
Videos	#videos published on YouTube project channel and average number of views	4 videos 150 views per video on average	Introduction, informative and educational videos to support awareness creation and stakeholders' engagement	6 76 views on average	26 83 views on overage
Workshop organisations	#workshops Average # participants per workshop	3 20-40 participants	Attendance proof, presented materials, photos, social media animation, events' reports	5	5
Event participation and presentations	#external events partners attended for project (results) dissemination, demo showcases and promotion	≥ 10	Attendance proof, presented materials, photos, social media animation, events' reports	20	36

3 STANDARDIZATION AND REGULATION ACTIVITIES

3.1 OBJECTIVES AND APPROACH

Standardization and regulation activities in 6G-XR are carried out under Task 8.2 – Standardization and Regulation (M5–M36). The main objective of this task is to ensure that the key technical innovations and architectural concepts developed in the project are aligned with, and contribute to, the evolution of relevant standards and regulatory frameworks. In particular, T8.2 aims to:

- Identify which standards, working groups and technical committees are impacted by 6G-XR results;
- Promote 6G-XR concepts in those fora through technical discussions, liaison, and contributions;
- Monitor and interpret emerging European regulatory frameworks (e.g. AI, cybersecurity, data, and resilience legislation) and assess their implications for 6G-XR technologies;
- Provide input to the project's exploitation and sustainability work (T8.3) so that future productisation and deployment are compatible with both standards and regulation.

The approach has been incremental and iterative. Initially, a **standardisation roadmap** and a **workflow for tracking SDO activities** were defined, supported by the internal spreadsheet *6G-XR SDO Activities.xlsx*. All partners were asked to report their ongoing and planned standardisation work, including relevant groups, topics, and potential contributions. This information was periodically reviewed in WP8 meetings and updated in plenary and GA sessions, ensuring an up-to-date map of where 6G-XR can have impact.

In parallel, T8.2 established a **close link with regulatory developments**, in particular new EU legislation on AI, cybersecurity, resilience and data. A dedicated training session and internal material were prepared (e.g. the January 2025 training on the AI Act, Cyber Resilience Act, and related regulations), and a structured questionnaire was circulated to WPs to evaluate how 6G-XR research outputs relate to the categories and requirements of the **EU AI Act**. These regulatory insights are fed back into technical work and into the sustainability and ESG analysis in T8.3.

3.2 MAPPING OF RELEVANT SDOS AND FORA

Based on the Description of Action and partners' existing memberships, 6G-XR identified a set of priority SDOs and industry fora for its standardisation and regulation work. These include:

- **SNS / 6G-IA ecosystem**
    - *SNS-IA 6G Architecture Working Group*: used as a forum to present and discuss the 6G-XR reference architecture and its alignment with broader 6G architectural visions.
    - *SNS-IA Pre-Standardization Working Group*: leveraged to report standardisation-relevant outputs and ensure coherence with other SNS projects; 6G-XR participates in regular meetings and contributes standardisation status updates.

- *SNS-IA Trials Working Group*: used for cross-project exchange on trials and testbed topics; 6G-XR is represented here although the effort is not accounted to T8.2, ensuring coherence with trial-oriented standardization topics.

- **One6G Association**: 6G-XR participates in One6G activities, with particular relevance for the **Work Item on "Immersive Communications"**, which addresses XR and holographic services at system level. This provides a channel to align project results with broader 6G research directions and pre-standardization discussions.

- **ETSI**: 6G-XR maintains dialog with ETSI activities of interest, in particular **ETSI MEC**, via project partners and through collaboration with other SNS projects. For instance, collaboration discussions with the VERGE project have focused on how the 6G-XR holographic communication use case and XR-related APIs could be reflected in MEC work items.

- **Other SDOs and consortia**: Through partner organisations, 6G-XR monitors and, where appropriate, feeds into work in mobile and networking SDOs such as **3GPP** and open API initiatives such as **CAMARA** (Linux Foundation/GSMA). These are particularly relevant for topics like QoD / QoS APIs, network exposure for XR, slicing support for immersive services, and deterministic communication features. The precise contributions are captured in the internal SDO tracker and summarised in this deliverable at an aggregate level.

This mapping is not static. As the project progressed and technical results matured (e.g. on congestion analytics, network exposure, XR orchestration, deterministic networking, and sub-THz experimentation), the T8.2 team periodically revisited the mapping to confirm which fora remained most suitable for contributions, especially in light of emerging **Release-19/Release-20 topics** in 3GPP and related work in ETSI and CAMARA

3.3 STANDARDIZATION ACTIVITIES AND CONTRIBUTIONS

3.3.1 Tracking and Reporting Mechanism

Standardisation activity is tracked centrally through a 6G-XR SDO Activities tracker and regularly reviewed in WP8 status updates and plenary meetings. Partners report:

- SDO / forum name and working group;
- Role of the partner (member, rapporteur, editor, contributor, attendee);
- Topic or work item addressed;
- Type of input (contribution, liaison, presentation, discussion paper, etc.);
- Relation to 6G-XR work packages and innovations.

The tracking mechanism also distinguishes between planned, under discussion, and completed actions. This enables WP8 to monitor progress against the standardisation KPIs and to identify gaps (e.g. under-represented innovations or SDOs).

3.3.2 Engagement in SNS / 6G-IA and Cross-Project Context

Within the **SNS / 6G-IA** ecosystem, 6G-XR has:

- Participated in regular meetings of the **Architecture WG**, where the 6G-XR architecture was presented and discussed, including its treatment of programmable network enablers, XR orchestration, and experimental platforms.

- Actively attended the **Pre-Standardization WG**, reporting 6G-XR's standardisation activities and exchanging information on relevant work items in 3GPP, ETSI, ITU, and other SDOs.

- Contributed to the **Trials WG**, providing input on testbed capabilities and XR-related trials; this complements, but is not counted as, T8.2 effort.

Through these WGs, 6G-XR has ensured that its technical concepts – such as in-network support for volumetric streaming, deterministic communication for digital twins, and programmable exposure of 5G/6G capabilities for XR – are taken into account in cross-project discussions on 6G architectures, KPIs and future standardisation priorities.

3.3.3 Collaboration with Other SNS Projects and ETSI MEC

In addition to the SNS-IA structures, 6G-XR has engaged in bilateral collaboration with other SNS projects. A notable example is the interaction with VERGE, where coordinators approached 6G-XR following a talk at EBDVF 2023 and expressed interest in how the Holocomms use case could inform ETSI MEC standardization efforts. These discussions explore how deterministic XR and holographic services over MEC platforms could be reflected in ETSI work items, and how 6G-XR concepts (e.g. QoS-aware multimedia pipelines, congestion-aware orchestration) might align with MEC APIs and service models.

Such collaborations are used as a pre-standardization bridge, allowing projects to jointly refine their requirements and interface concepts before bringing them formally into SDOs.

3.3.4 Topic Areas and Technical Focus

Across the different fora, 6G-XR's standardization-relevant work clusters around a number of technical themes that are directly derived from the project's innovations (described in the Innovation Opportunity documents), including:

- **Network exposure and QoS / QoD APIs for XR:** The project's Network Exposure API innovation (e.g. UE location, KPI exposure, QoS session control) is closely aligned with work on network exposure in 3GPP and API abstraction in CAMARA. This includes discussions around exposing device location, slice/QoS configuration, and per-flow control to applications in a secure and operator-friendly manner.

- **Edge-Cloud NaaS APIs and traffic influence for XR:** The Edge-Cloud NaaS API innovation defines developer-friendly APIs for edge discovery and traffic influence, implemented within Capgemini's IEAP orchestration platform and contributed to the CAMARA project. This work feeds into API standardisation discussions around service-level QoS and edge selection, of particular relevance for XR services.

- **Deterministic networking and TSN for 3D digital twins:** The 3D Digital Twin use case relies on deterministic networking and TSN support over a 5G private network, highlighting requirements for time-sensitive and slice-enabled communication with XR clients and robots. Related requirements are relevant for 3GPP SA2/SA5 and IEEE TSN activities.

- **XR-centric congestion analytics and network monitoring:** Innovations such as the Congestion Detection Function (CDF) and QoS-aware multimedia pipelines for holographic communication provide concrete use cases for advanced NWDAF-like analytics, O-RAN interfaces, and cross-layer adaptation mechanisms. These insights are relevant to discussions on 5G-Advanced and 6G features for real-time media services.

- **Sub-THz radio and waveform research:** Work on a 300 GHz radio front-end and waveform/channel estimation techniques for doubly-dispersive channels contributes to the knowledge base relevant for future sub-THz 6G bands, feeding into long-term standardisation discussions (e.g. in ITU-R, 3GPP and research-driven fora).

While not all of these topics have yet resulted in formal contributions or change requests, they define the technical scope within which 6G-XR is preparing or influencing standardization inputs. The SDO tracker and this deliverable capture their evolution over the project.

3.4 REGULATION-RELATED ACTIVITIES

Regulatory aspects form the second pillar of Task 8.2. Over the project lifetime, 6G-XR has systematically monitored key EU legislative developments relevant to its research, in particular:

- EU AI Act
- Cyber Resilience Act (CRA)
- Data Act and related data-governance initiatives
- Other horizontal legislation touching on AI-enabled connectivity and digital services.

A concrete outcome is the preparation and internal rollout of an AI Act compliance questionnaire, which assesses whether, and to what extent, 6G-XR research results might fall under high-risk AI categories or touch on prohibited practices. The questionnaire is addressed to work packages and use-case owners and aims to:

- Identify any components that could be considered AI systems in the sense of the AI Act;
- Clarify their intended use, risk profile, and data handling practices;
- Anticipate possible requirements (e.g. transparency, human oversight, robustness) that would affect exploitation and industrial uptake.

In addition, WP8 coordinated a joint tutorial proposal to EuCNC & 6G Summit 2025 together with the 6G-ARROW and VERGE SNS projects, titled *"Supporting the Implementation of EU Legislation on AI, Cybersecurity, Data and others through research"*. This activity, while external-facing, also served as an internal structuring effort: it brought together knowledge on AI, cybersecurity and data regulation, and linked it directly to 6G-XR use cases and enablers.

Beyond the AI Act, the training session of January 2025 covered key obligations and implications of the Cyber Resilience Act, the Radio Equipment Directive (RED) in its security-related aspects, and the Data Act in terms of data sharing and portability. The outcome of this training is that partners are aware, at an early stage, of the regulatory constraints that may apply when turning 6G-XR prototypes into products or services and can factor them into exploitation planning.

These regulation-oriented activities **feed directly into T8.3**, where ESG considerations and long-term sustainability are analysed, and into technical design decisions (for example around data collection, telemetry exposure, and user-facing XR applications).

3.5 PROGRESS AGAINST OBJECTIVES AND KPIS

Task 8.2 contributes to Objective O8.2, which targets effective standardisation and regulatory alignment of 6G-XR results. Progress can be summarised as follows:

- A standardisation roadmap and tracking process were defined early in the project and operationalised via the SDO tracker; partners have been repeatedly engaged to populate and update it.
- 6G-XR secured and maintained active participation in key pre-standardisation fora (SNS-IA Architecture WG, Pre-Standardization WG, Trials WG, One6G), where its architecture, use cases and technical findings were presented and discussed.
- Collaboration with other SNS projects has been established (e.g. with VERGE), specifically to align XR and MEC-related standardisation opportunities and to coordinate inputs to ETSI MEC.
- A structured regulation assessment has been initiated via the AI Act questionnaire, and project results have been framed in the context of AI, cybersecurity and data legislation; knowledge has been shared via internal training and an external tutorial proposal.

Building on the SDO Activities tracker, Table 4 below summarises all standardisation contributions that have been explicitly reported under the 6G-XR umbrella.

Table 4: Contributions to SDOs

Partner	SDO / Forum	Group	Contribution ID / Reference	Title (short)	Type (tracker)	Status
Capgemini Engineering (CGE)	CAMARA	Edge Cloud WG	EdgeCloud/ pull/122	Proposal of harmonization of the EDGE DISCOVERY and TRAFFIC INFLUENCE APIs	Technology / solution	Merged – relevant aspects in commit #127
InterDigital Europe (IDE)	3GPP	SA2	S2-2302493	LS on the Granularity of PDU Set Integrated Handover Measurements	Technology / solution	–
IDE	3GPP	SA2	S2-2310657	WT-2.2, New Key Issue on QoS Handling when Traffic is	Issue / problem	–

				Migrated Between Slices		
IDE	3GPP	SA2	S2-2402966	KI#8, New Solution: Using SDP to Identify and Configure Multiple Related Media Flows	Technology / solution	–
IDE	3GPP	SA1	S1-244361	Reply to LS on PWS support for NB-IoT NTN	Technology / solution	–
IDE	3GPP	SA1	S1-244364	Rel-19 22.268 CR PWS support for NB-IoT	Technology / solution	–
IDE	3GPP	SA2	51629	Available Data Rate Reporting for GBR QoS Flows	Technology / solution	–
IDE	3GPP	SA2 / SA3	S2-2505326	KI#1, New Sol: architecture for sensing services in 6G	Technology / solution	–
IDE	3GPP	SA3	S2-2505329	KI#2, New Sol: UE-initiated sensing service requests	Technology / solution	–
IDE	ETSI	ISG ISAC	ISC(24)000076	Adaptive parameters for 6G ISAC	Technology / solution	–
IDE	ETSI	ISG ISAC	ISC(24)000078	TP on RCS modelling in large-scale and small-scale channel models	Technology / solution	–
IDE	ETSI	ISG ISAC	ISC(24)000079	Discussion on 6G ISAC waveform challenges	Issue / problem	–
Nokia	3GPP	RAN1	R1-2311732	XR-specific capacity enhancements	Technology / solution	–*
Nokia	3GPP	RAN1	R1-2401344	Draft Change Request for 38.213	Technology / solution	–*
Nokia	3GPP	RAN2	R1-2403411	Multi-modality work in Rel-19	Technology / solution	–*

Intel (INT)	ETSI	RRS WG3	RRS(24)068005r1	Viability of ETSI Software Reconfiguration Framework for 6G Systems	Technology / solution	–
INT	ETSI	RRS WG3	RRSWG3(25)069004r1	Common security requirements for software reconfiguration	Requirements	–
INT	ETSI	RRS WG3	RRSWG3(25)069005r1	Skeleton for API definition for 6G	Technology / solution	–
University of Oulu (UOulu)	ETSI	ISG THz	THz(23)000093	Measurement-based characterization of D-band high-resolution MIMO channels	Experimental result	–
UOulu	ETSI	ISG THz	THz(23)000082	Outdoor and indoor MIMO channel data at 140 GHz	Technology / solution	–
UOulu	ETSI	ISG THz	THz(23)000238	Channel model modification for large arrays, sub-arrays and hierarchical beamforming	Technology / solution	–
UOulu	ETSI	ISG THz	THz(24)000039	Terahertz molecular absorption loss based on HITRAN	Technology / solution	Accepted
UOulu	ETSI	ISG THz	THz(24)000119	Clarification for determining virtual locations in 3D ray-based channel models	Technology / solution	Noted
UOulu	ETSI	ISG THz	THz(24)000120	Text proposal for 5.1 Atmospheric Effects of Gaseous Attenuation	Requirements	Accepted

UOulu	ETSI	ISG THz	THz(25)000038	Near-field extension of the 3GPP Geometry-Based Channel Model (GSCM)	Technology / solution	Noted
Ericsson (ERI)	3GPP	SA2	S2-2412913	KI#1: IMS Subscribe/Notify Framework Architecture	Technology / solution	Accepted
Ericsson (ERI)	3GPP	SA2	S2-2505952	KI#1: Corrections to IMS Subscribe/Notify Framework Architecture	Technology / solution	Accepted

The detailed quantitative KPI values and per-partner contributions are reported in the internal tracker and summarised in the overall WP8 KPI overview. Qualitatively, the project has moved from an initial mapping and planning phase to tangible participation and influence in relevant groups and has laid the groundwork for partners to continue standardisation and regulatory work beyond the lifetime of 6G-XR.

In the Description of Action and in the WP8 KPI definition, the main KPI related to standardisation under the "Standardization and Outreach" objective is KPI9.1: "≥ 10 standardization contributions." Based on the latest SDO Activities tracker and the contributions listed in Table 4, 6G-XR has achieved 27 distinct standardisation contributions across 3GPP, ETSI and CAMARA, involving six partners (CGE, IDE, Nokia, Intel, UOulu and Ericsson). This means that, in quantitative terms, the project has reached 270% of the KPI9.1 target. These contributions cover architectural and service aspects (3GPP SA1/SA2/SA3, including XR Management and NG RTC work), RAN and XR-specific enhancements (3GPP RAN1/RAN2), integrated sensing and communications (ETSI ISG ISAC), reconfigurable radio and secure software update frameworks (ETSI RRS), sub-THz channel modelling (ETSI THz ISG) and open network APIs for edge computing (CAMARA Edge Cloud). Some of these items are still marked as Unhandled, Meeting ongoing or TBC in the tracker, but all of them qualify as formal 6G-XR-related contributions submitted to SDOs, in line with the KPI definition. Taken together with the regulation-oriented activities described in Section 3.4, this shows that 6G-XR has not only met but clearly exceeded its original ambition in terms of standardisation engagement, and has laid a solid basis for partners to continue influencing 5G-Advanced and 6G standards beyond the project lifetime.

4 EXPLOITATION AND SUSTAINABILITY PLAN

4.1 OBJECTIVES AND OVERALL APPROACH

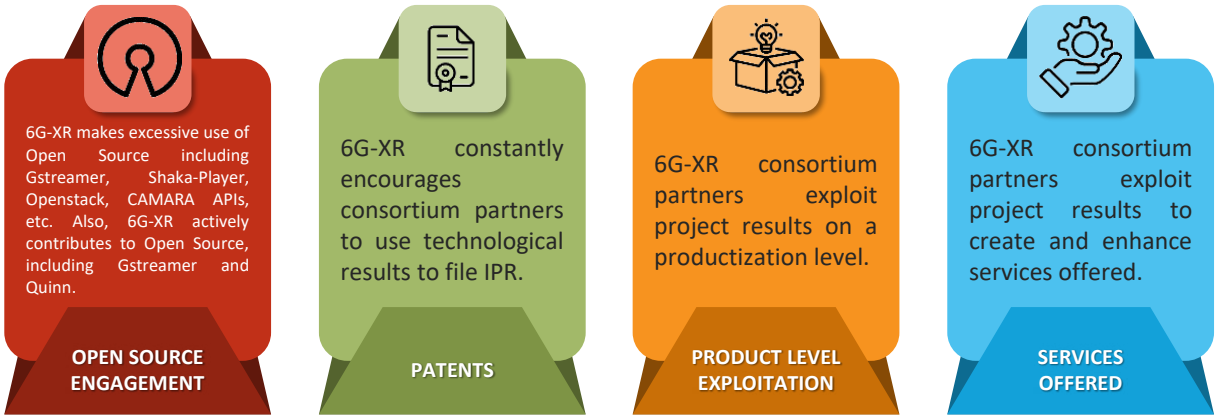

Figure 15: Four dimensions to characterize exploitation of project results.

The exploitation and sustainability plan of 6G-XR aims to ensure that the project's scientific and technical outcomes translate into long-term impact for partners and for the wider 6G and XR ecosystem. In line with the Description of Action, the main objectives are to:

- identify and continuously update exploitable results across all technical work packages;
- define exploitation routes for each result (e.g. internal use, products, patents, services, standardisation leverage, open-source, follow-up R&I);
- support partners in aligning their internal roadmaps and business strategies with 6G-XR outcomes;
- ensure that exploitation is compatible with regulatory developments (AI, cybersecurity, data, resilience) and aligned with Environmental, Social and Governance (ESG) principles;
- provide a sustainability strategy for continuing key assets (software, datasets, know-how, collaborations) beyond the project lifetime.

These objectives are operationalised via two main instruments:

1. The Innovation Tracker, which monitors the portfolio of project innovations (technical, methodological and tooling) and aggregates, for each one, its maturity, expected impact, and tentative exploitation path.
2. The Exploitation Tracker, where each partner records how it plans to use 6G-XR results (its own and, when relevant, other partners' results), mapped to high-level categories such as productisation, service creation, standardisation support, internal R&D reuse, open-source publication or intellectual property management.

The two instruments are synchronised through periodic WP8 reviews and WP-level discussions, ensuring that innovation outputs are systematically connected to concrete exploitation actions. This section synthesises the main outcomes of this process.

Furthermore, the present section is serving a dual purpose – first, to provide an exploitation report detailing how the results of the projects have been used and will further be used to the benefit of the concerned organizations in the project and to the benefit of society as a whole. Exploitation of project results will be measured according to the following four dimensions:

Second, the present section will provide an analysis of the overall project related to Environmental, Social and Governance (ESG) principles. For this purpose, an innovative novel approach for ESG related assessment will be provided based on publicly available information related to the European Union Green Deal and Accessibility related Standards ensuring that needs of disabled persons are being addressed appropriately. For those purposes, surveys have been conducted across all Work Packages of 6G-XR and the corresponding results are being summarized.

4.2 EXPLOITATION FRAMEWORK AND PARTNER ROLES

Exploitation in 6G-XR is decentralised but coordinated:

- Each partner is responsible for the primary exploitation of the results it generates (e.g. integration into products and services, internal process improvements, academic impact).
- WP8 provides the framework and guidance, including templates, tracking spreadsheets, and joint discussions to identify synergies and avoid overlaps.
- Exploitation is closely linked with standardisation (Task 8.2) and innovation management (WP9), ensuring coherence between technical, standardisation and commercial perspectives. Exploitation routes considered and used by partners include internal product and service development, standardisation contributions, open-source releases and, for selected high-value results, patent applications.

6G-XR partners fall broadly into the following categories:

- **Industrial vendors and integrators** (e.g. Ericsson, Nokia, Capgemini, INT, RAY) focus on incorporating 6G-XR results into products, platforms, and solutions, and on using them as input to standardisation and future R&I programmes.
- **Network operators and service providers** (e.g. Telefónica) exploit the project primarily through service concepts, operational know-how, and requirements injected into standardisation and internal R&D.
- **SMEs and application providers** (e.g. MATSUKO) exploit results by enhancing their XR applications and services, leaning on 6G-XR network and platform enablers.
- **Research and academic partners** (e.g. UOulu, i2CAT, VTT, universities) exploit results mainly via scientific publications, open-source contributions, datasets, and follow-up research projects, while also supporting industrial exploitation and standardisation.

The exploitation framework distinguishes between foreground generated within 6G-XR and external assets brought into the project as background. Exploitation plans explicitly consider IPR ownership, licences, and compatibility with open-source strategies, as recorded in the exploitation tracker and innovation artefacts.

4.3 EXPLOITABLE RESULTS AND EXPLOITATION ROUTES

6G-XR Innovation tracking and partner inputs identify a portfolio of innovations spanning network, computing, XR applications, sensing, and hardware. These can be grouped by type of exploitable asset.

In addition to the concrete routes described below, all partners have periodically reviewed their results for potential patentability as part of their internal IPR processes. While many exploitation decisions have favoured open dissemination and early ecosystem uptake (via standards and open source), several partners have also proceeded with patent applications for selected results, as documented in the patents sheet of the exploitation tracker and summarised in Section 4.6. This combination of open and protected routes allows partners to maximise ecosystem impact while safeguarding key competitive assets, in line with the IPR provisions of the Consortium Agreement.

4.3.1 Network and computing enablers

Several innovations in WP2–WP5 result in network and cloud-edge enablers that partners plan to exploit as part of their product or platform offerings:

- **Network Exposure and QoS/QoD APIs (ERI, CGE):** The NEF-based network exposure components developed in the project (e.g. for UE location, KPI exposure, and QoS session control) are planned for integration into commercial network exposure platforms, enhancing the ability of applications (including XR services) to dynamically request and monitor QoS. These results also provide concrete input for future NEF-related extensions in 3GPP and GSMA-aligned APIs, and are therefore exploited as both product features and standardisation leverage.

- **Edge-Cloud NaaS APIs and AI/ML-based continuum enabler (CGE):** The Edge-Cloud NaaS API work defines developer-friendly APIs for edge discovery and traffic influence, integrated into Capgemini's edge orchestration platform (*Intelligent Edge Application Platform*: https://www.capgemini.com/solutions/edge-ready/). The complementary ML-based continuum enabler introduces AI/ML-driven decision logic for placement and orchestration of functions across edge and cloud. This work positions Capgemini to be better prepared for requirements regarding AI-based autonomous network management. Together, these two 6G-XR results form a key component of CGE's exploitation strategy: they enhance the company's edge platform offering towards future commercial needs, and underpin contributions and alignments with open API initiatives (e.g. CAMARA), thus combining product exploitation with ecosystem influence.

- **Congestion Detection and Analytics Functions (I2CAT, ERI):** The congestion detection function (CDF) and associated analytics modules developed in WP3/WP4 are exploited in two main ways: (i) as internal building blocks for partners' network monitoring and optimisation solutions (e.g. enhancing NWDAF-type analytics and orchestration logic), and (ii) as evidence and prototypes for shaping requirements in standardisation on analytics-assisted traffic management and XR-specific KPIs.

- **Energy-Aware and QoS-Driven E2E Controller (VTT, UOULU, NOKIA):** The energy measurement framework and energy-aware controller that jointly optimises video streaming and 5G RAN parameters based on solar energy availability and QoS/QoE targets is exploited as a research demonstrator and as a source of methodologies for future energy-efficient networking products and services. The associated concepts (energy KPIs, measurement

datasets, control loops, experimentation methods) inform partners' internal R&D and can be leveraged in future projects and standardisation discussions on green networking.

4.3.2 XR applications, trial controller and use cases

The 6G-XR use cases and trial controller components also produce exploitable outputs:

- **Holographic IMS call and XR services (MATSUKO, Telefónica, Ericsson):** The holographic communication PoC integrating MATSUKO's application with an IMS-based architecture and operator network slicing is directly exploited by:
    - **MATSUKO**, by incorporating the design and learnings into its commercial telepresence product roadmap;
    - **Telefónica**, by using the PoC and associated KPIs to shape future XR service offerings and network requirements;
    - **Ericsson**, by reusing know-how and building blocks within its IMS and network portfolio. Ericsson Spain has been an active contributor to the Standardization activities of 3GPP SA2 in the field of IMS Data Channel Exposure (IMS Event Exposure Framework) for Release 19, along 2024 and 2025. Two patent applications have been filed on that field as well regarding the subscription to HSS-IMS node events.
- **QoS-aware adaptive multimedia pipeline for holographic communications (VICOM, i2CAT):** The holographic communications pipelines integrating i2CAT's HoloMIT platform and VICOM's Remote Renderer, developed in WP3, with WP4 QoS/QoD APIs has been subject of relevant scientific publications. Furthermore, the results can be leveraged in future research activities.
- **Trial controller, North/South node tools and portals:** The trial controller ecosystem (North Node, South Node, Unified and North web portals, and related proxies/adapters) is exploited as a flexible experimentation and demonstration platform, both in 6G-XR and beyond. Partners can reuse it to host new XR experiments, integrate additional enablers, and support future trials and pilot activities with different stakeholders (including future SNS projects and industry trials).
- **3D Digital Twin and deterministic networking:** The deterministic, TSN-enabled 3D digital twin setup provides a reusable demonstration environment for industrial XR, which can serve both as a reference architecture for future deployments and as a basis for consultancy, testing or training services by partners involved in this use case.

4.3.3 Hardware and sensing innovations

Hardware and sensing-related innovations are exploited primarily through research impact and long-term R&D roadmaps:

- **Sub-THz RF components and channel models (UOULU and partners):** The 300 GHz radio front-end prototypes, together with sub-THz measurement campaigns and channel models, are exploited as a strategic R&D asset. They strengthen partners' capabilities and visibility in THz research, support scientific publications, and provide input to ETSI THz channels and related 3GPP/ITU-R work. This indirectly supports future industrial exploitation of THz components.

- **Advanced XR capture and inspection (Raytrix):** Innovations such as thermal-compensated plenoptic cameras, RGB-D calibration techniques and XR-based inspection of HMDs are exploited by RAY through product improvements in its XR capture solutions and new service offerings (e.g. inspection and quality-assurance tools for XR devices). These outputs have clear commercial potential and also raise requirements for any future standardisation of XR device quality metrics.

4.4 OPEN-SOURCE SOFTWARE AND DATA REPOSITORIES

Open-source release is a key exploitation path in 6G-XR. The project adopts a dual strategy:

publishing project-owned code and datasets in public repositories (primarily under the SNS-JU / 6G-XR GitHub organisation), and

contributing improvements upstream to external open-source projects and foundations used by the consortium (e.g. CAMARA, GStreamer, QUINN).

This section summarises both aspects.

Open-source release is a **key exploitation path** in 6G-XR. To ensure long-term accessibility and visibility, several software components and datasets are made available under the **SNS-JU GitHub organisation**. As of late 2025, the organisation hosts **15 public repositories** directly related to 6G-XR. GitHub.

These repositories cover:

4.4.1 6G-XR repositories under the SNS-JU organisation

Several software components and datasets developed in 6G-XR are hosted in repositories under the SNS-JU GitHub organisation, ensuring long-term accessibility beyond the project lifetime. These repositories cover:

- Trial controller and node components (North Node, South Node and portal ecosystem), including:
    - a North Node adapter for AI-assisted slice resource optimisation in the energy-aware controller use case (North Node Adapter, NNA);
    - a South Node proxy to translate between trial controller interfaces and site-specific control planes;
    - dedicated web portals (South Node and Unified/North web portals) that support configuration, orchestration and monitoring of 6G-XR trials.
- Use-case datasets, such as the dataset generated for the remote rendering use case, providing logs and measurement data for further research and validation.
- Open Call project outputs, where selected Open Call teams have released their code in project-branded repositories (for example, energy monitoring/optimisation tools and QUIC/latency tools used in XR experiments).

These repositories are released under appropriate open-source licences (e.g. MIT, Apache-2.0, GPL-family, or other OSI-compliant licences as specified in each repository's LICENSE file). They constitute the primary vehicle for sustaining project-specific tools and datasets.

- **Core trial-controller and testbed components:**
    - 6gxr-nn-adapter – a North Node adapter used in the 6G-XR trial controller for AI-assisted resource optimisation.
    - 6gxr-north-node-digitaltwin – software for managing and exposing digital-twin capabilities at the North Node.
    - 6gxr-south-node-proxy – a South Node proxy that maps request formats between components of the 6G-XR architecture.
    - 6gxr-sn-web-portal and 6gxr-unified-north-web-portals – web portals that support the configuration and orchestration of trials in North and South nodes, including deployment guidance and automation scripts.
- **Use-case and dataset repositories:**
    - 6gxr-_uc1_remote_renderer_dataset – logs and data generated during the UC1 Remote Renderer validation experiments, released as an open dataset for further analysis.
- **Open Call projects:** Several repositories host the results of 6G-XR Open Call projects, e.g.:
    - 6g-xr_oc2_emseos – Energy Monitoring System for energy-efficiency optimisation and sustainability of multimedia VNFs.
    - 6g-remix-visualisation – visualisation tools for energy and load monitoring developed in the 6G-REMIX Open Call.
    - 6gxr-requiem, 6gxr-quinn, 6gxr-latency-clock, 6gxr-gst-plugins-rs – code and forks created in the REQUIEM Open Call, focusing on QUIC mobility support, latency measurement and multimedia transport.
    - Further information on Open-source repositories that are associated with open call projects can be found in the 6G-XR deliverable 7.1

4.4.2 Contributions to external open-source projects

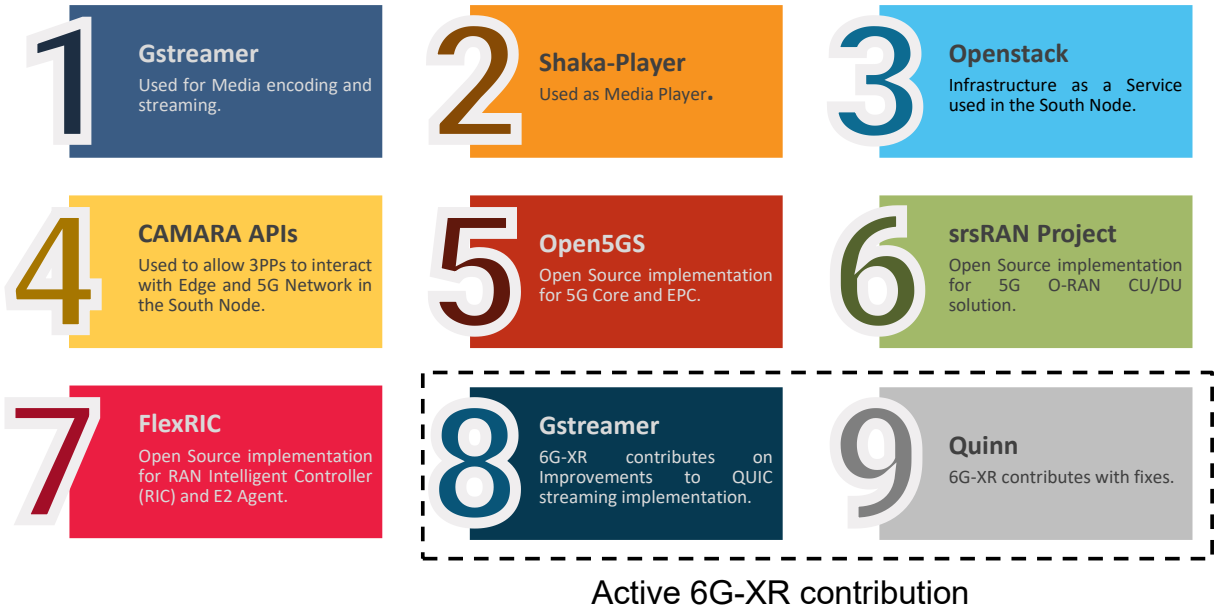

Figure 16: Summary of 6G-XR Open Source engagements.

In addition to releasing its own code, 6G-XR partners have contributed improvements to external open-source projects and foundations, as recorded in the 6G-XR Exploitation open-source sheet:

- **CGE → CAMARA (Linux Foundation/GSMA)**: Capgemini Engineering has contributed to the CAMARA Edge Cloud workstream by proposing and implementing changes to the Edge Discovery API (with follow-on work on the Traffic Influence API). These contributions, made as pull requests to the CAMARA Edge Cloud project, ensure that experience from 6G-XR's Edge-Cloud NaaS APIs is reflected in a widely adopted, operator-neutral API framework. This strengthens both CGE's product roadmap (via alignment with CAMARA APIs) and 6G-XR's impact on the wider ecosystem.

- **VICOM, REQUIEM Open Call, LCEVC-6G-XR Open Call → GStreamer, gst.wasm and QUINN**: VICOM and two open call projects (REQUIEM and LCEVC-6G-XR) have contributed upstream patches to:

    - **GStreamer**, via changes to gst-plugins-rs and gst-plugins-bad repositories, improving support of WebTransport/QUIC and DASH multimedia protocols for advanced transport scenarios;

    - **gst-wasm**, a WebAssembly port of GStreamer, though patches that enable web playback of LCEVC encoded streams over WebTransport;

    - **QUINN**, a Rust implementation of QUIC, through patches that enable experiment-driven features such as client mobility and latency measurement. The software developed during REQUIEM is maintained in the 6G-XR GitHub organisation, while selected patches have been submitted and merged into the official GStreamer and QUINN repositories. This ensures that 6G-XR-driven improvements benefit a broad developer community and will be maintained as part of mainstream open-source projects.

- **UOULU → North Node Adapter (NNA)**: The North Node Adapter (NNA), used to validate the AI-assisted network slice use case, is published as open source in the SNS-JU / 6G-XR GitHub organisation and is also mirrored in the University of Oulu's own version-control system. This dual hosting strategy both guarantees long-term availability under the project branding and allows the university to continue evolving the tool within its internal research infrastructure.

- **VICOM, CGE, I2CAT, ERI → South Node Adapter (SNA) and South Node Web Portal**: The South Node Adapter (SNA) and South Node Web Portal, used to validate Open Call 3 projects, are published as open source in the SNS-JU / 6G-XR GitHub organisation.

By contributing to these external projects, 6G-XR moves beyond standalone project repositories and directly enhances widely used open-source frameworks in multimedia processing, transport protocols and network APIs.

4.4.3 Exploitation strategy for open-source assets

The exploitation strategy for open-source assets both project-owned repositories and upstream contributions is threefold:

1. **Sustainability of project outputs:** Hosting software and datasets under the SNS-JU / 6G-XR organisation, and upstreaming relevant components (e.g. to CAMARA, GStreamer, gst.wasm, QUINN), ensures that the project's artefacts remain accessible and maintained by broader communities after the project ends.

2. **Ecosystem building and visibility:** By contributing to well-known projects (CAMARA, GStreamer, gst.wasm, QUINN) and releasing generic tools (e.g. NNA, trial control components), 6G-XR positions its results where developers already are, increasing the chances of reuse and feedback, and strengthening the project's visibility in the open-source and developer ecosystems.

3. **Commercial and research leverage:** Partners can build commercial offerings and future research on top of these open-source baselines—for instance, by providing supported, productised versions of the edge orchestration APIs, XR-aware congestion analytics, or trial-controller tooling, or by extending the upstreamed patches in proprietary solutions—while still benefiting from community maintenance and evolution of the underlying open-source projects.

Taken together, these actions ensure that open-source is not merely a dissemination channel but an active exploitation mechanism, enabling continued evolution, adoption and impact of 6G-XR results well beyond the project lifetime.

4.5 SUSTAINABILITY AND ESG CONSIDERATIONS

Sustainability in 6G-XR is addressed along three interconnected axes:

1. **Technical sustainability:** ensuring that the project's key software, datasets and methodologies remain accessible and usable after the project's end, primarily through open-source repositories (Section 4.4), public datasets, and detailed documentation in deliverables.

2. **Organisational and business sustainability:** supporting partners in integrating 6G-XR results into their strategies, product roadmaps and services, so that the project's work continues to evolve as part of their mainstream activities rather than standalone prototypes.

3. **ESG alignment**: embedding Environmental, Social and Governance considerations into exploitation plans and technology design, in line with the regulatory monitoring and AI-Act-oriented assessment described in Section 3.4. In practice, this means that, where relevant, partners take into account environmental aspects (e.g. energy consumption), social aspects (e.g. accessibility, user comfort, inclusiveness), and governance aspects (e.g. security-by-design, data-protection practices) when defining how they intend to exploit 6G-XR results.

Concrete examples of ESG-linked exploitation include:

- **Energy-efficiency enablers** such as the Energy-Aware and QoS-Driven E2E Controller and the EMSEOS Open Call outcome (6g-xr_oc2_emseos), which directly address energy monitoring and optimisation for multimedia VNFs and XR workloads.

- **XR device quality and user comfort** innovations (e.g. XR inspection tools, depth-consistency improvements) that mitigate VR sickness and improve usability, contributing to social sustainability.

- **Security and data protection** considerations integrated into trial controller components and APIs (e.g. South Node proxy, portals, NaaS APIs), which factor in secure exposure of network capabilities and privacy-preserving data collection.

These ESG aspects are reflected in partner-level exploitation plans, helping to ensure that future products and services based on 6G-XR results support green, inclusive and trustworthy 6G/XR deployments.

4.6 PATENTS AND INTELLECTUAL PROPERTY MANAGEMENT

Patents and broader intellectual property rights (IPR) are an important dimension of the 6G-XR exploitation strategy. In line with the Description of Action and the Task 8.3 mandate, partners have considered patenting as a potential exploitation route for selected innovations, in addition to product and service development, standardisation contributions and open-source releases.

To support this, 6G-XR maintained a dedicated patents table in the exploitation register, where partners report any patent applications directly linked to 6G-XR results. This sheet records, for each item, at least the partner, title or short description, technology area, filing status and relation to project innovations.

Based on the information reported by partners in this tracker, several patent applications have been filed or prepared during the project lifetime, covering topics such as:

- advanced networking and orchestration mechanisms (e.g. edge–cloud continuum management, QoS/QoD-aware control, energy-aware service orchestration);
- immersive XR capture and rendering techniques (e.g. plenoptic/Depth capture, inspection and calibration tools);
- radio and hardware innovations (e.g. sub-THz front-end and channel modelling methods);

- AI/ML-assisted control and analytics components relevant for 6G-ready infrastructures.

Table 5 provides an overview of the patent activities recorded in the exploitation tracker during 6G-XR, as reported by the partners.

Table 5: Reported IPR

Partner	Patent title/short description	Application #	Jurisdiction	Priority Date	Link to 6G-XR innovation(s) / WP(s)
IDE	CORE NETWORK DEVICES ASSOCIATED WITH PDU SESSION RELEASE OR RE-ESTABLISHMENT	PCT/US2024/028319	US	11-May-23	WP3
IDE	Multiplexing and Differentiating PDU Set Flows	PCT/US2024/039015	US	25-Jul-23	WP3
IDE	METHOD AND NETWORK NODE FOR DELAY-AWARE SCHEDULING FOR PROTOCOL DATA UNIT (PDU) SET FLOWS	PCT/US2024/036584	US	26-Jul-23	WP3
IDE	HANDLING DYNAMIC CHANGES IN TRAFFIC PATTERNS IN THE DL	63/541,172	US	28-Sep-23	WP3
IDE	Handling Dynamic Changes in Traffic Patterns in the DL	63/541,176	US	28-Mar-25	WP3
IDE	SUPPORTING PACKET DATA UNIT SET BASED HANDLING OVER NON-3GPP ACCESS	PCTUS2025014600	US	12-Feb-24	WP3
IDE	Synchronization of Sensing Operations and Connection Management States	24160661.5	EP	29-Feb-24	WP4
IDE	METHODS, ARCHITECTURES, APPARATUSES AND SYSTEMS FOR SYNCHRONIZATION OF SENSING OPERATIONS AND CONNECTION MANAGEMENT STATES	PCTUS2025015589	US	29-Feb-24	WP4

IDE	Association of Sensor Streams and Coordination of Sensor Operations for Synchronous Sensor Fusion	63/562,423	US	7-Mar-24	WP4
IDE	SYSTEM AND METHODS FOR ANALYTICS BASED PDU SET FEATURE ACTIVATION	PCTUS2025027241	US	16-May-24	WP3
IDE	PROVIDING INFORMATION ABOUT MULTI-MODAL SERVICES TO A RAN	18905943	US	3-Oct-24	WP3
IDE	METHODS FOR DETECTING UNDESIRABLE DEVICES WITH LOCATION TRACKING (DLT) CAPABILITIES IN A MOBILE NETWORK	19054004	US	14-Feb-25	WP3
IDE	UL BITRATE CONTROL WITH MOBILITY SUPPORT	19202138	US	8-May-25	WP3
IDE	Notifying UE over 5G network to receive 6G network Data	202500483	US		WP4
IDE	PDU Set Size Error Calculation and Reporting	19/298,877	US	13-Aug-25	WP3
IDE	WTRUS ASSOCIATED WITH PDU SESSION RELEASE OR RE-ESTABLISHMENT	63465664	US	11-May-23	WP3
IDE	ACCESS NETWORK DEVICES ASSOCIATED WITH PDU SESSION RELEASE OR REESTABLISHMENT	63465671	US	11-May-23	WP3
IDE	ACCESS AND CORE NETWORK DEVICES ASSOCIATED PDU SESSION RELEASE OR RE-ESTABLISHMENT	63465681	US	11-May-23	WP3
IDE	METHOD AND WIRELESS TRANSMIT/RECEIVE UNIT (WTRU) FOR DELAY-AWARE SCHEDULING FOR PROTOCOL DATA UNIT (PDU) SET FLOWS	63529087	US	26-Jul-23	WP3

ERI	Subscriber node, internet protocol multimedia subsystem node, event subscriber node and methods in a communication network	WO2025159685A1			IMSDC enabler WP2
ERI	Method of conveying network function's event capabilities to network function repositories/subscriber repositories	WO2025158377A1			IMSDC enabler WP2

These patent activities illustrate that some of the most mature and commercially promising 6G-XR results are being protected as IPR, in line with the partners' individual exploitation strategies described in the DoA. In parallel, many other results have followed open dissemination routes (scientific publications, standardisation contributions, open-source releases), reflecting a deliberate balance between open ecosystem impact and selective protection of key assets.

The project's IPR management framework, as defined in the Consortium Agreement and reflected in the exploitation tracker, remains applicable to these patent activities. Ownership of patentable results follows the foreground/background principles; any joint inventions are handled under the joint ownership provisions. Partners may also decide to file additional patent applications beyond the project end based on 6G-XR foreground or side-ground; such actions will be governed by the same principles and can further extend the impact and commercial value of the project's innovations.

4.7 POST-PROJECT CONTINUITY AND RISK MITIGATION

To maximise continuity beyond M36, the consortium has identified a set of post-project actions:

- continued maintenance (at least on a best-effort basis) of key GitHub repositories under the SNS-JU organisation;
- use of the 6G-XR trial controller and associated tools as a reference platform in future SNS JU projects and bilateral collaborations;
- follow-up joint R&I proposals that build on 6G-XR results (in areas such as XR over 6G, energy-efficient networking, THz communications, and AI-assisted orchestration);
- ongoing contributions to relevant SDOs, leveraging 6G-XR innovations and experimental evidence.

Potential risks to exploitation and sustainability (e.g. lack of manpower for maintaining open-source assets, shifts in partner priorities, or changes in regulatory requirements) are mitigated by:

- distributing responsibilities across multiple partners for key assets (e.g. repositories with more than one maintainer);
- ensuring that knowledge is captured in documentation and publications, not only in code;

- designing exploitation paths that do not rely on a single funding source or single project (e.g. integrating results into existing commercial products or long-term research lines);
- monitoring regulatory developments beyond the project end, so that partners can adapt their exploitation strategies as needed.

In summary, the exploitation and sustainability plan ensures that 6G-XR's technical results, software artefacts, and know-how are not only successfully demonstrated during the project but are also positioned for continued use, evolution and impact in the wider 6G and XR ecosystem.

5 CONCLUSIONS

This deliverable has provided a consolidated view of 6G-XR's activities and achievements in communication and dissemination (T8.1), standardisation and regulation (T8.2), and exploitation and sustainability planning (T8.3), over the full duration of the project. It updates and complements the initial strategy set out in D8.1 by reporting concrete actions, measurable outcomes, and their alignment with the project's objectives and KPIs, as defined in the Description of Action and WP8 planning.

On the communication and dissemination side, 6G-XR has established a strong and recognisable presence in the European 6G ecosystem. A coherent visual identity, a well-maintained project website, and active social media channels underpinned continuous outreach to researchers, industry stakeholders, policymakers, and the wider public. The website served as the primary hub for project information, Open Calls, and public deliverables, attracting substantial and sustained traffic and downloads over the project lifetime. Participation in high-impact conferences, SNS JU events, and specialised workshops ensured that 6G-XR's technical results and trial outcomes were visible to key communities, while targeted campaigns successfully supported the three Open Calls and the Final Impact Day.

In the area of standardisation and regulation, 6G-XR has moved from initial mapping and planning to tangible, traceable impact. A structured SDO tracking process and a maintained standardisation roadmap enabled systematic engagement with 3GPP (SA1/SA2/RAN1/RAN2), ETSI (ISG ISAC, RRS, THz), CAMARA and relevant industry fora, resulting in 27 documented standardisation-related contributions attributable to the project across multiple partners and technical themes. These contributions cover XR traffic handling, QoS/QoD exposure, sensing architectures, sub-THz channel modelling, and software-reconfigurable radios, among others, and are closely linked to the project's innovations. In parallel, T8.2 established a regulatory monitoring and awareness process, notably around the EU AI Act, Cyber Resilience Act and Data Act, including internal training and an AI Act-oriented assessment of project results. This provides an informed foundation for future industrialisation of 6G-XR technologies in a tightening regulatory environment.

Exploitation and sustainability planning have been addressed through a combination of innovation tracking, partner-level exploitation plans, open-source releases, patent activities and ESG considerations. The exploitation register and innovation opportunity documents capture a broad portfolio of exploitable results, from trial-controller components and XR enablers to sub-THz radio developments and energy-aware control solutions, together with concrete exploitation routes at partner level (products, services, further research, standardisation). Open-source has been used as a major vehicle for sustaining impact, with multiple software components and datasets released under the SNS-JU / 6G-XR GitHub organisation and additional contributions upstream to external open-source projects. Patent activities recorded in the exploitation tracker demonstrate that selected high-value results are also being protected as IPR, complementing the open and standards-oriented routes. Finally, sustainability and ESG aspects have been addressed through dedicated analysis, linking 6G-XR's technical work with environmental efficiency, responsible AI use and resilient digital infrastructures.

Overall, the work reported in D8.2 shows that 6G-XR has effectively delivered on its WP8 objectives: it has provided high-visibility communication and dissemination for the project, contributed substantially to the evolution of relevant standards and regulatory discussions, and laid credible foundations for the exploitation and long-term sustainability of its results. The established research infrastructure, open-source artefacts, standardisation footholds and emerging IPR portfolio give partners and third parties concrete assets to build upon after the end of the project. Continued engagement in SDOs and industry fora, maintenance and evolution of open-source repositories, and

follow-up exploitation of the identified innovations are expected to carry forward the impact of 6G-XR beyond the project's lifetime, reinforcing Europe's position in 6G and XR technologies.

REFERENCES

[1] Environmental, social, and governance, Wikipedia, available at https://en.wikipedia.org/wiki/Environmental,_social,_and_governance

[2] Who cares wins, 2004, United Nations

[3] COMMUNICATION FROM THE COMMISSION: The European Green Deal, COM(2019) 640 final, 11th December 2019, available at eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640

[4] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS European Climate Pact, European Commission, 9th December 2020, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2020%3A788%3AFIN

[5] The European Climate Pact, European Commission, available at https://climate-pact.europa.eu/index_en

[6] The Paris Agreement, United Nations, available at https://www.un.org/en/climatechange/paris-agreement

[7] The European Green Deal Striving to be the first climate-neutral continent, European Commission, available at https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

[8] ETSI EN 301 549 V3.2.1 (2021-03), Accessibility requirements for ICT products and services, available at https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.02.01_60/en_301549v030201p.pdf

[9] WHAT DOES "INCLUSIVE GOVERNANCE" MEAN? CLARIFYING THEORY AND PRACTICE, Organisation for Economic Co-operation and Development (OECD), March 2020, available at https://www.oecd.org/content/dam/oecd/en/publications/reports/2020/03/what-does-inclusive-governance-mean_8b38bb2b/960f5a97-en.pdf

[10] ESG: A comprehensive guide to the main principles, The Corporate Governance Institute, available at https://www.thecorporategovernanceinstitute.com/insights/guides/esg-a-comprehensive-guide-to-environmental-social-and-governance-principles/

APPENDIX A: QUESTIONNAIRE ON AI ACT AND ESG REQUIREMENTS

The present appendix includes the questionnaire which was developed by 6G-XR and used within the project to perform an assessment on potential compliance issues with respect to the European AI Act and Environmental, Social and Governance (ESG) best practices. A novel methodology was introduced which binds the ESG assessment closely to the European Union Green Deal.

Questionnaire for assessing 6G-XR project results with respect to the EU AI Act & ESG requirements

Intel Deutschland GmbH has given a training related to recent EU Legislations to 6G-XR in the context of the Oulu, Finland 6G-XR project meeting on 30th January 2025. Among multiple new legislations (including the Cyber Resilience Act, the activation of new articles of the Radio Equipment Directive, the Data Act, the EU AI Atc, etc.), it was agreed that 6G-XR will specifically consider new market access requirements introduced by the EU AI Act. The present document includes a questionnaire which will be provided to 6G-XR Working Packages to identify any potential issues with respect to the recently published European AI Act (*specifically related to forbidden practices and requirements for High-Risk AI Systems*). The questionnaire and the underlying methodology has been newly developed by 6G-XR and represent one of the project results.
Also, the original 6G-XR project proposal includes the following: Task T8.3 *will also identify the latest Environmental, Social and Governance (ESG) standardization and best practices. It will then develop a consolidated report on how the project activities and developed technologies are carried out considering the ESG guidelines*. The 6G-XR project has studied available – rather commercial – ESG assessment bodies and methodologies where is typically tailored to industrial activities. We have decided to define a novel and innovative methodology which is – in the view of 6G-XR – better aligned to the research framework and closely aligned to the European Union Green Deal. A corresponding questionnaire is provided in the present document to be given to all 6G-XR Working Packages to assess potential issues.

A. European AI Act requirements

I. Introduction

In July 2024, the European Union Artificial Intelligence Act (EU AI Act) [1] was published in the Official Journal of the European Union. It is a major regulation governing the access to the European Union Single Market for Artificial Intelligence (AI) systems. A general introduction is provided in [2] and potential implementation solutions meeting the requirements of so-called “High Risk” AI systems are discussed in [3].
As outlined in [2], The EU AI Act applies a risk-based approach to AI – with the term risk to be understood in relation to health, safety and fundamental rights. In the context of the AI Act, we thus apply a very specific and narrow meaning of risk. For AI systems, the following 4-step classification approach is applied as outlined in [3] and illustrated below:

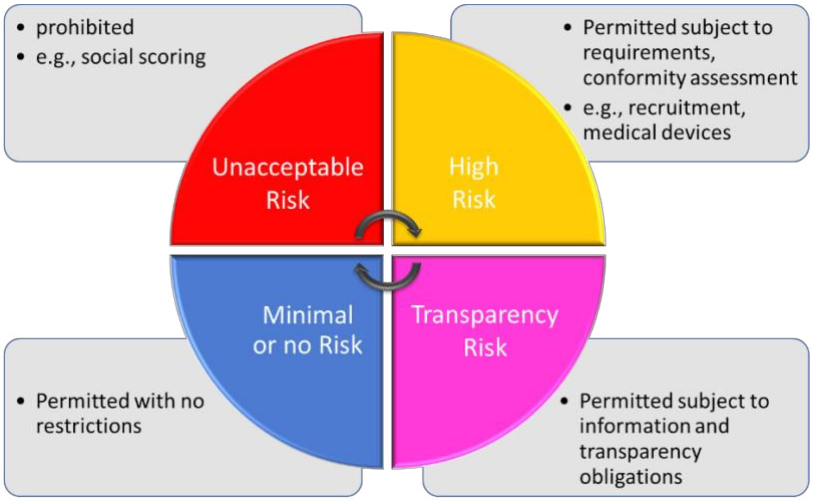

Figure 1: Risk based approach to regulating AI systems [2].

In the present document, we propose a self-assessment-based methodology that allows for determining whether

i) A concerned AI System may fall under the "*prohibited practices*" of the EU AI Act [1] and thus pose an unacceptable risk. Obviously, such a system is not authorised to be placed on the European Union market

ii) Whether a concerned AI System fulfils the requirements of the "High Risk" category as defined in the EU AI Act [1].

Concerning item ii) above, we choose not to offer a methodology for assessing whether or not a equipment in question falls under the "High Risk" category. Especially for Cellular Communications Infrastructure there is still some level of ambiguity which part of it (or the system as a whole) may be considered "High Risk". Recently, the European Commission has provided a draft input to the Expert Group Radio Equipment which discusses possible clarifications [4]. When the present document was drafted, the corresponding debate was still ongoing and needs thus to be further monitored. Still, whether or not equipment in question formally needs to comply with the "High Risk" requirements introduced by the EU AI Act, compliance with those requirements may be useful even on a voluntary basis. The reason is that those requirements lead to a high level of quality assurance of the underlying operational principles, such as relevance of training data used for generating AI models, avoidance of biases, etc. Users may indeed prefer products which satisfy those requirements rather than alternatives which do not. The questionnaire presented below is thus considered to be of relevance of any AI system and not limited to those which formally fall under the "High Risk" category.
Note that the methodology proposed in the present document is a draft proposal for further discussion. It DOES NOT provide legal certainty for assessing whether or not equipment in question falls under a certain category or fulfills certain requirements of the EU AI Act.

II. Prohibited Practices

CHAPTER II (PROHIBITED AI PRACTICES), Article 5 (Prohibited AI practices) of the EU AI Act introduces which *AI practices shall be prohibited*. The following questionnaire is designed for self-assessment whether a concerned AI equipment may fall under the "prohibited practices".
Note that the questionnaire below does not provide any legal certainty. It is designed to initiate discussions on how to conduct an assessment related to prohibited practices.

☐	Does the AI system deploy subliminal techniques beyond a person's consciousness or purposefully manipulative or deceptive techniques, with the objective, or the effect of materially distorting the behaviour of a person or a group of persons by appreciably impairing their ability to make an informed decision, thereby causing them to take a decision that they would not have otherwise taken in a manner that causes or is reasonably likely to cause that person, another person or group of persons significant harm?
☐	Does the AI system exploit any of the vulnerabilities of a natural person or a specific group of persons due to their age, disability or a specific social or economic situation, with the objective, or the effect, of materially distorting the behaviour of that person or a person belonging to that group in a manner that causes or is reasonably likely to cause that person or another person significant harm?
☐	Is the AI systems used for the evaluation or classification of natural persons or groups of persons over a certain period of time based on their social behaviour or known, inferred or predicted personal or personality characteristics, with the social score leading to either or both of the following: I. detrimental or unfavourable treatment of certain natural persons or groups of persons in social contexts that are unrelated to the contexts in which the data was originally generated or collected and/or II. detrimental or unfavourable treatment of certain natural persons or groups of persons that is unjustified or disproportionate to their social behaviour or its gravity?
☐	Is the AI system used for making risk assessments of natural persons in order to assess or predict the risk of a natural person committing a criminal offence, based solely on the profiling of a natural person or on assessing their personality traits and characteristics; this prohibition shall not apply to AI systems used to support the human assessment of the involvement of a person in a criminal activity, which is already based on objective and verifiable facts directly linked to a criminal activity?
☐	Is the AI system used to create or expand facial recognition databases through the untargeted scraping of facial images from the internet or CCTV footage?
☐	Is the AI system used to infer emotions of a natural person in the areas of workplace and education institutions, except where the use of the AI system is intended to be put in place or into the market for medical or safety reasons?

☐	Does the AI system correspond to biometric categorisation systems that categorise individually natural persons based on their biometric data to deduce or infer their race, political opinions, trade union membership, religious or philosophical beliefs, sex life or sexual orientation; this prohibition does not cover any labelling or filtering of lawfully acquired biometric datasets, such as images, based on biometric data or categorizing of biometric data in the area of law enforcement?
☐	Does the AI system make use of 'real-time' remote biometric identification systems in publicly accessible spaces for the purposes of law enforcement, unless and in so far as such use is strictly necessary for one of the following objectives: I. the targeted search for specific victims of abduction, trafficking in human beings or sexual exploitation of human beings, as well as the search for missing persons; II. the prevention of a specific, substantial and imminent threat to the life or physical safety of natural persons or a genuine and present or genuine and foreseeable threat of a terrorist attack; III. the localisation or identification of a person suspected of having committed a criminal offence, for the purpose of conducting a criminal investigation or prosecution or executing a criminal penalty for offences referred to in Annex II and punishable in the Member State concerned by a custodial sentence or a detention order for a maximum period of at least four years?

Note that the EU AI Act, Chapter II, Article 5, items 2-8 provide some further details, for example relating to the *use of 'real-time' remote biometric identification systems in publicly accessible spaces for the purposes of law enforcement*. Those items need to be considered in combination with the upper proposed assessment methodology.
In case that any of the upper boxes are "ticked", the concerned AI system is likely to fall under the "prohibited practices" and may thus not be placed on the market, put into service or used.

III. Requirements of High-Risk Systems

The EU AI Act, CHAPTER III (HIGH RISK AI SYSTEMS), SECTION 1 (Classification of AI systems as High Risk), Article 6 (Classification rules for High-Risk AI systems) defines under which conditions an AI system is considered "High Risk". As discussed above, there is some ambiguity still to be resolved – as also further discussed in [2]. Therefore, the present section focuses on the question whether a concerned AI System is or is not meeting the requirements of a "High Risk" AI System under the EU AI Act.
The EU AI Act, CHAPTER I (GENERAL PROVISIONS), Article 3 (Definitions) introduces the following definition on conformity assessment for "High Risk" AI Systems:

'Conformity assessment' means the process of demonstrating whether the requirements set out in Chapter III, Section 2 relating to a high-risk AI system have been fulfilled;

The EU AI Act, CHAPTER III (HIGH-RISK AI SYSTEMS), SECTION 2 (Requirements for high-risk AI systems) indeed consists of Article 8 to Article 15 introducing related requirements. This is complemented by SECTION 3 (Obligations of providers and deployers of high-risk AI systems and other parties).
Key technical requirements are summarized by the following illustration proposed in [2]:

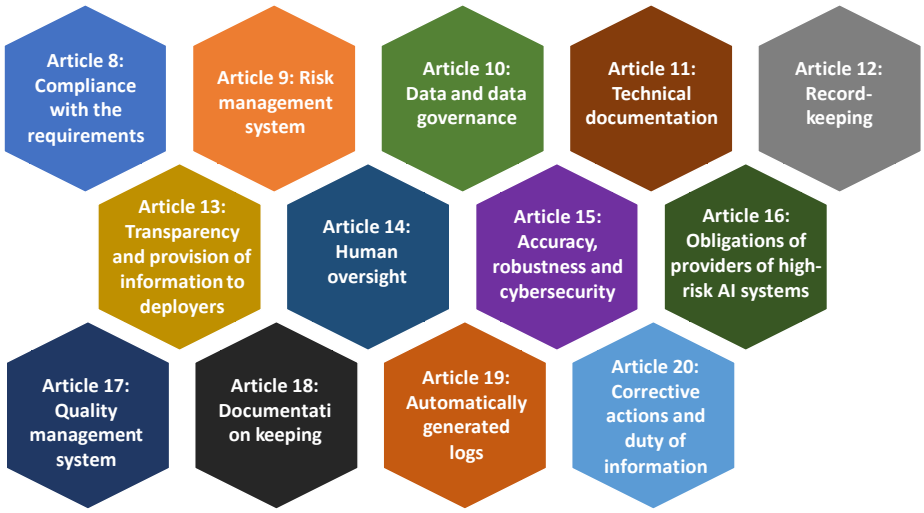

Figure 2: Summary of technical Articles of the EU AI Act [1, 2].

The following questionnaire introduces a self-assessment of key technical requirements introduced by the Articles 8 to 27 of CHAPTER III (HIGH RISK AI SYSTEMS) of the EU AI Act. Note that those items are not designed to provide legal certainty but are rather proposed for further discussion. For product compliance assessment, strict compliance to the EU AI Act needs to be ensured.

☐	Is a risk management system shall be established, implemented, documented and maintained in relation to high-risk AI systems as defined in Chapter III, Article 9? Is it ensured that the relevant residual risk associated with each hazard, as well as the overall residual risk of the high-risk AI systems is judged to be acceptable? Has the High-risk AI systems been tested for the purpose of identifying the most appropriate and targeted risk management measures?
☐	Are training, validation and testing data sets compliant to data governance and management practices appropriate for the intended purpose of the high-risk AI system as defined in Chapter III, Article 10 (for example including appropriate measures to detect, prevent and mitigate possible biases, assessment of the availability, quantity and suitability of the data sets that are needed, etc.)? Are training, validation and testing data sets relevant, sufficiently representative, and to the best extent possible, free of errors and complete in view of the intended purpose? Do data sets take into account, to the extent required by the intended purpose, the characteristics or elements that are particular to the specific geographical, contextual, behavioural or functional setting within which the high-risk AI system is intended to be used?
☐	Has the technical documentation of a high-risk AI system been drawn up before that system is placed on the market or put into service and shall be kept up-to date as defined in Chapter III, Article 11?
☐	Does the High-risk AI systems technically allow for the automatic recording of events (logs) over the lifetime of the system as defined by Chapter III, Article 12 (for example to help identifying situations that may result in the high-risk AI system presenting a risk, to facilitate the post-market monitoring, etc.)?
☐	Has the High-risk AI systems been designed and developed in such a way as to ensure that their operation is sufficiently transparent to enable deployers to interpret a system's output and use it appropriately as defined by Chapter III, Article 13? Is the High-risk AI systems accompanied by instructions for use in an appropriate digital format or otherwise that include concise, complete, correct and clear information that is relevant, accessible and comprehensible to deployers?
☐	Has the High-risk AI systems been designed and developed in such a way, including with appropriate human-machine interface tools, that they can be effectively overseen by natural persons during the period in which they are in use as defined by Chapter III, Article 14 (for example allowing a human supervisor to correctly interpret the high-risk AI system's output, etc.)?
☐	Has the High-risk AI system been designed and developed in such a way that it achieves an appropriate level of accuracy, robustness, and cybersecurity, and that they perform consistently in those respects throughout their lifecycle as defined by Chapter III, Article 15 (for example, the High Risk AI system

	shall be resilient against attempts by unauthorised third parties to alter their use, outputs or performance by exploiting system vulnerabilities, etc.)?

In case that any of the above-mentioned criteria do not apply to the AI System concerned, it may not comply with the requirements of a High-Risk AI System according to the EU AI Act.

B. Assessment of 6G-XR with respect to ESG requirements

I. Introduction

As explained in [5], the term *Environmental, Social and Governance (ESG)* principles initially attracted substantial attention following a report by the United Nations entitled "*Who Cares Wins*" [6]. In the meantime, the ESG movement has grown to a global phenomenon and ESG report has become common practice. In this context, organizations provide financial and non-financial data for evaluation according to standards by agencies such as the Sustainability Accounting Standards Board, the Global Reporting Initiative, and the Task Force on Climate-related Financial Disclosures [7].

In the present document, we take an innovative approach to ESG related assessment and disclosure. The main idea is evaluating project activities according to the following:

- To which extent are project activities and results contributing to the European Union Green Deal?
- To which extent are we able to address Social requirements, specifically focusing on Accessibility requirements for disabled persons?

We believe that the upper objectives are well suited for the evaluation of a research project and will be useful to position the impact of the project in the broader Environmental and Social Context.

II. The European Union Green Deal

The Communication of the Commission of 11th December 2019 has officially introduced the *European Green Deal* [8]. Considering current climate challenges, it is understood to be a generational task to *transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use*. In this communication, the European Commission furthermore announces the launch of a European Climate Pact, a corresponding communication was issued on 9th December 2020 [9-10]. The Pact should be understood as a *Commission initiative to engage with different stakeholders and civil society with the aim to commit them to climate action and more sustainable behaviour*.

Furthermore, the European Green deal is positioned within related global initiatives. The European Union will take the role of a global leader, advocating related actions and objectives in other regions. This includes the *intention to ensure that the Paris Agreement remains the indispensable multilateral framework for tackling climate change* [7, 10]. The European union targets the establishment of bilateral engagement with partner countries, with a specific focus on the G7 and G20 as key

stakeholders. The 2020 EU-China summits in Beijing and Leipzig, and the 2020 summit between the African Union and the EU are identified as additional opportunities to influence global debates.

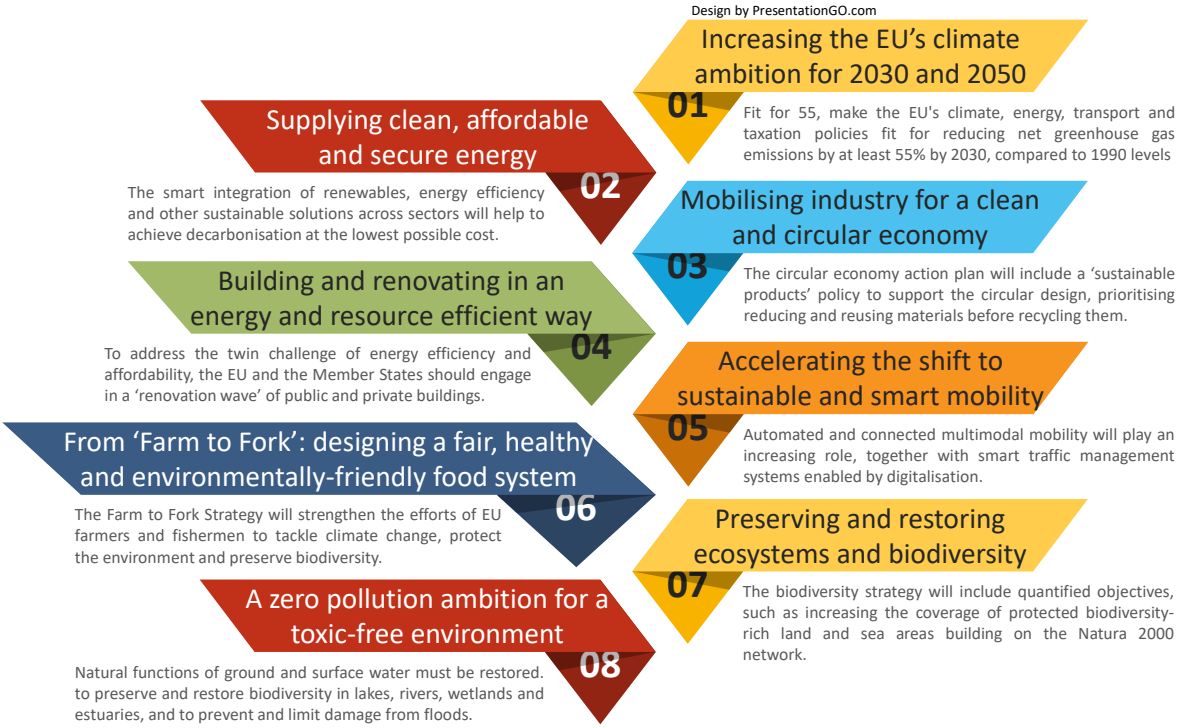

Figure 17: Designing a set of (eight) deeply transformative policies [5].

In this context, the Communication of the Commission [7] introduces the specific need for

1. Designing a set of (eight) deeply transformative policies and
2. (A set of five) initiatives for mainstreaming sustainability in all EU policies.

The initiatives on designing a set of (eight) deeply transformative policies are summarized in Figure 19. Initiatives for mainstreaming sustainability in all EU policies are summarized in Figure 20.

Figure 18: (A set of five) initiatives for mainstreaming sustainability in all EU policies [7].

Since the initial presentation of the European Green Deal on 11th December 2019, a substantial number have been taken over time and more will follow [11].

III. Accessibility Requirements

It is proposed to base an evaluation on Accessibility Requirements on **ETSI EN 301 549: Accessibility requirements for ICT products and services** [12].

Annex C of **ETSI EN 301 549** details conformity assessment, key related requirements are summarized below:

- Usage without vision
- Usage with limited vision
- Usage without perception of colour
- Usage without hearing
- Usage with limited hearing
- Usage with no or limited vocal capability
- Usage with limited manipulation or strength
- Usage with limited reach
- Minimize photosensitive seizure triggers
- Usage with limited cognition, language or learning

Technical requirements supporting the upper items are detailed throughout **ETSI EN 301 549.**

IV. Governance Requirements

In terms of Governance, we propose to focus on the requirements of an "inclusive Governance" approach as detailed by OECD [13] and the broad concepts of "Good Governance" detailed by the The Corporate Governance Institute and adapted to the context of a research project:

- Board structure: Having a diverse and independent advisory board.
- Transparency: Transparent reporting and disclosures to give stakeholders accurate ESG performance data.
- Ethics: Having a strong code of ethics and encouraging ethical behaviour.
- Accountability: Companies must be accountable to stakeholders for their ESG performance.

V. ESG related questionnaires to all 6G-XR WPs

All 6G-XR WPs are invited to respond to the questionnaires below.

1. Relevance of 6G-XR WPs to support the European Union Green Deal policy objectives

☐	Support of EU Green Deal policy on increasing the EU's climate ambition for 2030 and 2050
☐	Support of EU Green Deal policy on supplying clean, affordable and secure energy
☐	Support of EU Green Deal policy on Mobilising industry for a clean and circular economy
☐	Support of EU Green Deal policy on building and renovating in an energy and resource efficient way
☐	Support of EU Green Deal policy on accelerating the shift to sustainable and smart mobility
☐	Support of EU Green Deal policy on from 'farm to fork': designing a fair, healthy and environmentally-friendly food system
☐	Support of EU Green Deal policy on preserving and restoring ecosystems and biodiversity
☐	Support of EU Green Deal policy on a zero pollution ambition for a toxic-free environment

2. Relevance of 6G-XR WPs to support the European Union Green Deal initiatives for mainstreaming sustainability in all EU policies

☐	Support of EU Green Deal initiative on pursuing green finance and investment and ensuring a just transition
☐	Support of EU Green Deal initiative on green national budgets and sending the right price signals
☐	Support of EU Green Deal initiative on mobilising research and fostering innovation
☐	Support of EU Green Deal initiative on activating education and training
☐	Support of EU Green Deal initiative on a green oath: 'do not harm'

3. Accessibility requirements

All 6G-XR WPs are invited to assess their results for usage with respect to accessibility requirements as listed below.

☐	Usage without vision
☐	Usage with limited vision
☐	Usage without perception of colour
☐	Usage without hearing
☐	Usage with limited hearing
☐	Usage with no or limited vocal capability
☐	Usage with limited manipulation or strength

☐	Usage with limited reach
☐	Minimize photosensitive seizure triggers
☐	Usage with limited cognition, language or learning

4. Governance Requirements

Governance requirements are rather established on a project level (and not WP level). The 6G-XR PMT is thus invited to respond to the following questionnaire:

☐	Board structure: Having a diverse and independent advisory board.
☐	Transparency: Transparent reporting and disclosures to give stakeholders accurate ESG performance data.
☐	Ethics: Having a strong code of ethics and encouraging ethical behaviour.
☐	Accountability: Companies must be accountable to stakeholders for their ESG performance.

Bibliography

[1] REGULATION (EU) 2024/1689 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act), available at https://eur-lex.europa.eu/eli/reg/2024/1689/oj/eng

[2] European Digital Regulation, Markus Mueck & Christophe Gaie, Springer Nature Book, ISBN 978-3-031-80808-1, to appear in March 2025

[3] Upcoming European Regulations on Artificial Intelligence and Cybersecurity, Markus Dominik Mueck & Amit Elazari Bar On & Stephane Du Boispean, IEEE Communications Magazine, Volume: 61, Issue: 7, July 2023

[4] INTERPLAY BETWEEN THE RADIO EQUIPMENT DIRECTIVE AND THE ARTIFICIAL INTELLIGENCE ACT, EUROPEAN COMMISSION DIRECTORATE-GENERAL FOR INTERNAL MARKET, INDUSTRY, ENTREPRENEURSHIP AND SMES, submission to 19th EC Expert Group Radio Equipment, EG RE (19)21, 2024, available at https://circabc.europa.eu/ui/group/43315f45-aaa7-44dc-9405-a86f639003fe/library/bdfad6eb-8934-4b55-865d-ecda2695f2d5?p=1&n=10&sort=modified_DESC

[5] Environmental, social, and governance, Wikipedia, available at https://en.wikipedia.org/wiki/Environmental,_social,_and_governance

[6] Who cares wins, 2004, United Nations

[7] COMMUNICATION FROM THE COMMISSION: The European Green Deal, COM(2019) 640 final, 11th December 2019, available at eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640

[8] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS European Climate Pact, European Commission, 9th December 2020, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2020%3A788%3AFIN

[9] The European Climate Pact, European Commission, available at https://climate-pact.europa.eu/index_en

[10] The Paris Agreement, United Nations, available at https://www.un.org/en/climatechange/paris-agreement

[11] The European Green Deal Striving to be the first climate-neutral continent, European Commission, available at https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

[12] ETSI EN 301 549 V3.2.1 (2021-03), Accessibility requirements for ICT products and services, available at https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.02.01_60/en_301549v030

201p.pdf

[13] WHAT DOES "INCLUSIVE GOVERNANCE" MEAN? CLARIFYING THEORY AND PRACTICE, Organisation for Economic Co-operation and Development (OECD), March 2020, available at https://www.oecd.org/content/dam/oecd/en/publications/reports/2020/03/what-does-inclusive-governance-mean_8b38bb2b/960f5a97-en.pdf

[14] ESG: A comprehensive guide to the main principles, The Corporate Governance Institute, available at https://www.thecorporategovernanceinstitute.com/insights/guides/esg-a-comprehensive-guide-to-environmental-social-and-governance-principles/

6 ANNEX

6.1 SUSTAINABILITY PLAN: A NEW APPROACH ON ENVIRONMENTAL, SOCIAL AND GOVERNANCE (ESG) PRINCIPLES

As explained in [1], the term *Environmental, Social and Governance (ESG)* principles initially attracted substantial attention following a report by the United Nations entitled "*Who Cares Wins*" [2]. In the mean-time, the ESG movement has grown to a global phenomenon and ESG report has become common practice. In this context, organizations provide financial and non-financial data for evaluation according to standards by agencies such as the Sustainability Accounting Standards Board, the Global Reporting Initiative, and the Task Force on Climate-related Financial Disclosures [1].

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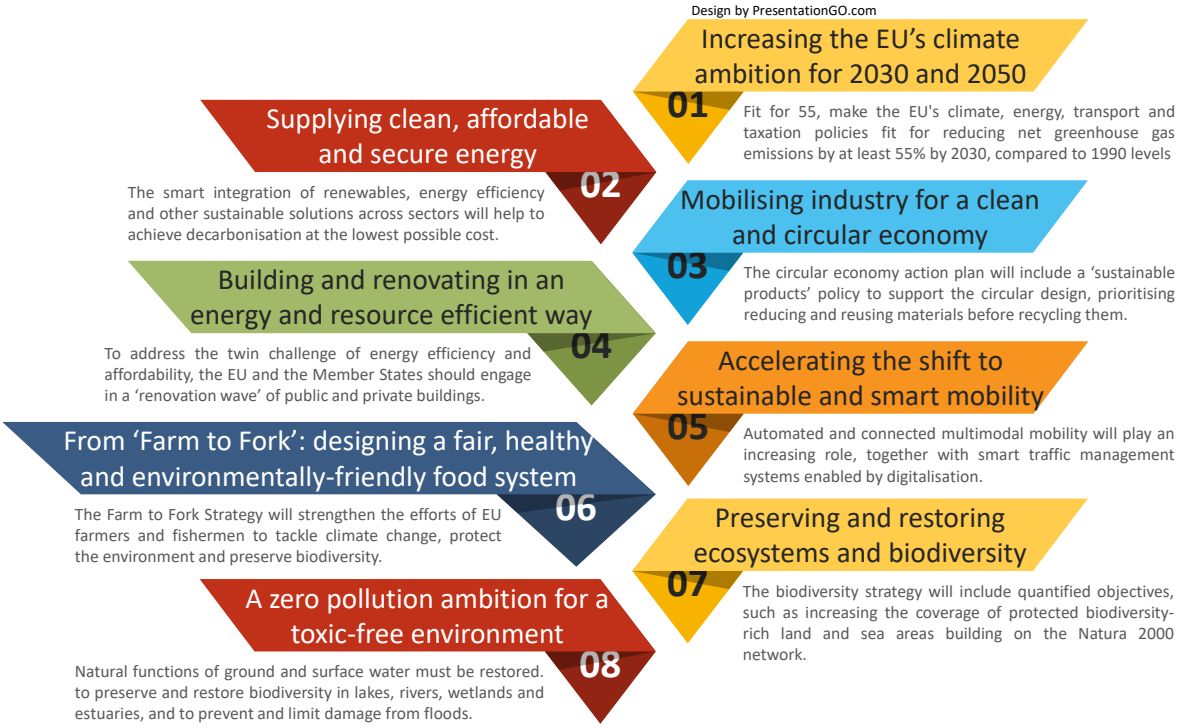

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