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XTIC
EXPERIENTIAL TECHNOLOGY INNOVATION CENTRE

A perspective on **European Union's Web 4.0 and Virtual Worlds Strategy**

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Executive Summary

The European Commission's 2023 communication, "An EU initiative on Web 4.0 and virtual worlds: a head start in the next technological transition," outlines a transformative roadmap for Europe's leadership in the next evolution of the internet. It envisions a human-centric, open, secure, and values-driven Web 4.0 ecosystem that seamlessly integrates physical and digital realities through advanced technologies such as extended reality (XR), artificial intelligence (AI), blockchain, and the Internet of Things (IoT). The initiative underscores the EU's commitment to shaping immersive technologies grounded in democracy, inclusivity, sustainability, and trust, principles central to European identity and governance.

The strategy recognizes virtual worlds as immersive, persistent environments capable of transforming multiple sectors, from healthcare and education to manufacturing, culture, and public administration. The EU seeks to balance innovation with regulation, ensuring that new digital spaces uphold citizens' rights, privacy, and security while fostering competitiveness and technological sovereignty. This balance is achieved through a robust legislative ecosystem comprising the Digital Services Act (DSA), Digital Markets Act (DMA), General Data Protection Regulation (GDPR), Artificial Intelligence Act (AI Act), and Markets in Crypto-Assets (MiCA) regulation. Together, these frameworks provide accountability, transparency, and data protection as foundational pillars of Europe's digital transition.

The EU's Web 4.0 vision is organized around four strategic pillars.

1. **People and Skills:** Focuses on digital literacy, awareness, and workforce development through initiatives such as the European Year of Skills and partnerships with the European Institute of Innovation and Technology (EIT). A "Virtual Worlds Toolbox" will guide citizens on data rights, identity management, and safe participation in immersive environments.
2. **Business and Industry:** Strengthens Europe's industrial ecosystem by supporting innovation, entrepreneurship, and creative sectors through funding mechanisms like Horizon Europe, Creative Europe, InvestEU, and the Digital Europe Programme. It encourages regulatory sandboxes, interoperability standards, and open-source collaboration to ensure fair competition and global leadership.
3. **Government and Public Services:** Demonstrates the application of immersive technologies in governance and societal development through flagship projects such as CitiVerse-a metaverse-based digital twin for smart cities, and the European Virtual Human Twin, aimed at advancing personalized healthcare and research.
4. **Governance and Global Cooperation:** Emphasizes multi-stakeholder governance, interoperability, and international collaboration to ensure that virtual worlds remain open, inclusive, and ethically governed. It calls for a technical governance forum to address cross-border standards, digital identity, and rights management.

The EU strategy's strengths lie in its comprehensive design, emphasis on ethical innovation, and strong regulatory foundation that ensures user protection and market fairness. It integrates economic growth with social responsibility, reflecting Europe's ability to link technology with societal benefit. Challenges include varying levels of technological readiness across Member States, dependence on global technology suppliers, high infrastructure costs, inclusive of global south, and the need for continuous investment and skills development. Nonetheless, opportunities abound for Europe's creative industries, sustainability goals, and leadership in standardization position it as a global influencer in defining responsible digital futures.

While the strategy emphasizes inclusion, it provides limited clarity on implementation beyond the EU. High costs of hardware, software, and skilled development capacity remain major barriers, particularly for the Global South. Without improved affordability and access, mass adoption and the development of meaningful use cases are likely to remain limited.

Introduction

The eXperiential Technologies Innovation Center (XTIC) is established by IIT Madras, one of India's premier institutes. XTIC has recently constituted a committee to draft India's Metaverse Policy: the Metaverse India Policy and Standards (MIPS) Committee. This initiative brings together international standards agencies and various stakeholders to foster a global metaverse that is pervasive, open, and inclusive.

The MIPS forum does not directly produce standards or policies. Instead, it coordinates resources and identifies needs to support the development of standards and policies within relevant organizations. This collaborative approach of all the stakeholders ensures that the evolving metaverse ecosystem benefits from comprehensive and well-aligned guidelines.

MIPS has recently been very active in contributing to new standards in ITU as part of few study groups in the field of Metaverse.

The MIPS committee was tasked to analyze the metaverse policy of various other counties before formulating our own. In this process, MIPS is creating our perspective on the EU's metaverse policy to understand its vision and approach in depth. This will help us gain insights that can guide the drafting of a well-grounded metaverse policy for India. We have several of our members from the MIPS committee that have contributed to creating this perspective.

The eXperiential Technologies Innovation Center (XTIC), IIT Madras, has undertaken a detailed study of the European Commission's 2023 communication titled "An EU initiative on Web 4.0 and virtual worlds: a head-start in the next technological transition"[1]. This initiative is central to the EU's ambition to shape the next phase of the internet, Web 4.0, and to guide the safe, ethical, and inclusive evolution of immersive virtual environments.

This review forms part of the Metaverse India Policy and Standards (MIPS) Committee's ongoing comparative analyses of global metaverse and virtual world strategies. Understanding the EU's approach provides insights for India as it frames its own policies to promote an open, interoperable, and human-centric metaverse ecosystem.

The MIPS committee draws upon international standards, academic research, and stakeholder consultations to contextualize the EU framework and assess its implications for global governance, industrial growth, and digital rights.

Why did we study the strategy in detail and create our perspective?

This perspective helps policymakers, technologists, and researchers in India understand the EU's comprehensive approach to Web 4.0 - one that integrates regulation, innovation, and ethics.

By studying this model, India can identify pathways for embedding rights-based frameworks in immersive technologies, encouraging industry innovation while maintaining accountability, and shaping international standards for a responsible and equitable metaverse ecosystem.

What We in India Learn from the Strategy?

- **Integrated Governance:** The EU model embeds Web 4.0 policy within broader digital, industrial, and innovation frameworks, ensuring continuity and coherence.
- **People-Centric Design:** Human empowerment, digital literacy, and inclusion are treated as prerequisites for technological leadership.
- **Standards and Regulation:** The EU's emphasis on interoperability and legislative foresight ensures both innovation and protection of rights.
- **Global Engagement:** India can adapt the EU's collaborative model for multi-stakeholder participation in global standards bodies (ITU, ISO, IEEE, etc.).
- **Ethical and Sustainable Development:** The strategy aligns digital transformation with sustainability and well-being, principles relevant for India's development goals.

The EU approach offers lessons on how policy coherence, robust regulation, and investment in skills and research can create a safe and competitive immersive ecosystem. Adapting these principles to India's socio-economic realities can strengthen its roadmap India's own Metaverse Policy initiative.

The committee analyzed the policy of the EU published by Centre for European Policy Network(CEP) [1][3].

The committee referred the definition and analysis of Metaverse from the ITU standards committee [2]

The European Union's Web 4.0 and Virtual Worlds Strategy, released in 2023, outlines a visionary roadmap for developing immersive, interconnected digital environments built on EU values of trust, inclusion, and sustainability. It seeks to position Europe as a global leader in Web 4.0 through four key pillars, People and Skills, Business and Industry, Government and Public Services, and Governance and Global Cooperation.

Summary or Highlights of EU's Metaverse Policy (ref[1,3])

1. The EU frames the metaverse as an extension of the digital single market, aiming to strengthen competitiveness, innovation, and economic growth while upholding European values.
2. The strategy emphasizes an open, human-centric, and inclusive metaverse that respects fundamental rights, democratic principles, and cultural diversity.
3. Strong focus is placed on interoperability and open standards to avoid platform monopolies and ensure cross-border and cross-platform participation.
4. Investment priorities include core technologies such as XR, digital twins, AI, cloud and edge computing, semiconductors, and high-performance networks.
5. The metaverse is positioned as a key enabler for industrial transformation, skills development, education, healthcare, smart cities, and sustainable mobility.
6. Trust, safety, and governance are central pillars, with strict attention to data protection, privacy, cybersecurity, consumer protection, and online safety.
7. Support mechanisms target startups, SMEs, research institutions, and creative industries through funding programs, innovation hubs, and public-private partnerships.
8. The EU seeks global leadership by shaping international rules and standards for the metaverse while promoting cooperation with like-minded partners.

Strengths

Despite its normative and institutional strengths, the EU's Web 4.0 and Virtual Worlds Strategy faces several structural and operational challenges. Chief among these is the gap between regulatory ambition and industrial execution. While the EU excels at setting rules and ethical standards, it has to increase focus in fostering agile innovation and commercialization of emerging technologies.

First, Europe's fragmented digital market remains a limitation. Variations in digital infrastructure, investment capacity, and policy implementation across Member States create disparities that hinder scalability and cohesion. The lack of unified industrial champions in immersive technologies, comparable to the U.S. Big Tech or China's platform giants, limits Europe's global competitiveness in hardware, cloud computing, and immersive content production.

Second, overregulation and compliance complexity may discourage innovation. While frameworks such as GDPR and the AI Act strengthen user protection, they can also impose heavy administrative burdens on startups and SMEs. The emphasis on legal compliance over experimentation may slow the pace of innovation in fast-moving areas such as XR, NFTs, and decentralized finance.

Third, the EU's innovation ecosystem is constrained by limited risk capital and fragmented venture funding. Although programs like Horizon Europe and the Digital Europe Programme provide grants and research support, Europe still trails behind the U.S. and Asia in private R&D investment and scale-up funding. This limits the ability of European firms to commercialize research breakthroughs in immersive technologies.

Fourth, the EU faces a digital skills gap. Despite efforts to promote digital literacy through initiatives like the Digital Skills and Jobs Coalition, Europe lacks sufficient talent in XR development, blockchain engineering, and immersive design. The slow pace of curriculum reform in higher education and limited private–academic partnerships is a challenge. Building a human centric metaverse is key to adaptation.

Fifth, While the policy underscores inclusion, it lacks a clear implementation roadmap. High costs associated with hardware, software, and skilled development resources continue to act as significant barriers that the policy does not sufficiently address. Without affordability for the Global South, mass adoption is unlikely, limiting both technological progress and the development of meaningful use cases.

Measurable goals / metrics will have to be defined, else it will be hard to track progress and hold stakeholders accountable.

Metaverse capacity index(MCI) can be defined. MCI refers to various frameworks and initiatives designed to evaluate, measure, or index the development, adoption, and infrastructure capabilities of the metaverse defined.

Defining other indices may be necessary as well.

The Whitepaper that XTIC published last year [4] refers to three different Metaverse Indices:

1) Ethical Metaverse Index that includes interoperability, content moderation and privacy,
2) Responsible Metaverse Index that includes global connectivity, particularly to the global south, innovation and creativity, diversion and inclusivity, and sustainability,
3) Transparent Metaverse Index that includes trustability and platform governance.

Finally, while the EU's ethical leadership enhances global credibility, it may reduce short-term agility. The cautious, consensus-driven approach—while ensuring democratic legitimacy, often delays timely responses to technological disruptions.

Challenges

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Opportunities

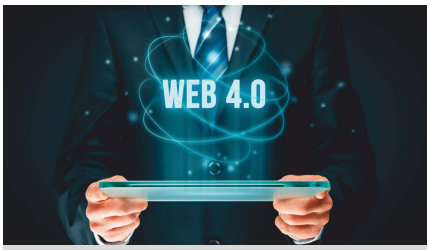
The EU's Web 4.0 and Virtual Worlds Strategy opens significant opportunities for industrial transformation, global influence, and inclusive digital growth. By leveraging its strong regulatory base, research networks, and ethical reputation, the EU can shape the normative and technological foundations of the next internet generation.

First, Europe can position itself as a global standard-setter for trustworthy and interoperable virtual worlds. As concerns grow over data privacy, algorithmic bias, and digital monopolies, the EU's governance framework can become the reference model for human-centric metaverse development. By engaging with international bodies such as the OECD, ITU, and ISO, Europe can export its digital values through standards and certifications.

Second, the EU's innovation ecosystem can capitalize on Horizon Europe's €95 billion research budget and the Digital Europe Programme to support cross-sectoral experimentation. Virtual worlds offer immense potential for industrial applications-digital twins in manufacturing, immersive training in healthcare, cultural heritage digitization, and smart city management. The EU's advanced manufacturing and creative industries can integrate metaverse solutions to improve productivity and user engagement.

Third, virtual worlds can enhance Europe's social and cultural cohesion. By promoting inclusive digital spaces that reflect linguistic and cultural diversity, the EU can strengthen its internal unity while exporting its multicultural model globally. Initiatives that use virtual environments for education, tourism, and cultural exchange can bridge generational and geographic divides.

Fourth, the EU's commitment to data autonomy presents a major strategic opportunity. By developing decentralized identity systems, European cloud infrastructure (e.g., GAIA-X), and privacy-preserving technologies, the EU can offer alternatives to foreign-controlled platforms. This would not only safeguard European data but also enhance technological autonomy.



Finally, the intersection of green transition and digital transformation offers Europe a first-mover advantage. Virtualization can reduce physical resource consumption through virtual prototyping, remote collaboration, and sustainable digital infrastructure. The EU's Green Digital Coalition can play a leading role in promoting climate-friendly virtual world architectures that align with the continent's net-zero objectives.

Vulnerabilities

The implementation of the EU's Web 4.0 and Virtual Worlds Strategy faces multiple external and systemic threats that could undermine its effectiveness. Geopolitical rivalries, technological dependencies, and market competition represent significant challenges to Europe's digital sovereignty and industrial competitiveness.

First, Europe's dependence on non-EU technologies-particularly in semiconductors, cloud services, and XR hardware-poses strategic risks. U.S. and Asian corporations dominate the supply chains for critical components and platforms. Without indigenous capacity in chips, AI models, and immersive hardware, Europe may remain a regulatory power but a technological follower.

Second, intensifying global competition in metaverse and AI markets could marginalize European firms. The rapid scaling capacity of American and Chinese tech giants gives them significant advantages in market penetration and R&D intensity. If Europe's innovation cycle remains slow, its startups risk acquisition or displacement.

Third, cyber threats and misinformation present growing dangers. As virtual worlds integrate identity, finance, and social interactions, they become prime targets for cyberattacks, deepfakes, and data manipulation. The EU's cybersecurity strategies, while strong, will need continuous adaptation to new threat vectors in immersive environments.

Fourth, the global regulatory landscape could fragment. Competing data protection regimes, AI governance models, and digital asset regulations may reduce interoperability between jurisdictions. Effective communication of benefits and strong digital literacy initiatives is required to mitigate privacy fears and job displacement anxieties.

Additional Insights from Recent EU Research on Virtual Worlds Standardization.

- Recent academic analysis (Küsters, 2024[3]) on the EU's metaverse policy, "A Tale of Two Metaverses," highlights how the EU's strength lies in its regulatory influence and normative power in shaping global standards rather than dominating the commercial XR ecosystem. The study underscores that the EU's Digital Services Act (DSA), AI Act, and Data Governance Act provide the institutional foundation for ethical and interoperable virtual world development.
- The research identifies a duality in the EU's approach, balancing market innovation with rights-based governance, described as the "two metaverses": one driven by technological leadership (private sector) and another steered by normative leadership (public regulation). This duality positions the EU as a standard-setter in ethics, safety, and accountability, though it trails behind the U.S. and Asia in commercialization and platform dominance.

The study concludes that the EU's success in virtual world governance will depend on its ability to translate normative frameworks into actionable global standards through coordination with ISO, ITU, and IEEE, and to support innovation ecosystems that align with these standards.

EU INITIATIVE ON WEB 4.0 AND VIRTUAL WORLDS

Summary

The European Union's Web 4.0 and Virtual Worlds Strategy embodies a unique synthesis of regulatory excellence, ethical commitment, and technological ambition. It represents the EU's attempt to shape the next evolution of the internet not through domination or deregulation, but through normative leadership and strategic coordination.

From a policy perspective, the EU's strength lies in its ability to integrate legislation, ethics, and industrial strategy into a coherent framework. The initiative complements key digital policies such as DSA, DMA, GDPR, AI Act, and MiCA, ensuring that innovation occurs within a safe and rights-based environment. This positions the EU as a global leader in digital trust and governance.

From a business perspective, the strategy offers new pathways for European companies to innovate responsibly. Opportunities in industrial metaverses, cultural content, and sustainable digital infrastructure can boost competitiveness if supported by sufficient investment and skills development. Strengthening venture capital ecosystems, promoting public-private partnerships, and streamlining regulation will be critical to success.

However, the EU may consider the innovation paradox inherent in its governance model: balancing protective regulation with entrepreneurial freedom. Achieving agility without sacrificing accountability requires adaptive policymaking, experimental sandboxes, and greater regional policy coherence.

In the global context, the EU's approach appears to contrast with that of other powers. Whereas China seeks control, and the U.S. champions corporate freedom, Europe positions itself as the normative broker of a fair, sustainable, and interoperable digital order. By deepening strategic partnerships, investing in digital sovereignty, and focussing on inclusion, particularly human capital of the global south, the EU can transform its regulatory strength into technological influence.

Despite its commitment to inclusion, the strategy does not adequately address cost barriers that restrict participation from the Global South. The continued high costs of immersive technologies and development skills risk limiting mass adoption and constraining the emergence of impactful, real world metaverse applications.

Ultimately, the Web 4.0 and Virtual Worlds Strategy is more than a technological blueprint; it is a societal vision. It aspires to create a digital future where citizens, companies, and communities can thrive within an ecosystem that is open, secure, and human-centered.

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