Ref. Ares(2024)2001902 - 15/03/2024

BEREC
Body of European Regulators
for Electronic Communications

BoR (24) 68

BEREC high-level position on artificial intelligence and virtual worlds

15 March, 2024

Contents

Executive Summary

Artificial Intelligence (AI) and virtual worlds (VW) are increasingly becoming relevant components of the (digital) economy. Their successful development and deployment require high quality electronic communications networks and services (ECN/ECS) and, in particular, very high capacity networks allowing for high speeds and low latency. Moreover, cloud services and edge computing – which are increasingly intertwined with ECN/ECS – are also essential for both technologies. A holistic approach on cloud, edge and ECN/ECS is key to ensure competition, high availability, quality and innovation for digital services.

In order to unleash the potential of AI and VW, and to make sure that these technologies develop for the benefit of European citizens, BEREC believes that some key issues concerning their competition dynamics, internet openness, environmental footprint and sustainability need to be assessed and tackled.

AI relies on four essential inputs: computing power (and related cloud services), data, financial resources and technical expertise. Privileged or exclusive access to such inputs can lead to a significant competitive advantage and create structural barriers to entry. This is particularly the case when AI firms, or major investors, are also the main providers of the inputs in adjacent markets (e.g. cloud infrastructures). Moreover, beyond these structural advantages, companies owning or controlling such inputs may have the incentive to impose unfair terms and conditions on other firms or users, thus further deteriorating competition dynamics.

On top of the competition issues, BEREC believes that the challenges raised by AI and VW should also be assessed as regards their impact on internet openness, that is on the way content is accessed and distributed online. The embedment of AI in digital services, products and devices represents a new gateway to the internet. While this can be beneficial in some cases, it also has the potential to shape the way users access content online, thus potentially affecting their freedom of choice. End-users' empowerment *via* e.g. the promotion of transparency and comprehensibility, the reinforcement of users' consent and control over the data they (directly or indirectly) share, as well as data portability will be crucial to raise awareness and related actions.

When assessing AI and VW's impact on users, on the industry and on society at large, the analysis of its environmental footprint and sustainability is also necessary. AI and VW are considered as particularly energy-intensive technologies. While many AI-based services could enable more sustainable solutions across the markets, their contribution to the green transition can only be effective if AI systems are themselves sustainable. In order to quantify the environmental footprint of AI and VW, their entire lifecycle must be assessed using a multi-component, multi-stage and multi-criteria approach. Moreover, environmental sustainability could also be integrated in the EU innovation strategies in order to successfully combine the green and digital transition.

Some EU legislations can partly address the issues raised by AI and VW. Obligations reinforcing access to data in the most widespread digital services and products, as well as interoperability and switching in cloud services – as foreseen under the Digital Markets Act (DMA) and the Data Act – will be key to tackle some of these challenges. BEREC is contributing to the DMA High-Level Group which provides the European Commission (EC) with advice, recommendations and expertise for its implementation. Moreover, in the context of the Data Act, several BEREC members may be designated as the competent authority implementing some parts of the legislation which are particularly relevant for AI (e.g. switching obligations between data processing services, interoperability etc.). Finally, BEREC members could play a role in the implementation of the AI Act at the national level, in particular – but not limited to – when AI is used in the provision of ECN/ECS.

BEREC will keep analysing the evolution of digital markets, in order to identify the potential challenges and contribute to the definition of possible solutions. In this context, BEREC will continue to collaborate with the EU institutions and other European bodies and networks to make sure that new digital technologies, services and products are provided for the benefit of European citizens.

1. Introduction

On 9 January 2024 the EC launched two calls for contributions on competition in generative AI and VW and sent requests for information to several large digital players[1].

BEREC's work on the application of AI solutions for the provision of ECN/ECS and of AI solutions used for regulatory purposes[2], highlights the potential AI risks and benefits to consider when adopting AI solutions. It also explores a number of selected use cases in telecommunications in which it is possible to gain efficiencies and possibly to enable new opportunities for value creation.

BEREC reports on the internet ecosystem[3] and on the *ex-ante* regulation of digital gatekeepers[4] show that digital markets can be fast-evolving and innovative, but they may also present certain structural characteristics, which can result in entrenched market positions, and behaviours that may hinder the benefits of healthy competition. In this context, a forward-

[1] Commission launches calls for contributions on competition in generative AI and VW, see: https://ec.europa.eu/commission/presscorner/detail/en/IP_24_85.

[2] BoR 23 (93), BEREC Report on impact of AI solutions in telecommunications sector on regulation, 08.06.2023, see:https://www.berec.europa.eu/system/files/2023-06/BoR%20%2823%29%2093%20BEREC%20Report%20on%20impact%20of%20AI%20solutions%20in%20telecom%20sector%20on%20regulation.pdf.

[3] BoR (22) 167, BEREC Report on the Internet Ecosystem, 12.12.2022, see: https://www.berec.europa.eu/system/files/2023-04/20230418_BoR%20%2822%29%20167%20%20BEREC%20Report%20on%20the%20Internet%20Ecosystem.pdf.

[4] BoR (21) 131, BEREC Report on the *ex-ante* regulation of digital gatekeepers, 30.09.2021, see: https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-the-ex-ante-regulation-of-digital-gatekeepers.

looking analysis of technologies, like AI, is relevant to anticipate market trends and potential competition issues that may arise.

On top of the competition issues, and given its broader expertise, BEREC believes that the challenges raised by AI and VW should also be assessed as regards their impact on the environment and on openness, that is, on the way content is accessed online. End-users' empowerment will be crucial to tackle some of the issues.

Finally, digital networks are undergoing a transformation where connectivity infrastructure is converging with cloud and edge computing capabilities, not only at the infrastructure layer, but also the service operations. In this context, as highlighted in the EC White Paper "How to master Europe's digital infrastructure needs?"[5], the players in such converged ecosystem may not fall under equivalent rules applicable to all, and the users may not benefit from equivalent rights. It is therefore relevant to flag the issues that AI may pose in this specific context.

When referring to AI and to VW, BEREC adopts the OECD definitions:

- "*an AI system is a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments*"[6]. It is therefore broader than generative AI.
- a VW[7] is "*a persistent computer-simulated environment allowing large number of users, who are represented by avatars, to interact in real-time with each other and the simulated environment*"[8].

2. AI and VW value chains

2.1. Value chain for AI

BEREC observes that AI value chain is complex, involves different layers and components, and may be structured by relations between providers and users of varying nature. This value chain includes the following relevant layers:

[5] White Paper - How to master Europe's digital infrastructure needs? See: https://digital-strategy.ec.europa.eu/en/library/white-paper-how-master-europes-digital-infrastructure-needs.
[6] Updates to the OECD's definition of an AI system explained, see: https://oecd.ai/en/wonk/ai-system-definition-update.
[7] Which includes virtual reality platforms, multiplayer gaming platforms, among other platforms.
[8] Virtual Worlds, see: https://www.oecd-ilibrary.org/docserver/5kg9qgnpjmjg-en.pdf?expires=1708681725&id=id&accname=guest&checksum=B913B839901764AC2DF9479F625B5A07.

- Hardware – AI requires large clusters of graphic/tensor processing units with specialized “accelerator” chips capable of processing all the data across billions of parameters in parallel;
- Cloud and edge infrastructures and services – much of the work to build, tune and run large AI models occurs in the cloud. This enables companies to easily access computational power and manage their investment as needed;
- Data centres – the requests placed to the AI system are processed in data centres which involve communication services and networks;
- Foundation models – they are at the heart of generative AI. These large deep learning models are pre-trained to create a particular type of content and can be adapted to support a wide range of tasks that can be used for multiple purposes;
- Model hubs and machine learning technologies – they are necessary to build applications on top of foundation models as they curate, host, fine-tune or manage them;
- ECN/ECS – that allow for transmitting data and interactions with AI applications;
- Applications – business-to-consumer or business-to-business applications that use foundation models can be used either as general-purpose models or fine-tuned to a particular use case.

In some layers there are some competition issues at both downstream and upstream levels[9], while in other layers internet openness could be affected. This deserves in-depth scrutiny (see sections 4 and 5).

In the specific context of the environmental footprint of AI, the key value chain layers may be different from the ones referred above (see section 6).

2.2. Value chain for VW

The value chain in VW follows a similar model than other interactive audiovisual applications, but with special relevance and requirements for some parts:

[9] For example, at the upstream level, model and application developers use a cloud provider that hosts the model, becoming its customers. The cloud provider might develop an infrastructure dedicated to the hosted model and, thus might have the ability and an incentive to impose technical and commercial conditions to recover the investment cost, for instance, by limiting the ability of model and application developers to switch cloud provider. This restriction might negatively impact competition in the cloud sector and reinforce the position of the cloud provider hosting the model.

- Virtual/Augmented Reality-devices are much more sophisticated and complex than general purpose devices, being VR head-mounted displays the most relevant ones[10]. The main devices are currently commercialised by hyperscalers and are configured with a relevant computing capacity, like Meta Quest and Apple Vision Pro.

- Software platforms supporting the virtual experience in communication with the device and acting as a plug-in support for contents and applications aimed to make use of the specific characteristics of VR devices are key. These content and applications may be provided by the owner of the platform (which is currently also the provider of the VR devices) or by third parties (being typically the case of VR games or 3D films).

- Cloud, edge computing and ECN/ECS also play a key role to enable VW. Depending on the computing capacity of the devices, a very relevant part of the computation may be needed to be done at cloud computing servers and/or edge computing located in the network, close to the final user to improve performance and specially latency.

3. AI, VW and ECN/ECS

The EC's white paper "How to master Europe's digital infrastructure needs?"[11] highlights that advanced digital network infrastructures and services will become a key enabler for transformative digital technologies and services such as AI, VW and the Web 4.0. A successful development of AI and VW requires the features presented here below.

3.1. Very high capacity networks with low latency

AI applications and VW require transmission of a large amount of data in short time.

Training AI relies on significant computing power and data requires dedicated transmission capacity to connect data centres. Such communication infrastructures will be increasingly needed, as the development of AI models and AI and VW applications is expected to increase. Moreover, AI and especially VR may rely on real-time data transmission and need very high speeds and reliability, and low latency that can only be provided by fixed connections using fibre optics, WIFI and/or 5G/6G networks.

When the device is in movement or is used in places where no fixed networks are available, VR applications need good quality wireless networks and tools to monitor and guarantee this quality. This implies that stand-alone 5G networks with broader coverage will be needed to ensure that wireless communications allow for the development and use of innovative VW

[10] As well as haptic devices.
[11] White Paper - How to master Europe's digital infrastructure needs? See: https://digital-strategy.ec.europa.eu/en/library/white-paper-how-master-europes-digital-infrastructure-needs.

applications. High speed/low latency wireless networks are also important for the use of some AI-based applications for the Internet of Things (IoT).

Finally, since AI-based applications and VR can also support applications to improve productivity and social and political participation, access to very high capacity networks for all users will be key.

3.2. Cloud and edge computing

High availability of cloud and edge computing will be crucial. AI-based and VW applications involve high computing requirements, and, in most cases, a large part of the computing (as well as storage) may not be supported on the device, but on the network, located as close as possible to the user to support a very low latency and save bandwidth.

ECS/ECN are undergoing a transformation where connectivity infrastructure is converging with cloud and edge computing capabilities. This convergence will facilitate the use of AI-based and VW applications. However, edge computing is still in its infancy, and initiatives to boost its deployment are needed. A holistic and consistent regulatory approach taking account of the convergence of ECN/ECS and cloud computing will be crucial to simultaneously encourage investment and the development of new, innovative edge services and prevent a restriction of competition that may also hamper innovation.[12]

3.3. AI in ECN/ECS

BEREC published in June 2023 a report on the impact of AI solutions in the ECN/ECS sector[13] based on views provided by NRAs, market actors and academics. The report presents several use cases for AI such as network and capacity planning and upgrades, channel modelling, prediction and propagation, dynamic spectrum sharing, quality of service optimization and traffic classification, security optimization, threat detection and fraud detection and prevention. Although most AI systems in the ECN/ECS sector are still in a development phase, AI is expected to play an important role in the sector in the mid-term (6-8 years).

Many of the changes in networks driven or enabled by AI systems are linked to network virtualization. Other developments could potentially impact on what networks do as well as how networks function[14] or allow to automatically orchestrate and manage network resources while assuring the quality of experience demanded by users. These improvements may bring

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[12] White Paper - How to master Europe's digital infrastructure needs? See: https://digital-strategy.ec.europa.eu/en/library/white-paper-how-master-europes-digital-infrastructure-needs.

[13] BoR (23) 93, BEREC Report on the impact of Artificial Intelligence (AI) solutions in the telecommunications sector on regulation, 08.06.2023, see: https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-the-impact-of-artificial-intelligence-ai-solutions-in-the-telecommunications-sector-on-regulation.

[14] For instance, networks could be used as sensors for AI applications or for managing responses in case of disasters.

significant benefits for the ECS/ECN sector (including considerable savings in terms of costs). AI techniques to optimize network operation can help to automate complex and/or repetitive processes, improve customer service or detect new business opportunities, support the expansion and densification of network infrastructure and devices in communication networks, and promote energy efficiency of networks. On the other hand, AI also entails a number of risks related to e.g. the availability of unbiased and reliable data, liability in case of error due to the complexity of AI ecosystems, ensuring the explainability in the decision-making, privacy issues and cybersecurity implications.

In this context, BEREC and NRAs could play a role in the implementation of the AI Act in a national level, in particular when AI is being used in the provision of ECN/ECS by coordinating with other relevant bodies and providing technical support based on their specialized knowledge and experience in the sector.

4. Competition dynamics

The integration of AI technologies can lead to transformative benefits in terms of innovation, efficiency, and service quality. However, without careful supervision, it could also exacerbate competition issues, potentially harming users' choice and innovation.

4.1. Competitive advantages

AI relies on four essential inputs: computing power (and related cloud services), data, financial resources and technical expertise. Privileged or exclusive access to such inputs can lead to a significant competitive advantage and create structural barriers to entry. Moreover, the ecosystem effect – where the same company provides services and products in adjacent markets –, as well as vertical integration, can further reinforce the competitive advantage coming from the control over such essential inputs.

4.1.1. Computing power and cloud services

Computing power plays a key role in the training and operation of AI models. Access to large, specialised computing capacities for the development, hosting and use of generative AI, especially large language models, can act as an entry barrier.

In principle, companies can consider the (capital-intensive) development of their own computing capacities or the use of (shared and scalable) cloud solutions. Given the high level of investments required, only few companies are able to deploy their own computing infrastructure. As an alternative, suppliers of foundation models and developers of generative AI-powered services can rely on cloud providers who offer scalable and flexible computing resources. In this context, cloud providers can achieve a comparative advantage through economies of scale as well as vertical integration in the development of generative AI. Existing capacities in data centres can be used for the in-house development of generative AI – and expanded at comparatively lower costs. The integration of AI models creates additional economies of scope.

Currently, the cloud market is concentrated around three major players (Amazon Web Services, Microsoft Azure and Google Cloud Platform), particularly for IaaS and PaaS[15] products. On top of the competitive advantage coming from the provision of such services, cloud providers also have the ability to engage in anticompetitive practices, thus reinforcing their position (see 4.2). **The competitive dynamics in the cloud markets can therefore affect competition in the generative AI markets**. Some of these competition issues will be addressed by the new legislations (see 4.3).

4.1.2. Data

Data is another key input to develop generative AI models **and its quality has a direct impact on the performance of the model and therefore on its competitiveness**. While AI models can rely on publicly accessible data, the demand for exclusive, licensed or non-public data to further enhance and specialise models and develop competing services and products could increase in the future. In this context, Big Tech companies whose business models rely on the collection and monetisation of data can enjoy an additional competitive advantage.

Moreover, access to interaction data (such as a "like" of a chatbot's response) appears to play an important role in the quality of training – it enables providers to continuously improve and personalise their services ("feedback effects"). There may also exist network effects in data acquisition if generative AI services allow users to upload files. If the generative AI developer has the ability and the permission, data submitted by users may be converted into training data. In this scenario, the larger the user base, the easier it is to acquire new training data. Providers with a large existing customer base therefore have an advantage over new entrants. Data is also gaining additional (commercial) value as input in the course of training and development of AI. For current services, the increased value of data can enable new monetisation strategies to sell access to existing content (e.g. user-generated posts), but also increases the financial resources needed for the development of AI[16].

4.1.3. Financial resources and technical expertise

Large digital ecosystems with high financial resources have significant advantages when it comes to accessing services or inputs for the development of AI models. Furthermore, the development and maintenance of AI systems requires specialised skills and knowledge. Entrants can find it difficult to secure the necessary funding and expertise. If innovative start-

[15] IaaS: infrastructure as a service. PaaS: platform as a service.
[16] For example, see: Google cut a deal with Reddit for AI training data, https://www.theverge.com/2024/2/22/24080165/google-reddit-ai-training-data.

ups manage to develop AI systems, “killer acquisitions” by large digital ecosystems might remove independent sources of future competition.

4.2. Practices and strategic behaviours affecting competition

Providers of large digital ecosystems have the ability and may have the incentive to leverage their market power among different areas of business.

As highlighted above, the impact of the competitive dynamics in the (e.g. cloud) markets can affect the AI market. Large computing capacities are required to host and operate AI. For example, many companies decide to operate a third-party AI model with a cloud provider. Switching cloud providers can be prohibitively expensive when fees for transferring data out of the cloud (“egress fees”) are imposed or in case of lack of interoperability. This would result in vendor lock-in and hampering competition[17].

AI firms with market power also have the ability and may have the incentive to impose unfair terms and conditions on other firms or users (e.g. high access costs, rights over the content and data generated by the AI). For instance, they may privilege or give preferential treatment to their own downstream services, raising barriers for competitors[18]. Moreover, providers of large digital ecosystems who own exclusive datasets can combine them across different services thus gaining a competitive advantage[19,20].

The trend towards closed or exclusive partnerships, such as high-profile collaborations between major tech and AI companies (e.g. on usage of cloud-services or access to data), presents a challenge.[21] These partnerships can accelerate short-term innovation, but may also lead to a higher market power and concentration and thus to a major control over key technologies and assets. Additionally, AI firms may adopt tying or bundling practices and strategies, by integrating their AI models and/or services in other products. This may contribute

[17] Switching barriers (costs and expenses that users incur or are perceived to incur when switching) give providers a certain market power. A company can also encounter certain barriers when switching the generative AI model (e.g. particularly when the providers' solutions are incompatible and require the preparation of company data to be repeated and software adapted), creating set-up and learning costs. Similar costs may also be relevant for private users if the personalisation of the model’s output is to be maintained.

[18] AdC issue paper: “Competition and Generative Artificial Intelligence”, see: https://www.concorrencia.pt/en/articles/adc-warns-competition-risks-generative-artificial-intelligence-sector.

[19] The generative AI model Adobe Firefly, for example, can use its own stock photos for training and thus avoid legal uncertainties. See: https://www.adobe.com/products/firefly.html. Furthermore, search engine providers can realise a particular advantage in the development of generative AI through their access to the register of websites ("index") and interaction data ("click & query" to improve the accuracy of search results).

[20] Cross-service consents facilitate the sharing of a wide range of personal (interaction) data between the provider's services and thus enable the personalisation of generative AI and access to personal data in real time without additional effort from the user. Existing providers of large digital ecosystems can realise a competitive advantage here through access to the data already available within their ecosystems.

[21] See for example: https://openai.com/blog/openai-and-microsoft-extend-partnership and https://www.reuters.com/technology/reddit-ai-content-licensing-deal-with-google-sources-say-2024-02-22/.

to the reinforcement of their ecosystems, not only by increasing their market power, but also by allowing them to leverage it to other markets.

AI models vary in their degree of control of access, licensing or possible customisation by the owner of the model. Open-source models are usually freely shared and can be used without cost within their respective license.[22] Their code and model weights can be accessible, enabling further development or training by third parties and increased transparency. Access to closed source models is controlled and up to the owner.[23] In general, open-source models can lower costs for third parties using or adapting them, maximize network effects and scale advantages. Closed models can increase compatibility between the components (e.g. inputs) of the systems provided by a same entity due to increased control and coordination, avoiding free-riding (e.g. on investments in single inputs).[24] The choice between open-source and closed models is the result of a strategy. We can observe that several important market players tend to adopt a mixed strategy, either by developing open-source models and commercialising closed models at the same time, or by moving from open-source models to closed models. Better market outcomes are likely to be expected if both types (open-source and closed models) are available and businesses and consumers can experiment, as unfair prices and terms could be imposed if only closed models of few large digital ecosystems exist on the markets.[25]

When integrating applications with AI, dominant providers of large digital ecosystems can gain an (additional) competitive advantage through the existing large user base. For example, the integration of generative AI (in the form of bundling and tying) in operating systems, productivity software and social networks can already be observed.

4.3. Legislations concerning access and use of key AI inputs

Some existing and upcoming legislations – such as the Data Act, the Digital Markets Act (DMA) and the AI Act – can play an important role in shaping the regulatory environment for AI technologies, as they can mitigate structural competitive advantages by reducing barriers to entry to these essential inputs and fostering innovation in AI-driven services.

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[22] License terms vary depending on the license. E.g. Meta's LLAMA 2 License allows free use only up to 700 million active users: https://github.com/facebookresearch/llama/blob/main/LICENSE.

[23] CMA, AI Foundation Models Initial Report, 2023, see: https://assets.publishing.service.gov.uk/media/650449e86771b900014fdab4c/Full_Non-Confidential_Report_PDFA.pdf , p. 14. There is no established definition of open or closed source models.

[24] Autorité de la concurrence and CMA, The economics of open and closed systems, 2014, see: https://assets.publishing.service.gov.uk/media/5a75c284e5274a545822e01a/The_economics_of_open_and_closed_systems.pdf

[25] CMA, AI Foundation Models Initial Report, 2023, see: https://assets.publishing.service.gov.uk/media/650449e86771b900014fdab4c/Full_Non-Confidential_Report_PDFA.pdf , p. 42.

The Data Act includes provisions on data access, usage rights, interoperability and switching in cloud services. For AI technologies, especially generative AI, access to vast amounts of data is critical for training algorithms and improving their capabilities, and the Data Act provides a framework for access, sharing, and control of data, seeking to ensure that it is shared and used in a way that promotes innovation while protecting the interests of data creators and users. Moreover, the Data Act establishes new rules to facilitate switching between cloud services and interoperability which are essential to stimulate the market, tackle lock-in effects, and ensure free choice and lower costs for users.

The DMA aims to ensure fair and open digital markets, by preventing gatekeepers' anti-competitive practices, and promoting innovation and contestability. Specific services that may incorporate AI, such as search engines, number-independent interpersonal communications services, virtual assistants[26], social networks or operating systems are considered core platform services under the DMA. However, some obligations may need to evolve to correctly address the challenges related to AI. The measures related to data portability and access obligations (e.g. Art. 6 (9), 6 (11)) are highly relevant for AI technologies. Additionally, the DMA's focus on vertical interoperability (e.g. Art. 6 (7)) and the prohibition of unfair tying and bundling practices (e.g. Art. 5 (8)) directly addresses the anticompetitive practices and strategic behaviours that can arise in the context of AI. The DMA also addresses the combination of personal data across different services (e.g. Art. 5 (2)). In addition, these Acts complement the General Data Protection Regulation (GDPR) with regard to data portability (Art. 20 GDPR). Both the DMA (Art. 15) and the GDPR (Art. 22) also provide for transparency obligations regarding the profiling of consumers. Transparency obligations can enable a better understanding of the collection, blending and use of data in connection with the use of AI – also for authorities/regulators.

The AI Act, by codifying roles and responsibilities along the value chain, can also help to increase transparency and accountability in B2B and B2C relations.

BEREC is contributing to the DMA High-Level Group which provides the EC with advice, recommendations and expertise for any general matter of implementation or enforcement of this regulation, as well as on the need to amend, add or remove rules to ensure that EU digital markets are contestable and fair. Moreover, in the context of the Data Act, several BEREC members may be designated as the competent authority implementing some chapters of the text which are particularly relevant for AI (e.g. switching obligations between data processing services, interoperability, etc.). Finally, BEREC members could play a role in the implementation of the AI Act at the national level, in particular – but not limited to – when AI is used in the provision of ECN/ECS, by coordinating with other relevant bodies and providing technical support based on their specialised knowledge and experience in the sector. NRAs should also be equipped to address sectoral competition concerns that might arise in the future regarding the application of AI.

[26] Although at the time of the writing of this report, no gatekeeper providing virtual assistants has been designated under the DMA.

BEREC will continue to collaborate with the EU institutions and other European bodies and networks for the implementation of the DMA, as well as for any other regulatory instrument addressing the internet ecosystem elements.

5. AI potential impact on internet openness and end-users' empowerment

5.1. Threats and opportunities of AI

The end-users play a key role in AI: on the one hand, they benefit from the capacity/potential offered by AI services, but on the other hand, they also contribute to their development over time by providing data and feedback which improve and develop such services further.

A significant part of data (especially personal data which is generated by smart devices) can provide detailed information related to health, safety, professional activities, leisure and other personal preferences. It is therefore key that end-users become aware of the potential risks they face and are informed about the choices they can make to enhance their skills and experience while lowering AI's potential negative effects. Furthermore, the advent of generative AI plays a big role in content creation within professional fields related to information, democratic participation, and it simultaneously raises issues related to pluralism[27], authenticity and copyright.

This is why AI is an opportunity for end-users, but at the same time it poses challenges and legitimate concerns in terms of ethical and legal impact on their rights. In particular, the increasing pervasiveness of AI raises important questions about internet openness, privacy and cybersecurity, data integrity and reliability, as well as societal biases perpetuated by algorithmic bias and abstruseness.

5.2. Potential impact on internet openness

AI has the potential to enrich user experience and complement traditional ways of accessing online content and services. By representing a new intermediary, embedded AI can also affect the overall user experience on the internet as it has the potential to directly define online content/services, to influence the way users access them and thus to potentially affect their freedom of choice.

[27] AI can raise challenges for democracies, pluralism and social cohesion, as it can be a powerful tool for disinformation and misinformation. For example, professional journalism, which is a primary source of information and democratic participation, is challenged by generative AI that falters the traditional classifications of sources, investigative work, testimony, verification. Any fake or manipulated text and image can easily be generated by a machine and presented to the end-users as a trustworthy, accountable piece of information, and the actual manipulation process or result may not be evident to the users.

The Open Internet Regulation 2015/2120[28] guarantees the principle of the "open internet", meaning the right of users to freely access any content available on the internet and, in return, to be able to disseminate any content they wish on the internet. It aims to protect end-users and simultaneously to guarantee the continued functioning of the internet ecosystem as an engine of innovation. While most provisions of the open internet regulation target internet service providers, users' access to the internet can be affected beyond access networks.

BEREC considers that it **important to assess and monitor the potential impact of AI on openness**, that can be defined here **as the ability of users to access and distribute information and content, without unlawful interference or discrimination, as well as the ability to innovate.**

While some use cases of LLM[29]-based systems used for information retrieval can be beneficial[30], for example programming or tip-of-tongue research, the authors draw the attention to the way these systems can shape our information landscape in harmful way, if not designed properly. Moreover, by shaping and influencing the way online content is accessed, the intermediation done by AI-based services may lead to i) narrowing of the available content, depending on the choices made by the AI provider or the quality of the training corpus and ii) a depreciation of the quality of the content available (with generated content).[31]

Moreover, generative AI applications also allow users to generate *ad hoc* content. Being this capacity useful and productivity-enhancing in many contexts, this may question the reliability and credibility of the information provided. As some researches show[32], generative AI is still struggling with severe reliability and bias problems: the corpus used to train the systems may not be reliable enough or may be already biased, and the algorithmic treatment itself "accelerates" already existing biases, leading, for example, to an over-stereotypisation of the generated content.[33]

However, scholars have produced encouraging work that could be used to reduce the risks just exposed: they set out recommendations to developers for a better evaluation and design

[28] Regulation (EU) 2015/2120 of the European Parliament and of the Council of 25 November 2015 laying down measures concerning open internet access and amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on public mobile communications networks within the Union, see: https://eur-lex.europa.eu/eli/reg/2015/2120/oj.
[29] Large language model
[30] In a recent study, Bender & Shah analyse the impact of LLM-powered search systems on information search and on the Web as an information ecosystem: Chirag Shah and Emily M. Bender. 2024. *Envisioning Information Access Systems: What Makes for Good Tools and a Healthy Web?* See: https://doi.org/10.1145/3649468.
[31] X (formerly Twitter) can be seen as an example here: AI-generated content is flooding the platform, and leading to a serious decrease in the overall quality of what can be read there. See: https://www.abc.net.au/news/science/2024-02-28/twitter-x-fighting-bot-problem-as-ai-spam-floods-the-internet/103498070 and https://www.theguardian.com/technology/2023/sep/09/x-twitter-bots-republican-primary-debate-tweets-increase.
[32] See, for example, Kirk, H. R., Jun, Y., Iqbal, H., Benussi, E., Volpin, F., Dreyer, F. A., Shtedritski, A., and Asano, Y. M. (2021). *Bias out-of-the-box: An empirical analysis of intersectional occupational biases in popular generative language models*. In *Neural Information Processing Systems* and Hovy, D. and Prabhumoye, S. (2021). *Five sources of bias in natural language processing*. Language and Linguistics Compass, 15(8): e12432.
[33] See: https://restofworld.org/2023/ai-image-stereotypes/.

of research services.[34] In order to reduce bias amplification, tools for a better evaluation of the models are emerging.[35] Incentives to properly evaluate and design models could be put in place.

5.3. End-users' empowerment

To mitigate some of the risks identified, it is key to enhance end-users' control, understanding, and rights, namely *via*:

- **Transparency and comprehensibility**: ensuring that end-users have complete, clear, accessible information about how AI is applied in the services they use[36]. Transparency tools or indicators that distinguish AI-generated content from human-created content can empower users to make informed choices.[37]
- **Consent and control**: strengthening consent frameworks to give users more control on how their data are used by AI systems.[38] This includes clear options to opt-in or opt-out of AI-driven features and services, and granular control over the data they choose to share or withhold[39].
- **Data portability and access**: facilitating users' rights to access the data collected about/from them by AI systems, and to easily transfer this data to other services if desired. This enhances user autonomy and prevents lock-in effects, promoting competition and choice.
- **Privacy enhancements**: implementing and advocating for advanced privacy-preserving technologies in AI systems, such as differential privacy or federated learning, which can minimise the risk of personal data exposure while still providing personalised services.
- **Combating fraud, scams and other illegal behaviours**: Raising awareness among end-users is of vital importance, as the expanding use of AI can expose end-users (namely the most vulnerable, including the minors) to the risk of falling victim to fraud, scams and other

[34] Chirag Shah and Emily M. Bender. 2024. *Envisioning Information Access Systems: What Makes for Good Tools and a Healthy Web?* ACM Trans, see: https://doi.org/10.1145/3649468.

[35] Some works in that field: Nangia, N., Vania, C., Bhalerao, R., and Bowman, S. R. (2020). *CrowS-pairs: A challenge dataset for measuring social biases in masked language models*. In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP*), pages 1953–1967, Online. Association for Computational Linguistics; and Zhao, J., Wang, T., Yatskar, M., Ordonez, V., and Chang, K.-W. (2017). *Men also like shopping: Reducing gender bias amplification using corpus-level constraints*. In Proceedings of the 2017 *Conference on Empirical Methods in Natural Language Processing*, pages 2979–2989, Copenhagen, Denmark. Association for Computational Linguistics.

[36] Including understanding and being aware that any data they input in AI / LLM can be used for training the LLM. For example, understanding how AI-generated content is created, the sources of data it uses, and any potential biases.

[37] For example, conducting public awareness campaigns about the rights and protections available to users in the context of AI, including how to exercise these rights.

[38] Strong consent mechanisms are crucial in environments where personal data can be more extensive, including biometric data, movement tracking, and behavioural data.

[39] For example, AI-driven verification systems such as age verification tools provide a more secure standard of verification than age-gating does, preventing minors from accessing age-restricted products, services or content.

illegal behaviours, resulting in financial losses. These scams often mislead end-users by providing accurate information about seemingly trustworthy activities. Given the rapid evolution of such schemes, where it is challenging to apply detection tools, AI can be employed to recognise, report, and combat fraudulent activities by both end-users and service providers in order to prevent significant losses.

Moreover, as digital environments offer new forms of social interaction, commerce and entertainment, and may raise some concerns regarding users' rights, safety, and privacy, other aspects may be considered:

- **Privacy and safety**: implementing and enforcing standards for users' safety and protecting users' privacy in VW, especially considering the depth of interaction and data involved.[40] All possible regulatory measures[41] should be taken to prevent misuse of user content, i.e. modification of user's content and data by AI which could cause harm to end user. If such abuses occur, it should be possible to immediately intervene to remove modified or harmful content, to prevent further personal damage.
- **Equitable access and inclusivity**: promoting equitable access to VW and AI is essential for empowering end-users. This includes addressing digital divides[42] and ensuring that virtual environments are accessible to all users, irrespective of their impairment. Efforts should be made to create inclusive spaces that respect diversity and prevent discrimination.

While assessing how AI and VW will impact on end-users, BEREC and NRAs suggest pursuing a data and fact-driven regulatory approach, supported by their expertise and experience in end-users' rights, and also engaging in multi-stakeholder[43] discussions to ensure that end-users are adequately represented and protected in the development and governance of AI and VW technologies.

The European AI strategy and the proposal of the Commission for the upcoming AI Act aim to preserve European democratic values and citizens' rights in the context of AI. BEREC and NRAs suggest to adopt a collection of possible solutions – a regulatory toolbox, that should include specific tools aimed at enhancing the principle of human-centric approach to generative AI and VW :

- best practices and/or guidelines for effective regulation and multi-stakeholders' self/co-regulation practices, starting with the definition of ethical, legal and quality standards in the use of generative AI (especially in, but not limited to, the provision of ECN/ECS) or

[40] This includes ensuring options for anonymity or pseudonymity where appropriate and employing robust encryption and data protection measures to safeguard user information. VW should have clear community guidelines, effective moderation, and support systems in place to promptly address users' concerns and incidents.

[41] Including those previewed in the Digital Services Act, see: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R2065.

[42] Enhancing digital literacy is vital in helping users navigate VW safely and effectively. Education initiatives should cover understanding virtual economies, recognizing potential scams or harmful content, and knowing one's rights within these digital spaces.

[43] For example, with consumer advocacy groups, AI (and VW) developers, ECN/ECS providers, and policymakers.

immersive technologies and in the other areas of competence, also in collaboration with other competent authorities in adjacent areas;

- solutions to improve transparency and protection from VW and AI systems' data-related risks, such as clearly defined systems, AI-driven verification systems[44] and tools embedded in technology ("by design")[45] that detect the type of content generation process and block the illegal content and unlawful interactions.[46]

6. Environmental footprint and sustainability

6.1. AI systems and VW in the twin green and digital transition

The European Union has set the target of reducing gas emissions at least by 55% between 1990 and 2030. Connectivity and digital services are identified by the European Green Deal as levers to support the transition of EU industries through optimisation, transparency and decarbonisation. At the same time, to reach these targets, the Green Deal underlines that **digital technologies should also minimise their own environmental** footprint and apply high green standards, as any other sector of the economy. This includes preventing possible rebounds effects of digitalisation, that should be assessed.

Like any digital service, AI systems and VW rely on physical infrastructure and devices that generate multiple environmental impacts. They require a significant and increasing amount of resources to operate: water, energy, as well as material components for servers and equipment. As highlighted in BEREC previous work[47] on sustainability, **it is key to accurately assess the environmental impacts of digital technologies –** including AI and VW services **– through robust data collection and sustainability indicators.** For example, it would be useful to plan energy requirements as the rising energy consumption of AI, that needs to be

[44] Meta has announced that, building on their implementation of both visible markers on the images, and invisible watermarks and metadata embedded within image files, they are building industry-leading tools that can identify invisible markers at scale – specifically, the "AI generated" information in the C2PA and IPTC technical standards – so to label images from Google, OpenAI, Microsoft, Adobe, Midjourney, and Shutterstock as they implement their plans for adding metadata to images created by their tools.
[45] 'User-centric design', i.e. the design of AI-driven ECN/ECS with a focus on user needs and preferences, including accessibility features for users with disabilities. This approach ensures that AI technologies serve a broad spectrum of users effectively and inclusively.
[46] For example, developing new camera technology that embeds digital signatures in images to provide way to tell real photos from deepfakes.
[47] Relevant previous work from BEREC on environmental sustainability: BoR (22) 93, BEREC Report on Sustainability: Assessing BEREC's contribution to limiting the impact of the digital sector on the environment, 09.06.2022, see: https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-sustainability-assessing-berecs-contribution-to-limiting-the-impact-of-the-digital-sector-on-the-environment; BoR (23) 166, BEREC Report on Sustainability Indicators for Electronic Communications Networks and Services, 05.10.2023, see: https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-sustainability-indicators-for-electronic-communications-networks-and-services; BoR (23) 207, BEREC Draft Report on empowering end-users through environmental transparency on digital products, see: https://www.berec.europa.eu/en/document-categories/berec/reports/draft-berec-report-on-empowering-end-users-through-environmental-transparency-on-digital-products.

correctly measured, could be a burden to the energy goals of Member States**.** Additionally, best practices should be incentivised and supported to promote more sustainable digital solutions in the market, for instance through data-driven regulation or regulatory intervention. In this context, the Energy efficiency recast was an important step towards greener data centres. In line with the recent EC White Paper[48], all players of the digital value chain, including digital services providers, should be considered environmentally accountable. Additionally, with the rise of public-wide AI and VW applications, the empowerment of end-users is relevant in an environmental perspective. AI and VW users should be both aware of the environmental footprint of these technologies and of the ways to mitigate it.

6.2. Key issues for AI systems, and especially generative AI

Some AI-based services could enable more sustainable solutions across the markets. AI has the potential of being used to process the ever-growing amount of data created during industrial, environmental, health and other processes, in order to optimise their energy consumptions and efficiency. For instance, the EU Action Plan on Digitalising the Energy System[49] mentions that AI can be used in the energy sector to better use the potentialities of data obtained from smart monitoring and measuring devices to monitor and optimise individual and collective electricity consumption. **However, this potential contribution to the green transition of industrial sectors can only be effective if AI systems themselves are sustainable.** The rapid development of AI is raising questions about its environmental footprint, that echoes more general issues related to the sustainability of digital technologies.[50]

If the ICT sector carbon footprint is estimated to 3% of EU's GHG emissions, it should be noted that it is currently difficult to know whether AI total emissions are included in this figure.[51] This is due to the issue of defining "ICT sector's" technological frontiers in the context of emerging digital services, and the accountability of these new technologies' footprint as the OECD points out.

AI systems are identified as particularly energy-intensive technologies. The International Energy Agency (IEA), recently published its report on the electricity market[52]: global data centre electricity consumption could double, in the worst-case scenario, between 2022 and 2026 and this increase is likely to be driven by AI (due to a demand potentially ten times greater in 2026 than in 2022). This growth will mainly depend on the pace of AI deployment and whether efficiency gains are achieved. The Joint Research Centre has also published a

[48] White Paper - How to master Europe's digital infrastructure needs? See: https://digital-strategy.ec.europa.eu/en/library/white-paper-how-master-europes-digital-infrastructure-needs.

[49] Digitalising the energy system - EU action plan, see: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0552&qid=1666369684560.

[50] See section 6.1.

[51] OECD, Measuring the environmental impacts of artificial intelligence compute and applications: The AI footprint, 2022, see: https://doi.org/10.1787/7babf571-en.

[52] Electricity 2024 - Analysis and forecast to 2026, see: https://www.iea.org/reports/electricity-2024.

report on the energy consumption in data centres[53], considering that “*emerging technologies such as artificial intelligence […] are poised to boost demand for digital infrastructure […] and is likely to have significant implications for data centre energy use in the upcoming years*”.

Besides, AI systems are responsible for other environmental impacts such as water consumption and mineral/metal depletion. To illustrate this point, servers and their components need abiotic metallic and mineral resources to be manufactured. These servers need the high computing power made possible by electronic chips, a general term for semiconductors (CPU, RAM, GPU or TPU). The manufacturing of these semiconductors requires very high levels of electrical power and consumes a lot of energy[54] and water[55].

AI-based services are digital services that need ECN/ECS and ICT equipment to function, and in particular computing power. In most cases, these are servers operating in data centres and require additional resources compared to those used for the operation of other digital services. Servers need to be cooled by refrigerants, water or air. They also require inverters to supply them with direct current. It is for this reason that it is necessary to consider all of the infrastructure as a whole, using the total energy consumption of the whole data centre.

It is also necessary to consider the manufacturing and use phases of devices, which are not always specific to AI, but some can be.

In order to quantify the environmental footprint of AI, especially generative AI, it is necessary to consider the entire lifecycle of AI-based services, using a multi-criteria, multi-component and multi-stage approach (using the European “Product Environmental Footprint methodology”).

Regarding the transparency related to the environmental footprint of generative AI, there is a lack of data and multicriteria assessments from industry players and even of the scientific literature. Some academic papers have initially focused on the footprint of the training phase that consumes significant amount of resources, energy and water. Nevertheless, it seems that the inference phase (where the capabilities learned during training is put to work) could become the most intensive-energy stage compared to the training phase, due to the number of end-users. Additional assessments are needed to track the energy consumption of the different phases of AI as there is a lack of feedback for this inference phase.

To ensure a comprehensive assessment, it is important to capture all the generative AI system lifecycle stages that are not limited to the two above-mentioned phases[56] (where the

[53] Energy Consumption in Data Centres and Broadband Communication Networks in the EU, see: https://publications.jrc.ec.europa.eu/repository/handle/JRC135926.
[54] Including not only electrical, but also fossil fuel, renewable energy, and others.
[55] Wang et al, Environmental data and facts in the semiconductor manufacturing industry: An unexpected high water and energy consumption situation, 2023, see: https://www.sciencedirect.com/science/article/pii/S2666445323000041.
[56] Next to training and inference other stages can include for example: data collection, data pre-processing (encompassing data cleaning, data augmentation, data preparation and labelling).

environmental footprint can be “hidden” because they are generally shared with other systems or difficult to isolate).

As AI is increasingly integrated into many sectors, including ECN/ECS, their (both direct and indirect) environmental footprint should be properly assessed, in order to minimise adverse effects and promote the potential use cases that can benefit the twin green and digital transitions. Such assessments should be based on the existing standards.[57] At policy level, information could allow including environmental considerations in the risk assessments as defined by the AI Act aimed at minimising the environmental footprint for the use of AI systems in the EU digital markets. Integrating environmental considerations of AI system from its early stage advocates for the promoting sustainability-by-design AI services, such as frugal AI.

6.3. Key issues for VW

Only few assessments exist to quantify the environmental impacts (direct or indirect) of VW. As for generative AI, **the entire lifecycle of VW should be considered when it comes to its environmental footprint, including manufacturing of VR/AR/MR[58] headsets.**[59] VW tend to be paired with the use of a dedicated device (for instance: VR headsets). This characteristic can be problematic in an environmental perspective: devices – especially their manufacturing – constitute the majority of the ICT sector environmental impact (between 60-80% of GHG emissions of the ICT sector[60]). Special attention should be paid to preventing an increase of devices environmental footprint caused by VW applications. In the same line, it will also have an impact on data centres and networks, as VW require computation resources, connectivity and networks infrastructures to meet the needs[61], in order to provide increasingly rich content. Indeed, the design of certain VW applications is based on “economy of attention” strategies, that is on practices to capture the user’s attention, leading to incremental online consumption associated with increasing needs for resources.[62]

6.4. Promoting more sustainable and frugal AI and VW

Environmental studies are needed to identify the main levers in order to reduce the environmental footprint of AI, towards a “frugal AI”, and sustainable VW. Environmental issues should be included in EU policies supporting innovation. As there is a strong interdependency

[57] ITU-T L.1480, Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors.

[58] VR – virtual reality/ AR – augmented reality /MR - mixed reality.

[59] Cas d'Étude Pour un Immersif Responsable, see: https://www.cepir.info/.

[60] BoR (22) 34, External Sustainability Study on Environmental impact of electronic communications, 10.03.2022, see:https://www.berec.europa.eu/en/document-categories/berec/reports/external-sustainability-study-on-environmental-impact-of-electronic-communications.

[61] The Shift Project, Energie, climat: Quels mondes virtuels pour quel monde réel?, 2023.

[62] BoR (23) 207, Draft BEREC Report on empowering end-users through environmental transparency on digital products, 07.12.2023, see: https://www.berec.europa.eu/en/document-categories/berec/reports/draft-berec-report-on-empowering-end-users-through-environmental-transparency-on-digital-products.

between devices, data centres and networks, attention should be given to minimise digital services impact on devices and infrastructures' footprint by promoting proper eco-design criteria and environmental transparency on these devices. Thus, AI-based services and VW should include eco-design considerations at the beginning of the projects.[63] To sum up, it appears important to include environmental sustainability in EU innovation strategy – including where AI and VW are concerned – to combine the green and digital transition.

7. Cybersecurity

On the one hand, AI may bring threats and attacks to systems to a whole other level of complexity[64], and may even jeopardize the provision or the availability of the ECN/ECS itself. It will transform the risk landscape in a more profound way[65], since attackers are able to exploit the flexibility and power of those self-learning systems. Thus, it is of utmost importance to invest in a secure foundation that manages risks appropriately.

On the other hand, AI can be used to take network security to the next level as well, improving the learning curve in the management of cybersecurity issues. It could help in developing more agile and automated capabilities, able to react to subtly changing or threatening situations. AI could be leveraged to identify fraudulent behaviours in real time and to improve threat detection by continuously analysing data traffic (e.g. detecting system failures, security breaches, rogue devices, false base stations, malware).[66]

VW will be confronted with an extra layer of cyber risks and threats, that do not only relate to the underlying infrastructure and data. In this new VR, each person will have their own virtual identity and will be vulnerable for certain attacks that already exist in real life environment, but that will be easier to undertake in the anonymous VW. Hackers could rather alternate or mutilate someone's virtual avatar or steal someone's VR data or property, without having to have a confrontation with that person.

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[63] This emphasis on digital services eco-design echoes BEREC analysis on sustainability in its input to the future of the electronic communications sector and its infrastructure public consultation (BoR (23) 131), see: https://www.berec.europa.eu/en/document-categories/berec/others/berec-input-to-the-ecs-exploratory-consultation-on-the-future-of-the-electronics-communications-sector-and-its-infrastructure.

[64] For example, LLM can be used as a tool for the (automated, responsive) creation of (malicious) software code. Moreover, generative AI can be used to gather employee information and writing credible, persuasive text or creating recognizable voices and video, ringing in a new era of advanced spear phishing attacks. Orchestrated LLM can automate advanced attack workflows. At the same time, they can react to, and circumvent, defenders (real-time) countermeasures.

[65] As AI powers attacks by i) developing malware that can adapt to avoid detection, ii) generating personalized phishing / smishing attacks and deepfakes for impersonation scams, among other forms of risks.

[66] For example, LLM can analyse a very large amount of data related to cybersecurity intelligence, which is the core task of any Security Operations Center. They can also accelerate incident response by quickly reverse-engineering unidentified software code and get insights in its capabilities and orchestrated LLM can actively manage incident response, instantly reacting to an attack.

Furthermore, the devices used to access the VW may be susceptible to hacking as well. Head-mounted displays are used to create an engaging and fully immersive computing experience. But the images perceived and the audio listened to can be distorted to create physical harm.

BEREC plans to explore the challenges and opportunities related to the use of AI based solutions.