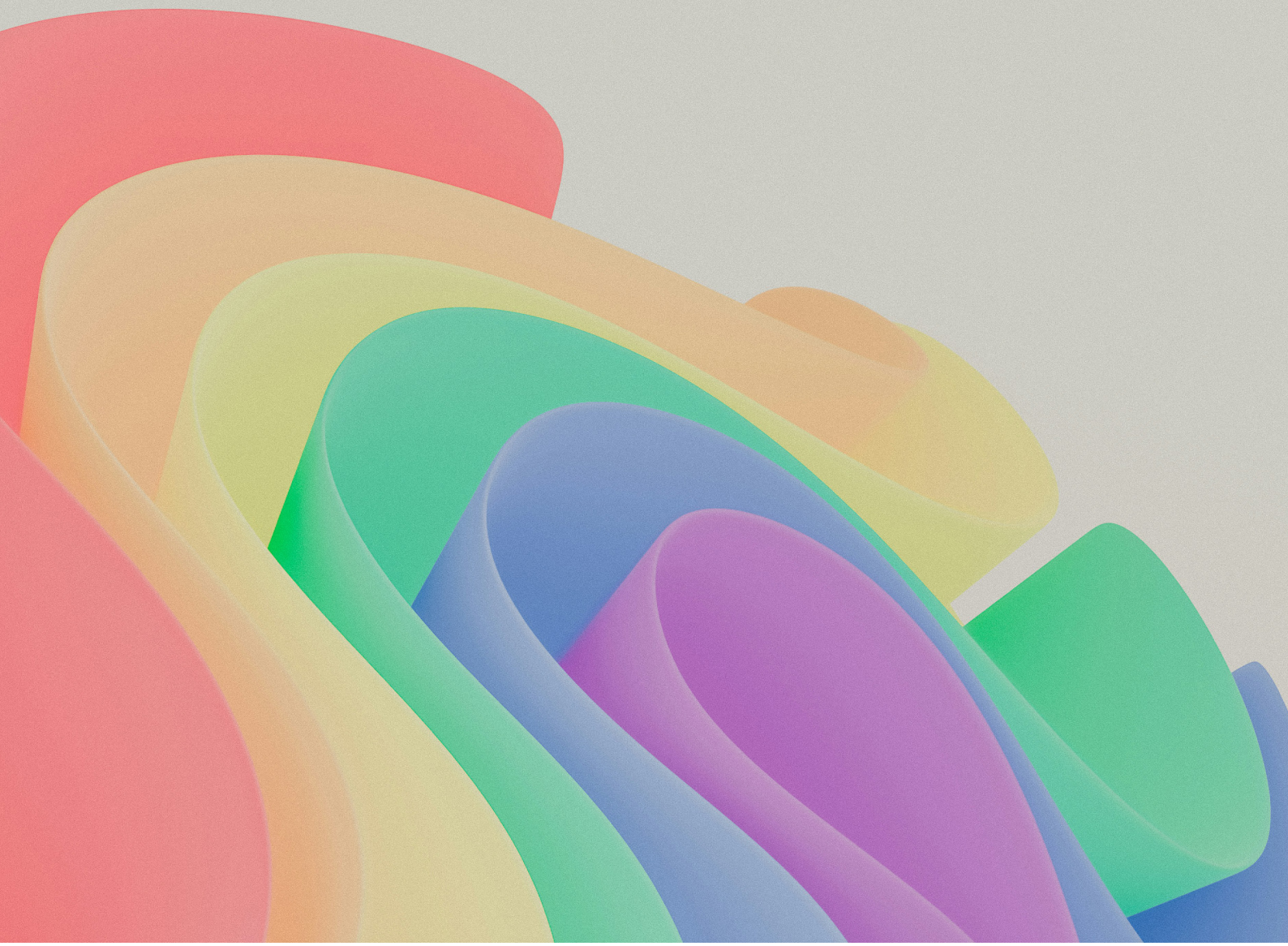
Immersive Technologies Foresight Paper

December 2023



DRCF

Digital Regulation Cooperation Forum

CMA Competition & Markets Authority · Ofcom making communications work for everyone · ico. Information Commissioner's Office · FCA Financial Conduct Authority

This paper aims to foster debate and discussion among our stakeholders. It should not be taken as an indication of current or future policy by any of the member regulators of the Digital Regulation Cooperation Forum (DRCF).

Contents

Executive Summary

Immersive technologies and immersive environments

'Immersive technologies' encompass a wide range of systems and services including virtual reality (VR), mixed reality (MR) and augmented reality (AR). 'Immersive environments' are computer-generated 'worlds' where a user can feel as if they are present. Whilst at its most expansive, immersive environments can refer to environments accessed using a range of technologies, including games consoles, this paper focuses primarily on immersive environments accessed through VR, MR and AR. Although currently most commonly used in gaming, use cases are expanding across a range of sectors including design, education and retail.

It is uncertain how immersive technologies will develop and how successful they will be. There is potential for immersive technologies to transform the way consumers use online services including shopping, entertainment, communications and social media. Compared to 'traditional' online platforms, people using these services could interact in ways that feel more akin to real life and in real time. Users might also create and manipulate digital content, such as avatars or objects, allowing them to find new ways to express themselves and interact with each other. The potential market for immersive technologies could be significant. Some estimates suggest the market will grow to well over USD 100 billion in the next decade.[1]

Factors shaping developments in immersive technologies

Immersive technologies could bring significant benefits to consumers, businesses, and the wider economy, but there are also potential risks to consider. It is therefore important for regulators to understand the different factors that will shape the impact of immersive technologies and the implications of those factors.

Through discussions with internal and external experts and desk-based research, we have identified several factors that could shape the future of immersive technologies and environments. These include consumer demand and behaviour, how relevant software and hardware evolves (including quality and price), the degree of interoperability, level of personalisation, different applications that may emerge (e.g. education, live events, retail), business models within immersive environments, as well as broader interactions such as with connectivity and other emerging technologies (e.g. AI or quantum computing).

We consider each of these factors in turn, how they might evolve or interact with each other, and the resulting impact on the wider future immersive technology landscape.

---

1 For example, Immersive Technology Market Size is Projected to Reach USD (globenewswire.com). suggests USD 144.5 billion by 2032. Another suggests it could be USD 167.75 billion: Immersive Technology Market Size, Trends, Growth, Report 2032 (precedenceresearch.com).

Regulatory implications

Immersive technologies and environments will give rise to a range of issues that regulators will need to consider. There are some regulatory implications that require consideration regardless of the level of adoption. There are also other more speculative implications that may arise or become more prominent in the future as the market develops and if adoption increases.

Implications which would be relevant at any level of adoption of immersive technologies include:

- **Processing of biometric data**. Immersive technologies may gather biometric data (such as iris patterns) for the purpose of identifying users, and biological data such as users' eye movements and heartrates to measure reactions to the immersive environment. Organisations will need to consider how to safely process that data.
- **Data protection and security**. If immersive technologies become more personalised, a greater volume of data is likely to be used to build sophisticated user profiles. In turn, it will be important for users to be able to understand what data is being collected and how it is used and protected, including if it is being shared with third parties. No matter what the level of uptake of immersive technologies, organisations will need to ensure they are transparent about how they are processing users' data and for what purposes.
- **New types of harms**. Some unique or novel forms of harm could arise specifically in immersive environments, including new types of misinformation and disinformation. Bad actors could alter a user's perception, subtly altering what they see and hear as they perceive it in real-time. Immersive technologies and services may also introduce unique risks and new channels for scams and fraud. In addition, the potentially heightened sense of immersion could lead people to make impulsive and uninformed financial decisions which are not in their best interests.
- **Online safety**. As with existing online services, harmful and illegal content may arise in immersive environments, but because immersive environments have the potential to feel more 'real', the impact and extent of harms could be exacerbated.
- **New types of scams, and scams made more convincing in immersive environments**. The technologies underpinning immersive environments may enable scammers to more easily target and apply pressure to users.
- **Exploitation of behavioural biases**. Immersive environments open an avenue for new, more complex and possibly opaque online choice architecture practices. This may enable further exploitation of behavioural biases.

- **Competition and consumer impacts laws**. Users may benefit significantly from innovation in immersive technologies if competition works well and consumers are appropriately protected. Barriers to effective competition could arise in a number of ways, including through the emergence of 'walled gardens' where interoperability between immersive products and services is limited, or users are unable to move their data easily between systems. This problem could be exacerbated if there are large players in this market.
- **The role of artificial intelligence**. AI systems may be used to provide users with the benefits of more convincing, engaging experiences in real-time. This use of AI will come with its own set of considerations, which will need to be addressed to ensure users aren't impacted negatively through implicit bias, for example.

The regulatory implications which may arise or become more prominent in the future as the market develops and if adoption increases include:

- **Competition and consumer impacts**. As above, while competition and consumer impacts could occur even with a relatively small user base, there is also the potential for some of these issues to be exacerbated where uptake of immersive technologies is high. For example, if there is a rise of dominant players in immersive technologies or environments.
- **Finance and payments**. As there is great uncertainty on how payments in immersive technologies and environments might evolve, potential regulatory implications will depend on uptake and how these develop. For example, there could be new payment methods offered and a high degree of competition in this space. Alternatively, if competition is low e.g. with high degree of self-preferencing then there could be negative impacts for consumers such as limited choice or higher prices.
- **Media content**. Immersive technologies could provide a new 'gateway' for people to view media content and, particularly if take up is significant, may even supplant existing media platforms. If so, there will be regulatory issues for Ofcom to consider in relation to public service media as well as strategic considerations for media stakeholders to grapple with.
- **Media literacy and the "digital divide"**. The way people interact with each other through immersive technologies and environments could be very different to how we communicate through current online services. As a result, users may require new skills and understanding to access the opportunities available, while avoiding the potential risks and harms. These harms might include new types of digital exclusion and the risk that as usage of emerging technologies such as immersive technology increases, those without the means to access them could get left behind.

- **Financial crime and fraud**. Immersive technologies and environments could develop in a way that enhances user experience of financial transactions, including customer verification to reduce the risk of fraud. As with any emerging technology there is also the potential for financial crime and fraud to occur.

- **Financial products**. If there is a growth in financial services such as personal banking or advice being provided through immersive technologies e.g. VR, then there will need to be clarity on any differing levels of regulatory protection. This will be particularly important if there is a high degree of interoperability.

- **Environmental impact**. Immersive technologies are likely to require large volumes of computing power, which in turn will have an impact on energy use and environmental sustainability.

- **A need for improved infrastructure**. Immersive technologies may increase demand for connectivity which in turn could place additional demands on telecoms networks including a need for more capacity and lower latency.

Many of these issues are relevant to multiple regulators within the DRCF, thereby emphasising the importance of regulatory coherence. As immersive technologies evolve, the DRCF member regulators will seek to support their development in ways that promote open, competitive markets, as well as protecting consumers and their information rights. We hope that these initial views on potential regulatory concerns will help to guide responsible development of these technologies. Going forward, ongoing dialogue with industry, government and academia, and other interested stakeholders will enhance our mutual understanding of the intersections of immersive technologies and existing regulation. This may help the UK harness the potential of immersive technologies and services while shaping responsible innovation.

Introduction

The Digital Regulation Cooperation Forum (DRCF) was established to ensure coherence between the regulatory regimes of its member regulators (the Competition and Markets Authority (CMA), Financial Conduct Authority (FCA), Information Commissioner's Office (ICO), and Ofcom), to work together on complex challenges and develop capabilities for the future. Through our horizon scanning and emerging technology programme, the DRCF takes a proactive approach to understanding the potential benefits, risks, and regulatory implications of emerging technologies.

This paper is the product of a research and foresight activity cycle to consider the future of immersive technologies, to better understand how immersive environments might evolve and the key uncertainties that could drive changes to them. This foresight paper summarises insight from that process and then sets out the potential regulatory implications that may arise depending on how these environments develop in the future.

'Immersive technologies' encompass a wide range of systems and services including virtual reality (VR), mixed reality (MR) and augmented reality (AR). 'Immersive environments' are computer-generated 'worlds' where a user can feel as if they are present. Whilst at its most expansive, 'immersive environments' can refer to environments accessed using a range of technologies, including games consoles, we focus primarily on immersive environments accessed through VR, MR and AR.

Immersive environments are already popular in gaming, with applications growing across a range of sectors such as education, retail and finance. Whilst the specifics of future developments remain highly uncertain, immersive technologies and their applications will increasingly fall within existing regulatory regimes and may raise novel issues for regulators. As part of the DRCF's horizon scanning and emerging technology programme, member regulators (the CMA, FCA, ICO and Ofcom) have considered how immersive technologies and environments might develop. In this paper we share insights, highlight key regulatory considerations, and contribute to ongoing dialogue with industry, government and academia and other interested stakeholders.

In developing this paper, we have conducted a range of research and futures analysis such as horizon scanning, trend analysis and the exploration of hypothetical scenarios for the future to consider the ways in which immersive environments might evolve. This has also enabled further engagement and the advancement of strategic thinking between relevant policy teams across member regulators. Figure 1 below summarises our research approach (for further detail on methodology see Annex 1).

Stage	Description	Details
1 **Desk based research**	Mapping of key developments in immersive tech across sectors including exploring tech dependencies, market maturity and dominant players	Conducted by each of the member regulators
2 **Stakeholder mapping**	Map relevant stakeholders across sectors to provide a diversity of perspectives for interviews and workshops	Conducted by each of the member regulators
3 **Expert interviews**	7 question style interviews to explore the drivers of change shaping immersive environments	10 expert interviews across industry, academia and technology fields
4 **Workshop 1: Driver mapping**	Workshop to explore: i. drivers of change shaping IE ii. uncertainty mapping of key drivers iii. trend extrapolation to identify direction	Over 20 attendees across academia, industry, technology fields and regulatory bodies
5 **Workshop 2: Scenario implications**	Workshop to analyse the implications posed by each of the four scenarios using: i. axis of uncertainty ii. futures wheel	
6 **Implications workshop**	Activity based workshop to explore the regulatory implications created by each of the scenarios and general regulatory implications posed by immersive technologies	Each member regulator held an internal-only workshop

Figure 1: DRCF Immersive Futures Methodology

The rest of the paper is structured as follows:

- **Section 1** begins with selected highlights of the findings gathered across the workshops and expert interviews, including the key uncertainties and drivers likely to shape the development of future immersive technologies and environments.
- **Section 2** explores some of the regulatory issues that may arise from immersive technologies and environments, that DRCF member regulators will need to consider.
- **Section 3** sets out our conclusions and the next steps.
- **Annex 1** provides further detail on our methodology.
- **Annex 2** sets out the four scenarios we developed based on two of the identified and prioritised uncertainties - interoperability and personalisation - and the key implications for each. These scenarios formed a key input into our regulatory considerations section.

Section 1: Factors shaping immersive technologies and environments

Immersive technologies and environments have the potential to bring significant benefits to consumers, businesses and the wider economy. However, the extent to which immersive technologies and environments are adopted, and exactly how they will impact our society is still highly uncertain. At one extreme, it is possible that immersive technologies do not extend their reach further and continue to be used for a discrete set of use cases, such as gaming, or even decrease in popularity, ultimately remaining niche. At the other extreme, immersive environments could be transformative, shaping the ways in which consumers access and use many online services including shopping, entertainment, communications, and social media, and ultimately how they live their lives.

Predicting exactly what the future will look like is not possible. The experts we engaged with held drastically different views on the possible trajectories of development - ranging from predictions that immersive technologies will render traditional TVs and smartphones obsolete by 2030, to scepticism that immersive technologies will become mainstream. As such, in this section we explore the key uncertainties identified through desk research, stakeholder interviews and internal and external workshops, that will impact the future of immersive technologies. In Annex 2, we set out the four plausible scenarios of the future we developed out of the countless possibilities to help further explore these uncertainties.

This section first focuses on uncertainties relating to the development and take-up of **immersive technologies** themselves - what might be required for immersive technology to become the next transformative universal computing platform, and what are the barriers. This section then explores some of the factors and uncertainties that might influence how **immersive environments** evolve and impact consumers. There are countless plausible paths immersive environments might take, so we set out some of the uncertainties rather than making predictions.

Factors shaping the development and uptake of immersive technology

Consumer demand and behaviour

Adoption of immersive technologies, and the development of the devices themselves, will in part depend on consumer demand and, particularly in the case of hardware, willingness to pay. Experts we spoke to had differing opinions; some argued it may take decades for immersive technologies to truly impact consumers' day-to-day lives, whilst others suggested that greater cultural acceptance of screen time and living life online, particularly among younger generations, means that once the right device emerges, adoption could grow rapidly and transform how consumers conduct a range of activities.

It is difficult to predict the future popularity of particular applications or devices. It may be that a device with the right form factor - size, shape and design - is able to stimulate mainstream demand. An example of this is the iPhone. Certain forms of smartphones, including many with physical keyboards but some with touchscreens, had been around for several years. However, the iPhone's launch with a high resolution and multi-touch screen, alongside a range of other features, meant it was able to break-through into the market. Despite some initial backlash to the iPhone's pricing, and some refinement over several generations before significant adoption, within less than a decade of the iPhone's 2007 launch, smartphones had become the centre of our digital lives.

However, it is also possible that, rather than becoming the next smartphone, immersive technologies could fail to gain broad adoption - it might be there is no form factor that will drive immersive technology towards mass adoption. A lack of adoption could be related to potential consumer concerns such as a lack of use cases, poor user experience or privacy. Or it may simply be that consumers do not see the attraction.

Evolution of devices

The extent to which devices and technologies improve and costs come down will be a key determinant of adoption. Improvements in the underlying hardware may be necessary. Such improvements may involve computing capacity and size, battery density, cameras and other forms of sensors, optics, screen quality and haptic technology - in some cases incorporated into a single device. This will all depend on a range of factors, including the extent of funding and investment from a range of sources, including technology firms.

It is possible that innovative solutions may overcome some of these physical limitations, such as device size. For example, through 'pixel streaming', whereby immersive environments are generated on a remote server rather than at the device level, devices can be smaller as they require less computing power. However, this relies on accessibility to high-speed, reliable and low latency connectivity (see below).

Another uncertainty is the extent to which different immersive technologies develop. For example, the degree of investment in Augmented Reality (AR) compared to Virtual Reality (VR) may determine which is more likely to develop, which will influence adoption. It is also possible that there may be some convergence between AR and VR rather than them requiring distinct equipment and software - Apple Vision Pro has done this to some extent, and such Mixed Reality (MR) appears to be the current focus for a number of device manufacturers. Similarly, there is uncertainty around the evolution of device designs - future immersive technologies could include headsets, further improved glasses, contact lenses, or something entirely new.

Developments in connectivity technologies and networks

If immersive technologies become widespread, and utilise computing models such as pixel streaming, the data transfer requirements could be enormous. The extent to which immersive technologies can become truly ubiquitous and enable real-time interaction will depend on the development and roll-out of connectivity technologies and networks - at least insofar as the immersive experiences have some online component. As shown in Figure 2, VR requires significantly higher throughput (rate of data transfer) and lower latency (time for data to get from source server to local device) than video applications.

As a result, the extent to which immersive technologies can become truly immersive and widely available will depend on the rollout and uptake of connectivity such as full fibre, 5G and future connectivity technologies like 6G.

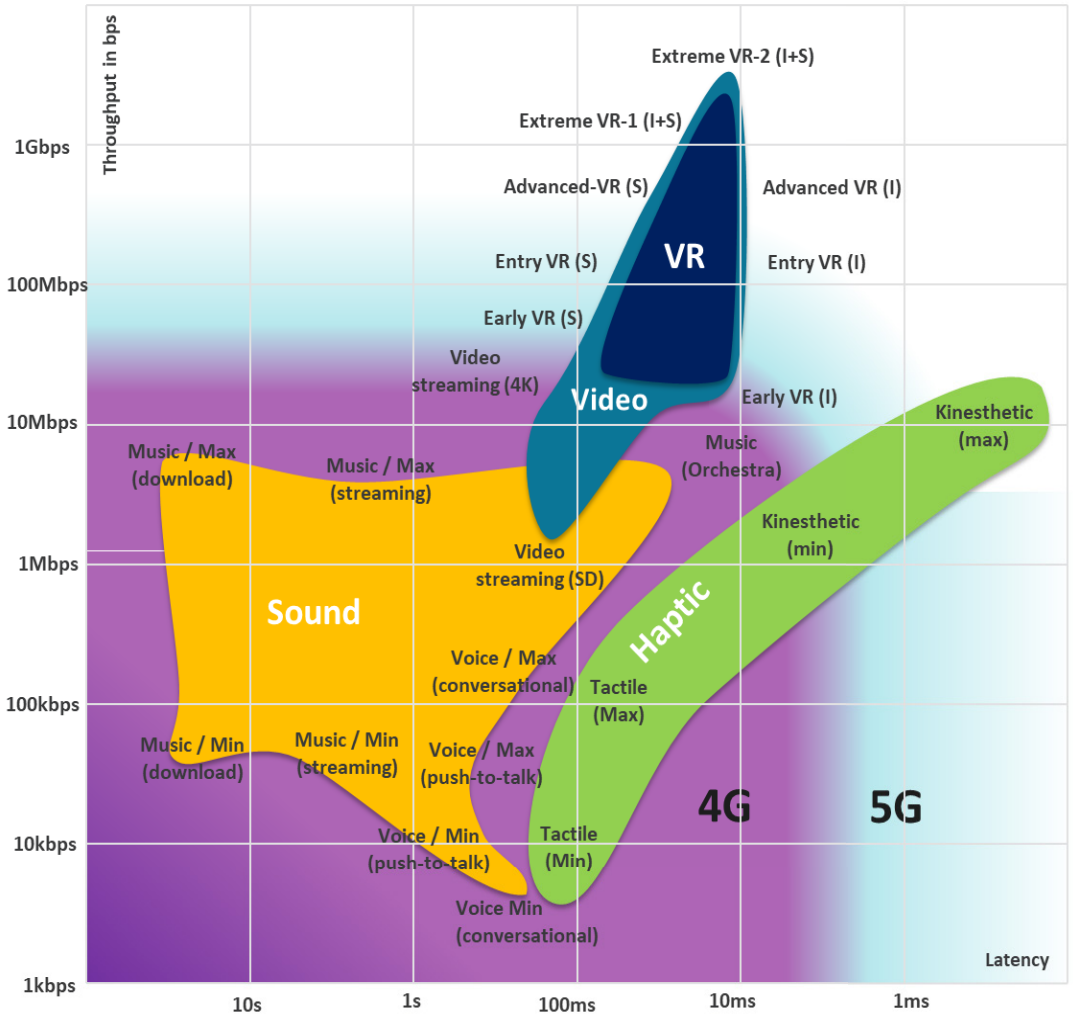


Figure 2: shows how advanced VR requires high throughput and low latency[2]

2 See Ofcom's Technology Futures report for more detail. Haptic refers to the communication of movement and touch. (S) refers to 'streaming' and (I) refers to 'interactive'. Note that the 1 ms and 10 ms represent over-the-air interface latency for or 4G and 5G, respectively. Real-world latency might be larger, depending on where relevant core network functions are implemented. e.g. a deployment with core functions at the edge will be able to achieve latencies closer to the numbers indicated in the figure.

Interaction with other emerging technologies

The uncertainty associated with immersive technologies is compounded by the lack of clarity about how they might interact with other new or emerging trends and technologies, such as web3,[3] IoT,[4] AI, neural interfaces[5] and quantum computing.[6]

New technologies could create the conditions for new device types to become popular, which could enable immersive technology to become mainstream. For example, immersive technologies may be better placed to incorporate generative AI than handsets - Meta, in partnership with Ray-Ban, has already announced new 'smart glasses' that incorporate Meta's AI 'conversational assistant'.[7]

New technologies could also aid the development of more sophisticated and scalable immersive technologies and environments. For example, generative AI may enhance the capabilities of AR or VR devices, including the creation of vast, complex virtual worlds more quickly than currently possible.

3 There is little consensus on the definition of Web3. Proponents of Web3 state that its aim is to re-balance power on the web between users and online platforms and provide users with greater control over their data. There are a range of ideas about how this might be achieved; most, however, point to decentralisation as the underpinning concept and DLT as the underlying technology. For more detail, see DRCF (2023) **Insight Paper on Web3 - GOV.UK (www.gov.uk)** and **The metaverse meets Web3: the state of convergence in the UK - Digital Catapult | Digital Catapult (digicatapult.org.uk)**

4 The Internet of Things (IoT) is the collection of all devices that can be connected to the internet or to other devices.

5 Neural interfaces are devices that connect a user's brain or other part of their nervous system to a digital device. See for example: Royal Society (2019) **Neural interfaces - 2019 report | Royal Society**

6 See DRCF (2023) **Quantum Technologies Insights Paper | DRCF**

7 **https://about.fb.com/news/2023/09/new-ray-ban-meta-smart-glasses/**

Factors shaping the evolution of immersive environments

The extent to which immersive technologies develop and are adopted will also influence how the immersive environments they enable access to will look and feel. For example, investment in the environments themselves is likely to be higher if there is a large user base. Similarly, environments accessed through AR will differ from VR environments. However, there are a number of other factors and uncertainties that will influence how immersive environments look and feel. We consider some of these below.

Applications

A range of current and potential applications are advertised by proponents of immersive technologies, such as Meta. These include immersive social interaction (as evidenced in Meta's Horizon Worlds), gaming, immersive experiences such as concerts and live events such as sport, shopping, skills and training, healthcare and medicine. Taken together, these applications could transform the lives of consumers, offering a wide array of economic and individual benefits.

Exactly which of these applications might become mainstream is uncertain. Additionally, it is possible entirely novel applications emerge as the technology develops and developers gain access – currently it is only possible to draw on known potential applications to imagine plausible futures, but we should expect that other applications we can't predict today might emerge. For example, a range of smartphone-native platform businesses such as Uber and Tinder achieved prominence based on advanced smartphones and true mobile broadband. These applications differed from those originally envisaged for the smartphone or 4G, such as video calling and mobile access to existing, PC-native online services. The same may be true for immersive environments, and the further into the future we look, the greater the uncertainty and difficulty in anticipating the types of applications.

For any given application with a non-immersive counterpart today, there is also uncertainty around the extent to which these might be considered 'extensions' of existing services. For example, will the leading immersive shopping experience be offered by Amazon? Will Activision Blizzard be a major player in a future immersive gaming ecosystem? Will existing content platforms, such as TikTok or YouTube, evolve to become more immersive? Or will new, 'immersive technology native' services emerge?

Business models

Similarly, the business models that will support future applications remain uncertain. Business models could be broadly akin to those that already operate on the internet. For example, some applications may be based on a traditional purchase or subscription options. Others may be free, but with the option to spend money on in-game currency or 'loot box' equivalents, whereas others may be ad-supported, driven by data-enabled personalisation.

It is also possible that the unique features of immersive environments could enable service providers to push existing models further. For example, ad-supported models could draw on biometric data to further personalise advertising. Or, given the immersive nature of the experience, real-world selling tactics, such as mood-altering soundtracks or product placement, could be deployed to increase sales by exploiting behavioural biases. Alternatively, entirely new business models could also emerge - for example decentralised platforms run by their users, or new models we have not yet envisaged.

Interoperability

Interoperability between immersive environments can be loosely defined as the ability of a user to seamlessly transfer information such as settings, preferences, and other data between environments.[8] Experts we consulted confirmed there is currently low interoperability between immersive environments from different providers.

Interoperability could remain at this low level or develop further. For example, it can be argued that federated sign-on solutions (typically signing into a service through a Google or Facebook account) are an example of low-level interoperability between services. A more complex form of interoperability might involve the ability to access the same services across different devices - for example being able to access an experience either on a mobile phone or through a VR headset. An even more complex example of interoperability might be the transfer of assets between immersive environments, though the ability to transfer, for instance, a virtual football might be complicated due to the different properties between different virtual worlds.

In the case of low or limited interoperability between future immersive environments, users would have to disengage from one environment to access another. Limited interoperability may be due to technical reasons, or in some cases a commercial decision. Even if settings or preferences were stored locally to the user, they would still have to be presented separately in each environment.

8 For the purpose of this report we focus on so-called 'horizontal interoperability' i.e. the ability to transfer certain information between two services operating at the same level of a supply chain (e.g. two social media platforms).

Personalisation

Personalisation is the extent to which an experience, the embodiment or identity of the user, and even the environment, are altered based on the user. There is uncertainty as to how personalisation may evolve in future digital services.

At one end of the scale, personalisation in immersive environments could be off by default and a user's experience would initially be set to a common, un-personalised template. This might be an agreed standard across industry (to facilitate interoperability, for example), because of regulations (for example, to meet the requirements of the ICO's Children's code[9]), or due to other factors. This would not prevent users from customising their avatar and experience, but it would mean that personalisation would not be a requirement. Should a user wish to limit the amount of information they present about themselves to third parties (including both the platform and other users of it) they could leave everything at a minimum level of personalisation.

At the other extreme, hyper-personalisation could become the norm and the totality of a user's experience would be customised by default. This would include everything from how they perceive the environment and others in it, to how they present themselves to others (their avatar's appearance or 'skin', any visual effects like auras or add-ons, even voice and associated sounds). This hyper-personalisation could extend into other aspects of the immersive environment, with advertisers and the platform able to understand the user's preferences in greater detail.

9 https://ico.org.uk/for-the-public/the-children-s-code-what-is-it/

Section 2: Regulatory Considerations

Whilst immersive technologies and environments develop and use cases evolve, existing regulation will continue to apply. However, the technology may raise novel issues, some of which might require regulators to think in new ways or take new, innovative approaches. In this section, we explore some of the regulatory issues arising from immersive technologies that DRCF member regulators may need to consider. Some topics are particularly relevant to one regulator, while others straddle the remits of multiple regulators and will require coordination.

We split the topics into two categories, to distinguish between issues that require active consideration now, and others that are more forward looking:

- **Regulatory issues that require consideration regardless of the level of adoption**. Member regulators will actively consider these issues in ongoing policy work.
- **Regulatory issues that may arise as the market develops and if adoption increases.** In relation to these issues, member regulators will continue to monitor market developments and the adoption of immersive technologies - including through coordination and sharing findings via the DRCF - and be prepared to act when necessary.

Regulatory issues that arise regardless of level of adoption

Consumer adoption of immersive technology is currently low[10] suggesting that participation in immersive environments is still a fairly niche activity. In addition, it is primarily used for a small set of activities, such as gaming. Despite this, it is important for DRCF member regulators to ensure that individuals can enjoy the benefits of immersive technologies while being appropriately safeguarded against any potential harms. Below, we explore regulatory issues that might need to be considered to deliver this goal.

Immersive technologies may collect biometric and other data to create inferences about users

It may be necessary for some forms of data to be captured for certain immersive environments or features of them to function. This could include data about usage, 'gaze tracking' to accurately render what the user should be able to see, and biometric data for user identification, such as facial or iris images. Some additional biological data not under the user's direct control might also be collected, for example pupil dilation or heart rate to measure their reaction to entertainment. The range and extent of this data collection could surpass data collected by traditional online services, which may lead to detailed inferences being made about an individual's tastes and interests, and the development of sophisticated user profiles.

As further inferences are drawn from combining and processing different data sources, there will be a need to ensure transparency. This includes presenting privacy information to the user (or whomever is responsible for them) about how their data is being used within the immersive environment, particularly where the data is given additional protections, such as special category data for example. Special category data, including biometric data, health data and data about a person's sex life or orientation, is afforded greater protection under data protection law. Without information about and understanding of where data is being used and by whom, users will be unable to exercise their data protection rights, such as requesting their personal information is corrected or deleted.

If immersive services become more personalised, there may be a greater volume of data used and retained to build user profiles. As generations potentially become immersive environment-native (in the same way that some adults have not known life without the internet or social media), the persistence and volume of sensitive data is likely to increase.

10 For example, **Ofcom's Tech Tracker 2022** found that only 7% of respondents had a VR or virtual reality headset in their home.

This is true both where an individual remains a user of a platform for an extended period (in walled-garden environments) or where a user frequents multiple platforms resulting in a significant transfer of that data between environments (in interoperable environments). User profile data retention will need to be necessary and proportionate to the purpose for which it is being processed.

It is uncertain whether there will be international standards, equivalency, and reciprocal agreements specific to immersive environment data in the future. If this happens, it is possible that it may be simple to switch between immersive environments by requesting data and importing that into the new environment. Even in scenarios where an immersive environment is operating as a walled garden, it is highly likely that immersive environment platform systems will be geographically diverse, raising questions about sharing data (potentially including sensitive data) across national boundaries and differing data protection regimes.

Nowadays, we are familiar with the concept of users paying for services through access to their data. In future immersive environments, care must be taken to ensure that users are not compelled to share more sensitive data captured in immersive environments to be able to access content without understanding the repercussions. Data collection and processing in future immersive environments must be based on necessity and proportionality. One way to achieve this might be to limit what types of data are shared with the platform, and which are processed locally on the user's hardware. Some current-day manufacturers and platforms are already using this model, where the biometric data used to authenticate a user is processed on the local hardware, and only the data created within the platform once it is accessed is available to that platform (and third parties with access to it).

The data needed to enable interoperability may raise further data protection and security concerns

Interoperability between immersive environments would mean that users could move between platforms and services with little to no friction, potentially taking their online wallets, avatars, contacts, interactions, assets and the data of their activities with them. To do this, platforms would need some way of identifying individuals as they move between environments. This could potentially mean a growth in third-party login managers or transferrable identity services. While this applies to current online services, the quantity and nature of data used for immersive services (verification of a user's identity or age using biometric data, for example) could make a material difference to the privacy and data protection implications.

Some of these issues could be addressed through privacy enhancing technologies such as zero knowledge proofs, which could be used to assert statements about a user (such as meeting age requirements), without having to provide the identity data itself. This may be used in age assurance[11] methods, for example.

The DRCF horizon scanning emerging technology programme[12] is planning to conduct further work on the regulatory issues associated with digital identity.

Immersive technologies may raise novel forms of harm

Harmful and illegal content can arise in immersive environments just like on any other platforms. As such, at a minimum, the uptake of immersive technology may provide another avenue for such content to be accessed. However, it is also possible that immersive technologies could enable unique or novel forms of harm that need to be considered specifically.

Content can be presented and discovered in new ways, and has the potential to expand beyond text, images, and videos. For instance, some interactions enabled by immersive technology may occur in real-time, meaning some content could be ephemeral with no or limited record of interactions. This, alongside the need to consider the conduct of the user as well as content may present challenges to moderation. Where users are able to transition easily between platforms, and experiences are highly interoperable, it may be more challenging to determine who is responsible for moderating a given piece of content or interaction.

In addition, it is possible that users may interact with a more diverse range of users relative to 'traditional' platforms, which may increase the number of potential sources of harm. For example, in social media, content may be curated based on who the user 'follows'. By contrast, when entering an immersive platform, users may be placed in an environment with other users based on factors such as availability and network latency, which may increase interaction with strangers.

Whilst we are likely to see existing harms experienced in an adapted form in immersive environments, there is also the possibility that new and unique harms may arise from technologies that enable a more realistic experience and collect more in-depth sensory data. For example, it is possible that the added realism increases the magnitude of a given harm to the user. It is also possible that when using AR technologies, users' perception and experience of the world could be altered, deviating away from what is objectively true.

11 Age assurance refers to a number of measures which would allow organisations to prevent children from accessing services which are inappropriate for their age, and also to tailor services to suit their developmental needs.

12 See: **https://www.drcf.org.uk/projects/projects/project-page-2**

Beyond potential uses to influence consumer choice, such alteration of sensory data might also manifest in more insidious and harmful ways, such as to disinform and misinform users for political gain by subtly altering what users see and hear in real-time.

In order to fulfil its new role as regulator for online safety,[13] Ofcom will publish codes and guidance, initially through a series of consultations. The Online Safety Act places obligations on a range of online platforms relating to the removal of illegal content, and content that is legal but harmful to children. The ways in which online safety codes and guidance apply to immersive environments will need to be carefully considered, particularly if uptake is significant. If new, unforeseen harms emerge due to the uptake of immersive technologies then Ofcom may choose to consider the case for updating its codes of practice to reflect them.

Immersive technology may enable new, convincing scams

Similarly, the use of immersive technologies such as AR, VR and XR introduces unique risks and new channels for potential scams. They provide a platform for the adaptation and amplification of traditional harms such as high-pressure sales tactics and boiler room scams.[14] Our existing regulatory frameworks will likely be relevant to this type of practice. For example, in respect of financial services, firms must ensure they act within the FCA's existing regulatory framework, including the new duty to meet a higher standard of consumer protection.[15] Similarly, the CMA has powers in respect of consumer protection law that might apply. The heightened realism and emotional immersion created by these technologies might lead individuals to make impulsive and un-informed financial decisions, posing new challenges for regulators. Immersive environments could enable the exploitation of heightened emotional states, intensifying the impact of these tactics. This aspect is a distinct concern for immersive technologies, representing a potentially new form of harm.

By nature of access to sensitive personal data, hyper-personalised scams could gain prominence in these environments. Tailored with the potential for unprecedented precision, such scams could target vulnerable individuals more effectively than in current digital environments. Whilst the concept of targeting vulnerable customers is not new, the level of personalisation and immersion achieved through such technologies adds a layer of complexity and could require close regulatory attention.

13 See **Ofcom** for more detail.
14 'Boiler Rooms' are where fraudsters cold-call investors offering them worthless, overpriced or potentially non-existent shares/bonds, **see here for more detail**.
15 See the **FCA consumer duty** for more detail.

The heightened exploitation of behavioural biases in immersive environments

Immersive environments open an avenue for new, more complex and possibly opaque online choice architecture practices - i.e. the design of the online environment where consumers interact with businesses.[16] There is the possibility that the platforms on which immersive environments operate may nudge users to take actions which they might not ordinarily be comfortable with, such as sharing personal information in return for "free" upgrades or assets. Practices designed to remove user's control have already been highlighted by the CMA and the ICO in current online platforms.[17]

Compared with regular two-dimensional text and images, immersive environments may offer greater 'humanisation' of content. This might create an impression of false familiarity for consumers, which might influence their choices without them being aware.

Merchants will be able to imitate real-world selling tactics without the physical constraints – for example, supermarkets can currently play music that influences shoppers' mood, and in immersive worlds they may be able to tailor that soundtrack to every individual shopper. Such greater personalisation might involve new tactics such as bringing an item to the forefront by subtly de-saturating colours of other products. The risk of exploitation of behavioural biases would be particularly heightened in scenarios with hyper-personalisation where there is a greater potential for bias and discrimination.

The convergence of immersive social media, retail and gaming might hinder redress

With the plausible convergence of immersive social media, marketplaces and gaming, there is the potential for gamification to expand to more services. There could be gamification of financial products and services, with unclear delineation between gaming environments and financial services. Such blurring of the lines might make complaints and redress murkier - what is the protection around funds in immersive environments, the complaints process and liability? These issues might be particularly challenging in highly interoperable and hyper-personalised immersive environments.

16 Online Choice Architecture: How digital design can harm competition and consumers (Gov. 2022)
17 ICO and CMA (2023) ICO and CMA: Harmful online design encourages consumers to hand over personal information | ICO

The need to ensure effective competition, regardless of uptake

Even if there is low uptake of immersive environments, DRCF regulators would want to see competition working effectively. Ensuring markets work well in the interests of consumers, businesses and the economy is a key focus for the CMA, but also relevant to Ofcom and the FCA as concurrent competition authorities.[18] If competition is working well, it could support the development of immersive technologies and environments e.g. through encouraging greater innovation and consumer choice. As explained below, we want to see immersive environments develop in a way that avoids harm e.g. through information asymmetries, or where certain players (no matter their size) become gateways to access these technologies.

At all times, but particularly as uptake grows and these technologies develop, regulatory interventions will require careful consideration. There is a risk that interventions that seek to open markets by sharing the benefits of innovations in the immersive ecosystem with third parties (e.g. through mandated interoperability) could degrade the quality of products for existing users or affect the underlying incentives to innovate. In addition to the interplay between competition and data protection mentioned below, we also note potential interactions between competition and online safety. For example, the size of relevant organisations may influence their capacity to invest in online safety tools and the degree of supervision through the online safety regime.

The use of AI in immersive environments has the potential to bring both benefits and harms

AI will play a pivotal role in the provision of large-scale future immersive environments, particularly where there is interaction between multiple users and those environments. In the future, the AI technologies powering these environments will be more complex and powerful than they are today. This presents similarly greater opportunities and risks for platform owners, third party developers, and the users themselves.

Even as AI technology develops, principles-based tools and frameworks are already being created to help developers and users maximise the power of AI whilst minimising the potential negative impacts. The DRCF has previously written about the benefits and harms of algorithmic processing.[19]

18 The concurrent competition powers shared between the sector regulators and the CMA are the powers to enforce the prohibitions in the Competition Act 1998, and the powers to conduct market studies under the Enterprise Act 2002, and if appropriate, make a market investigation references to the CMA.

19 https://www.gov.uk/government/publications/findings-from-the-drcf-algorithmic-processing-workstream-spring-2022/the-benefits-and-harms-of-algorithms-a-shared-perspective-from-the-four-digital-regulators

Other examples of this include the ICO's AI explainability framework[20] designed to help organisations be transparent and inform users how their data is being used by AI in their networks; proposed principles from the CMA's initial review on AI Foundation Models;[21] Ofcom's overview of what generative AI means for the communications sector;[22] the Bank of England and FCA's work on Artificial Intelligence and Machine Learning;[23] and the CDEI's portfolio of AI assurance techniques.[24]

The use of AI means that there is the possibility (particularly in highly–personalised environments) for an extremely tailored experience, where AI can adapt not only the content of the environment around the user based on their preferences, but also the behaviour of AI-controlled bot characters within that environment. AI systems will enable environments to react dynamically to the user's interactions with them. Alternatively, AI moderation might safeguard, monitor, and intervene where users are breaching terms of service, or platform rules. This would potentially enable a safer experience for children or vulnerable users.

As sophistication of AI increases, and bots and non-playable characters (NPCs) become less distinguishable from human users, there are potential issues around how identity might be established. Platforms may need to consider how they police not just human users but also artificially created content and entities in immersive environments.

It is also important to remember that it might not just be by design that users may be negatively impacted by AI. Implicit bias, poor training data, or inappropriate inferences all might cause a user harm. Whilst these are not issues specific to immersive environments, the underlying technologies involved are potentially much more intrusive (in monitoring preferences inferred from biological data) which could influence the extent of potential negative impacts. Platforms and developers will need to ensure that AI-enabled experiences are not harmful to the user, and that they do not direct or manipulate them to harm.

20 https://ico.org.uk/for-organisations/uk-gdpr-guidance-and-resources/artificial-intelligence/explaining-decisions-made-with-artificial-intelligence/
21 https://www.gov.uk/cma-cases/ai-foundation-models-initial-review
22 https://www.ofcom.org.uk/news-centre/2023/what-generative-ai-means-for-communications-sector
23 https://www.bankofengland.co.uk/prudential-regulation/publication/2023/october/artificial-intelligence-and-machine-learning
24 https://www.gov.uk/guidance/cdei-portfolio-of-ai-assurance-techniques

Regulatory issues that may arise as the market develops and if uptake grows

As discussed in Section 1, there are many uncertainties that will influence the development of immersive technologies and environments. It is important that the issues discussed above are already being considered by regulators. However, there are a number of further issues that may only become prominent in future, depending on how the market develops and the extent to which uptake of immersive environments grows. We discuss these below.

Immersive environments could see the rise of dominant players

As noted above, competition concerns could arise even with a relatively small user base. Depending on how uptake grows, there is the potential for some of these issues to be exacerbated, particularly if there is a rise of dominant players.

There are a number of reasons why immersive environments could see the rise of a few large players. A range of network effects may strengthen the position of a few providers. This includes direct network effects - for example, the more users are on a given immersive 'social' environment, the more value it has for other users. There are also data network effects, where platform usage generates data that helps improve the service. In 'walled gardens' future scenarios, market power issues are likely to be driven by network effects and a lack of interoperability.

The risk of large incumbent tech firms having exclusive access to data and creating information asymmetries for new entrants is a challenge that exists in current markets and is likely to persist in immersive environments too. This might be particularly heightened by the sensitive nature of data generated by immersive technologies (e.g., biometric data, consumer behaviour, geolocation), as large firms might argue such information should not leave their platforms. Access to such data in combination with existing data pools is likely to strengthen incumbents' position as data harvesters. Although, interoperable digital environments could potentially be supported by privacy enhancing technologies (PETs) that could help underpin greater data sharing and reduce information asymmetries. DRCF members may need to consider together the implications of PETs for information sharing, competition, data protection and online safety - this will likely depend on particular applications of PETs and context.

Furthermore, if immersive environments become the primary access point to other applications, it could create potential to reinforce and leverage market power. As the CMA found with mobile ecosystems,[25] we might see the emergence of prominent immersive environment ecosystems.

25 Mobile ecosystems market study - GOV.UK (www.gov.uk) CMA (2022)

Again, incumbent tech firms could end up with strengthened positions. They might levy a commission on third-party apps, similar to app stores. This might be relieved in part if products and services cannot only be accessed through apps but also through browsers. However, immersive platforms could seek to build in their own browser, as is currently done on certain social media platforms, or by limiting interoperability for browsers other than their own. In addition, firms might also potentially use their immersive environments as a gateway for selling other related services. This may raise issues in self-preferencing and potential exploitation, similar to those the CMA found in the case of mobile ecosystems.

There are also concerns that dominant infrastructure or service providers could acquire smaller businesses. Alternatively, they could make strategic partnerships with different layers of the ecosystem which could equally lead to higher prices for consumers and limited consumer choice. If the strong brand loyalty that exists in today's technology ecosystem continues into immersive environment, a 'loyalty' penalty could arise where loyalty to certain brands could lead to a lack of transparency across markets and poor outcomes for users. This is particularly concerning in the emergence of separate digital worlds or walled gardens where access to certain services may be limited by potential strategic partnerships. This would be compounded by the high potential of significant barriers to switching that is caused by walled gardens, leading to consumer lock-in. This in turn would reinforce the dominance of large players.

Immersive environments could enable a new channel for finance and payments

There is uncertainty over what form payments will take in immersive environments and the type of infrastructure that will underpin financial activity.[26] As such, the regulatory considerations for the FCA associated with payments in immersive environments could develop depending on the direction of payments and uptake. Applications could allow transactions to take place using a combination of methods such as fiat currencies, digital currencies (central bank digital currencies (CBDCs), tokens, cryptocurrencies, stablecoins etc) and new forms of money that may emerge. The successful integration of multiple payment options could increase the accessibility of systems for users and drive competition in the payment space. As flagged in the FCA's review of Big Tech entry into financial services, if operators choose to self-preference their own payment options or favour specific payment rails, this could lead to competition concerns and a negative impact for consumers in the form of limited choice and higher prices.[27] The emergence of platform-based business models[28] in immersive environments could enhance competition in the payments space and support more innovative embedded finance solutions, where users access financial services without directly engaging with the financial provider.

26 https://www.citigroup.com/global/insights/citigps/metaverse-and-money_20220330
27 https://www.fca.org.uk/publication/discussion/dp22-5.pdf
28 https://www.bis.org/events/20211006_bigtech/croxson.pdf

Immersive technologies may become a new 'gateway' for viewing media content, and could supplant existing media content

Immersive technologies are likely to be used to experience a range of content. In some cases, this may be overlaying 2D content over the real world or a virtual background. For example, one of the key use cases highlighted in Apple's Vision Pro announcement was to watch 2D content,[29] superimposing a large screen into the real world, or into a scenic backdrop.

This raises potential issues, particularly in relation to public service media, for example the prominence of public service media content on these new platforms and the associated commercial arrangements.

In other cases, immersive technologies may deliver a range of immersive, interactive and real-time experiences that differ from traditional viewing of 2D content, shifting how users spend their time. This, combined with a growth in uptake could have implications for the finances of media stakeholders, including public service media. It would raise strategic questions for these stakeholders too - do they invest to deliver content through this new medium? Ofcom will need to consider any potential implications for public service media.

A 'digital divide' could emerge if accessibility issues are not addressed

The way we interact with each other through immersive technologies and services could be very different to how we communicate through current online services. In turn, users will need new and different skills if they are to access the opportunities available while avoiding the potential risks and harms, including the risk of new types of digital exclusion. Ofcom has explored some of the potential issues involved in a publication on Future technology and media literacy[30] (which Ofcom defines as 'the ability to use, understand and create media and communications in a variety of contexts').

Today, given it is not widespread, an inability to access immersive environments or effectively use immersive technology is not a significant barrier. However, the issue of a 'digital divide' may become more acute if immersive technologies become necessary for critical activities such as education, healthcare or finance - which is only likely when uptake is near universal.

In relation to finance, just as the closure of physical bank branches can limit access to financial services for certain communities, the adoption of immersive technologies could create a similar divide.

---

29 https://www.apple.com/uk/newsroom/2023/06/introducing-apple-vision-pro

30 Read Ofcom's future technology and media literacy report here. In addition, Ofcom published research exploring how immersive tech is currently used, how it may be a part of people's lives in the future and emerging media literacy implications. Media literacy, immersive technology and the future (ofcom.org.uk)

Individuals with low digital literacy or limited financial resources, may not have access to the hardware or skills needed to navigate immersive financial environments (if immersive technology is used to facilitate immersive financial services). Ensuring continued access to traditional services for marginalised groups is akin to the challenge of maintaining access to traditional banking services in underserved areas.

Immersive technologies could serve as a new channel for consumers to access certain services. For example, immersive technology could help overcome some of the access issues associated with physical bank closures. By creating realistic and interactive virtual environments, financial institutions could offer consumers a more immersive and convincing way to access a wide range of financial services. Innovation in this area could help to bridge the gap and enable individuals to engage with personalised financial services in a virtual setting. However, the benefit from virtual services is unlikely to serve those who are digitally excluded.

Regulators will need to strike a balance between adapting to the opportunities presented by immersive technologies and safeguarding the interests of those who may be digitally excluded.

The potential for financial crime and fraud in immersive environments

Any electronically offered payment service must meet specified requirements that enable strong customer verification to minimise the risk of fraud.[31] Depending on how identity is verified in immersive environments, there may be specific questions that arise around identity verification for payments that may require further clarification. The use of immersive technologies could enhance the user experience by enabling secure and seamless transactions that could make financial transactions more convenient and secure. As immersive technology develops and applications mature, as with any emerging technology, it could be used by bad actors to facilitate illicit activities. In light of this, regulators must work collaboratively to ensure anti-money laundering (AML) and know your customer (KYC) regulations cover these channels effectively and understand how the financial crime landscape might evolve as the ecosystem develops.

Clarity of navigating different levels of regulatory protection across financial products in immersive environments

There is currently limited evidence of firms experimenting with immersive technology to deliver financial services to the market, and as such, this section explores potential considerations that may be of interest to the FCA as the market develops.

31 https://www.handbook.fca.org.uk/techstandards/PS/2021/2021_01/?view=chapter

Financial services firms could choose to use immersive technology, such as VR to engage with consumers and provide personalised services such as financial advice, banking services and more, particularly as uptake of the technology grows. Such future scenarios would raise concerns over how products and services with different levels of regulation and protections are communicated to consumers. This is extremely important if immersive environments are highly interoperable and the user can seamlessly move between spaces with different levels of protection. For example, a key question would be how organisations communicate their products to consumers and demonstrating clarity and what type of product is being promoted (i.e., regulated or unregulated).

Technologies used in immersive environments may impact the natural environment

As the technology develops, future immersive environments will require a significant amount of compute power, both locally in the home or office, and at the platform level. This will have a potentially large impact on energy use and therefore a real-world environmental impact, which will increase with the extent of uptake. Whilst some technologies may be more impactful than others, platforms and manufacturers will need to consider the possible damage different implementations might cause.

At a data storage level, it's possible to mitigate environmental impact by ensuring that only what is necessary is retained. The reduction in storage volume would help providers to comply with data retention and collection obligations, thereby aligning with best practices for both sustainability and privacy.

At a device level, greater interoperability of headsets between platforms would lower barriers to switching and also have benefits in terms of reducing e-waste.

Immersive technologies may increase demand for connectivity, placing additional loads on telecoms networks

As discussed in Section 1, many applications of immersive technology will require internet connectivity. In some cases, the latency and throughput requirements will be significant compared to existing applications such as audiovisual content or traditional gaming.

Delivering these applications will therefore require high quality connectivity. It may raise demand for high-speed fixed and mobile connectivity.

Currently, given low uptake, the impact on telecoms networks resulting from immersive technology is fairly low. However, if uptake grows and as the technology develops, the impact could become significant, and may have implications for the investment decisions made by telecoms operators.

However, the extent this will impact the investment requirements of telecoms operators will depend on how the increasing traffic driven by these new applications is delivered. Investment in upgrades to the public internet infrastructure, which may fall on telecoms operators, might be one option, but it is possible more efficient alternatives may arise. For example, the growth of content distribution over the internet led to some services installing their own caches close to customers and others making use of content delivery networks (CDNs) to do the same to improve quality of service, so that some of the costs of delivering traffic falls on the content and application providers themselves.

Exactly how the traffic generated by immersive technology applications is delivered will determine where the costs fall. Ofcom has considered some of these issues, including relevant market developments and trends such as new and emerging applications, in its Review of Net Neutrality Rules.[32]

Areas of potential overlap

In considering these issues, we have identified several areas of overlap that will benefit from cross-regulatory consideration. Examples of these areas include:

- **Interactions between competition and data processing** - DRCF members will need to ensure that data collected for the purposes of improving experiences, and thereby developing competitive offerings, will not negatively impact the data protection rights of users.
- **The exploitation of behavioural biases** - The ICO and CMA have reviewed how online practices influence consumer behaviours and will need to continue doing so as immersive environments develop. As immersive technology platforms develop, they must ensure that users remain in control of what information they share, and that they can refuse offerings without harmful techniques being used to get them to make deals or decisions they might otherwise not have.
- **The impact of privacy enhancing technologies (PETs)** - DRCF members may need to consider together how PETs might be utilised across their remits for information sharing, competition, data protection and online safety.

---

32 Net Neutrality is the principle that users of the internet (both consumers and those making and distributing content) should be in control of what they see and do online – not the broadband or mobile providers that connect people and businesses to the internet (otherwise known as internet service providers or ISPs). Read here for more info.

- **The role of artificial intelligence (AI)** - AI is a technology that is already having a profound impact across DRCF member regulators' remits and has the potential to drive how immersive technology and environments develop. The need for a joined-up approach to AI has already been recognised, as demonstrated by the new DRCF advisory service to help businesses launch AI and digital innovations.[33] Member regulators will continue to consider how AI developments could impact a range of areas, including immersive technologies.
- **Overlaps between competition and online safety** - Ofcom and the CMA will need to consider potential interactions between competition in relevant markets and online safety. For example, the size of relevant organisations may influence their capacity to invest in online safety tools and the degree of supervision through the online safety regime.
- **Overlaps between privacy and online safety** - The need to ensure the safety of users of immersive environments is likely to involve a certain degree of automated moderation and monitoring. Ofcom and the ICO will need to consider the interaction between that moderation and how the privacy of the user can be maintained.
- **Digital identity** - Digital identity is potentially relevant to the development of interoperability in immersive environments. It is also of wider interest to DRCF regulators given linkages to issues such as consumer access and digital exclusion, competition, and age assurance (which is relevant to online safety).

The DRCF will continue to provide a forum to explore cross-regulatory issues as well as providing a mechanism to enable necessary coordination. As a first step, to develop our joint thinking on digital identity, the DRCF horizon scanning emerging technology programme is planning to conduct further work on this topic, with the view to publish an output in 2024.

33 https://www.gov.uk/government/news/new-advisory-service-to-help-businesses-launch-ai-and-digital-innovations

Section 3: Conclusion and Next Steps

As we identified in Section 1, there is considerable uncertainty as to how immersive technology and environments will develop and how associated business models will evolve. The high degree of uncertainty makes it difficult, and perhaps premature, to develop a detailed roadmap or set of next steps. The DRCF member regulators will continue to monitor developments.

This uncertainty does not mean we should not actively consider regulatory considerations. There are many potential benefits of future immersive environments, but as regulators we must ensure that consumers are safeguarded against potential future harms, rather than waiting for the harms to emerge before acting. In Section 2 we identified a range of issues regulators may need to consider both in the near term and as the market develops. Some of these will be captured by member regulators' ongoing work including in relation to data protection, online safety, scams and competition. Others, such as the potential for a 'digital divide' to emerge, may only manifest as the market develops and uptake grows. The DRCF will enable member regulators to coordinate market monitoring and the sharing of findings, helping members to identify when it might be necessary to act.

Some of the issues identified clearly sit within the remit of a single regulator, but several issues will require a joined-up approach by two or more regulators. These include:

- **Interactions between competition and data processing** (CMA and ICO)
- **The exploitation of behavioural biases** (CMA and ICO)
- **The impact of privacy enhancing technologies** (All)
- **The role of artificial intelligence** (All)
- **Overlaps between competition and online safety** (CMA and Ofcom)
- **Overlaps between privacy and online safety** (ICO and Ofcom)
- **Digital identity** (All)

The DRCF will provide a forum to explore these cross-regulatory issues in due course and a vehicle to enable the necessary coordination to ensure consumer protection and well-functioning markets. In the meantime, member regulators will continue to keep a watching brief on immersive technologies and environments, including periodic engagement with external stakeholders. We remain open to revisiting the topic through the DRCF as the technology and markets develop, taking account of the issues identified in this paper.

Specifically, to develop our joint thinking, the DRCF horizon scanning emerging technology programme is planning to conduct further work on the regulatory issues associated with digital identity, with a view to publishing conclusions in 2024.

Annex 1: Methodology

This paper is an early analysis generated from our horizon scanning and foresight process and is intended as a guide to our emerging thinking. There are obviously innumerable possibilities for the development of immersive technologies and environments (and therefore regulatory implications that result from those varying futures), and we have not attempted to capture them all. Instead, we have focussed on those that would require greatest consideration by DRCF regulators and those which are cross-regulatory.

We have developed and explored these possibilities using a 'futures' approach. Futures methodologies are a resource used by government and policy makers to incorporate long-term strategic thinking into the policy and strategy process.[34] The methodologies are a key resource that can help decision makers to gather intelligence about the future and explore the dynamics of change that might impact how the future develops. By employing tools such as trend analysis, uncertainty mapping and scenario planning, policy makers can better understand the range of outcomes the future could hold and develop strategies that account for the uncertainty.

To explore the future environments created by immersive technology, we used a futures methodology tool called 'Scenario analysis' which involved creating multiple plausible future scenarios.

This annex provides an overview of our foresight methodology. It complements the summary diagram in the introduction:

- First, DRCF regulators identified drivers of change - the key factors shaping the long-term development of immersive environments - using a combination of desk research and expert interviews. We spoke with 10 experts across academia and industry, using the '7 questions' futures technique.[35]
- In the first of three workshops, we invited external experts to:
    - Map the drivers of change shaping immersive environments onto the PESTLE framework (a framework used to help identify drivers across Political, Economic, Social, Technological, Legal and Environmental categories). They also identified additional drivers to the ones we had suggested.
    - Map the drivers onto an uncertainty and impact matrix, which allowed us to identify the most impactful and uncertain drivers, or the 'critical uncertainties'. A number of these critical uncertainties are explored in Section 1 of this report.

34 Futures toolkit for policy-makers and analysts - GOV.UK (www.gov.uk)
35 '7 Questions is an interview technique for gathering the strategic insights of a range of internal and external stakeholders.' Futures toolkit for policy-makers and analysts - GOV.UK (www.gov.uk)

  - Describe possible trends and alternative trends for each of the critical uncertainties and vote to prioritise the critical uncertainties they felt were most important for how immersive environments might develop: these included personalisation and interoperability. These two critical uncertainties were used as opposing axes to build scenarios in our second workshop (see diagram and a write up of the scenarios in Annex 2).

- In our second workshop with external experts, we invited them to:

  - Discuss and describe each scenario based on the axes and incorporate other key trends identified in the first workshop. Incorporating these other trends allowed us to develop fuller and richer scenarios.

  - Further explore what the scenarios might mean for consumers with different backgrounds, values and interests.

  - Identify one or a few key issue(s) affecting consumers in each scenario, and use the 'futures wheel' technique[36] to draw out first-order, second-order and further implications stemming from those issues.

- In the final workshops, internal to DRCF regulators, we used the scenarios to:

  - Consider potential developments (including regulatory, business and consumer) that could emerge in the near-future and lead to the different possible future scenarios, using a 'backcasting' futures approach.[37]

  - Discuss regulatory implications of the future of immersive environments looking across the various future scenarios. These discussions formed the basis of Section 2 of this report.

36 'The Futures Wheel is a form of structured brainstorming that helps participants visualize how important trends or events might impact on the policy or strategy area in question. It is particularly useful for identifying and mapping connections and causalities.' **Futures toolkit for policy-makers and analysts - GOV.UK (www.gov.uk)**

37 A method for determining the steps that need to be taken to deliver a given future.

Annex 2: Scenario Analysis

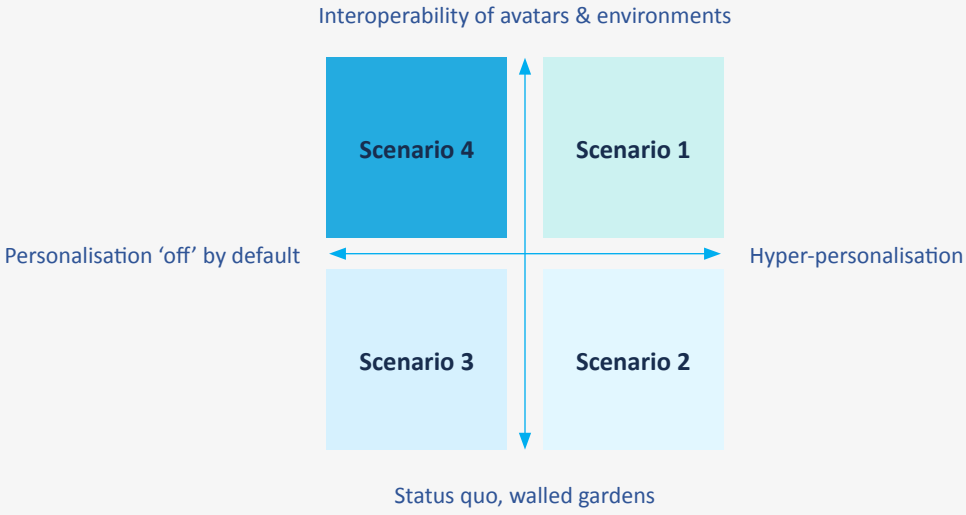
To explore how the future of immersive environments might evolve, we developed a set of scenarios. Scenarios are narratives that describe and illustrate possible, plausible, or preferable futures. The scenarios set out below are informed by the evidence from our interviews and workshops and as such are not predictions (see methodology in Annex 1). They are a range of possible futures that can be used to test current and future thinking against a range of outcomes.

Out of the various factors shaping immersive environments set out in Section 1, we identified the degree of interoperability between different platforms, and the extent to which services are personalised as factors that may have the greatest likelihood to create regulatory concerns. These uncertainties were chosen because of the rich insights that could be generated when analysing the polarities of each uncertainty. The polarities of the axes were selected as the extremes of each trend that are still realistic and plausible (see diagram below).

The first axis, the degree of interoperability of the hardware and/or software, refers to how easily the user can transition across different digital environments and transfer information such as user settings and presets. We do not prescribe the basis through which interoperability may arise, although it could be supported by the implementation of open-source software, infrastructure layers allowing interoperability and/or cross-industry standards.

The other axis, the level of personalisation within applications in immersive environments, refers to the degree to which a user's experience is individually tailored to them. This can be driven by the platform itself or determined by the user's willingness to share their data.

The intersection of these axes defines four scenarios (see diagram below), which are built around different degrees of interoperability and personalisation. We have made some assumptions in all four scenarios - primarily that the technology will develop, and that uptake will grow - which as discussed in Section 1 is not guaranteed.



The following section provides a summary of the assumptions underpinning each of the four scenarios and potential implications based on that specific future.

Please note the descriptions below are tailored to the assumptions made and are not the only way in which each of the futures may arise. They are designed to be illustrative scenarios only.

Scenario 1: Interoperable environments, hyper-personalisation

- Mixed, augmented and virtual reality applications are underpinned by a technology stack that achieves interoperability through open-source software, or common standards. Advanced privacy enhancing technologies could support data sharing challenges.
- The high degree of interoperability makes it easier for businesses to reach large user bases and access larger markets.
- Organisations provide tailored experiences leading to subjective perceptions of reality. This is used by targeted advertising, which supports the monetisation of immersive environments. In some cases, hyper-personalisation leads to exploitation of consumer vulnerabilities.

Potential Implications

In the scenario set out above, greater interoperability could come in the form of universal avatars as well as extensive data sharing between platforms and sectors. Interoperability could be achieved by a solution in the infrastructure layer that is dominated by one powerful provider. However, the application layer providing the products and services could be fragmented and highly competitive due to open data sharing. Third-party data access may lead to more niche business models and reduced barriers to entry or expansion.

Users would be able to seamlessly transition between environments without any noticeable friction. Individuals could have the freedom to express themselves through a single (or through multiple) avatar(s) that can be carried across environments and possibly tied to their physical identity. This could lead to a push towards a unified digital identity, and international unified standards of conduct.

In this enhanced attention economy, targeted advertising would likely be highly efficient, driven by large amounts of granular data such as eye-tracking data. Targeted product placement could be the norm, drawing on user moods and micro-reactions. There may be concerns that biometric data processing might draw incorrect assumptions about sex, race, or gender. It could happen that users might be alerted to possible medical issues both correctly and incorrectly.

In this scenario, as substantial data sharing occurs by default, users could feel as though they have little control over their data. Based on the assumptions here, users may find it hard to know exactly who has access to their data and how it is being used. Taken together, these developments could influence self-expression, meaning users may be more cautious about exactly how they are expressing themselves.

Sophisticated AI deepfakes could create digital versions of individuals, leading to catfishing, misrepresentation, and other frauds linked to false identities. Highly intelligent systems could take advantage of those with low financial resilience through gamification methods, leading to poor financial outcomes for users. In this scenario, peer pressure could lead to buy-now-pay-later debt as users seek to keep up with trends, acquire the latest skins (in-game character or item cosmetic options) and upgrades, and put real-world capital into virtual items with unstable value like on-trend NFTs.

There could also be positive impacts on those with vulnerable characteristics.[38] Immersive environments offer rich, tailored experiences to those who might otherwise be excluded, or find them overwhelming. For example, in the classroom, immersive technology could make neurodivergent learning easier. On the flipside, bad actors seeking to target vulnerable users could find it easier to identify them based on the data-rich ecosystem and expose them to new forms of harms. As such, in this scenario there may be calls for greater controls and restrictions for vulnerable consumers. For example, there could be a drive to implement parental controls and - to prevent children bypassing them - on-device age assurance systems.

Scenario 2: Walled gardens, hyper-personalisation

- Immersive environments are entirely separate from each other, characterised by incompatible hardware and applications across devices.
- In this scenario, consumers might be forced to choose a provider and invest resources in it. Hyper-personalised environments engage users in particular worlds but a difficulty of recreating personas and the inability to duplicate preferences means there is limited movement between platforms.
- Highly personal data (including biometric data) is collected by platforms, but not shared between platforms. Third parties could use this data for highly targeted advertising and non-platform businesses operate as applications within each of the platforms.

38 Vulnerable characteristics could be driven by health (physical disability, severe or long-term illness), life events (retirement, bereavement, income shock), resilience (inadequate or erratic income, over indebtedness) and capability (low knowledge, poor literacy or numeracy). This is not an exhaustive list, and noting not all with characteristics of vulnerability will be vulnerable.

Potential Implications

In this scenario the high degree of personalisation drives an attention economy with targeted advertising and tailored products and services across sectors (e.g., financial products, fashion, social media, commerce, education). Data captured from a user's session - for example, their 'likes' and 'dislikes' - is likely to remain within the walled garden. The platforms could build and curate highly valuable user databases, with unprecedented amounts of detail and richness. Experiences based on personalised biometric information are likely to be more immersive and reactive. Each platform would make its own decision regarding the extent of personalisation, in a way that might not always be transparent to users. There could be scandals where monetisation has been pushed to excess, for example where a platform used highly granular data to identify and exploit vulnerable users and get them to spend more.

In this future, it may be hard for creators to achieve scale and compete across walled gardens. Instead, creators may have to operate within a single technology stack controlled by a single player. They may need to develop experiences for a specific provider, e.g. to operate only within the App Store or within a specific application (for example within Roblox). Some platforms might differentiate themselves from large centralised walled gardens, by presenting themselves as decentralised and attempting to introduce a degree of interoperability.

With walled gardens, hardware may have limited functionality outside of the native platform. To access the full features and functionality of a given piece of hardware, users would have to engage with the associated platform. Certain platforms may offer low-price hardware, possibly sold at a loss or break-even, in attempt to attract users. As a result, some users may get 'locked in' to a particular provider.

Environments with elevated levels of user-driven personalisation could offer more opportunities for self-expression that make individuals more identifiable. However, some individuals could reject personalisation out of fear of being tracked across environments and being identified in the physical world. As a result, risk-averse users may prefer platforms that have privacy-preserving features or opt for niche independent immersive environments they deem safer.

In this scenario, users might be burdened by having to select permissions and controls for each walled garden who develop their own permission structures. This could have a dual effect of making users less likely to fully read and understand the choices and controls they are given and lose track of what they have agreed to. There may also be a lack of innovation about visualising data flows and transparency mechanisms in permission controls.

Providers of immersive environments might offer vulnerable users a choice of relevant spaces with tailored experiences. Groups who might be more vulnerable or less able to engage ordinarily may be able do so in a safe and appropriate way due to appropriate controls and safeguards. Whilst the isolated nature of the siloed immersive environments in this scenario could make it harder to track bad actors across platforms, it could make securing the environments easier (in terms of applicable jurisdiction and controlling entity) and make switching easier for users. Where users encounter a virtual space, individuals, or attitudes with which they are uncomfortable, they could move to another provider.

Scenario 3: Walled gardens, personalisation off by default

- In this scenario there are multiple immersive environments, all entirely separate. Users are likely to gravitate to environments which represent their interests.
- The underlying technology is similar, but not necessarily compatible. This means that at least initially user profiles are non-personalised and default status to allow ease of onboarding. This is supported by a series of technology standards which manufacturers and platforms build on.
- Monetisation occurs within environments themselves through enrolment or membership fees for applications, hardware and streaming. Businesses find interest-based advertising easy even when identities are left at default. Users are encouraged to purchase in-environment upgrades, further incentivising them to remain in that environment.

Potential Implications

Such monetisation of environments could, in this scenario, lead to the emergence of several large platforms that cater to the interests of users, so that users never need to move to another environment.

As far as personalisation goes, platforms may offer generic and disconnected experiences that are not individualised. On some platforms, users might be given a choice to pay to personalise their experience and express individuality. Users may want to purchase skins, overlays, and other modifiers to change how they interact with the environment and each other. Being offered a generic experience which does not account for user circumstances might dissuade some vulnerable groups (and carers) from trying the hardware. On the other hand, the lack of hyper-personalisation might give some vulnerable users a degree of protection and freedom as they feel less conspicuous, and less able to be targeted by bad actors. Users that are the targets of nefarious practice may find they can switch to another platform.

With limited interaction and interoperability between environments, and limited personalisation, data about individuals would likely be siloed and businesses might have a more limited picture of their customers. Advertising may be more generic and tailored to the users based on the nature of the experience and data that is collected during their experience.

To balance the lack of income generated by data sharing and more tailored advertising, it might be that many platforms and manufacturers charge a fee to access or purchase systems. Those electing to pay the higher price might get a sense of security and reassurance that their information is being protected. Users who choose not to or are unable to pay for access might be driven to environments and options where they are incentivised to share data, view adverts, and take certain actions.

Scenario 4: Interoperable environments, personalisation off by default

- In this world, there is interoperability for consumers and app developers.
- Users can set preferences which follow them across interoperable environments through transfer frameworks, and baseline template avatars.
- Monetisation happens principally through purchasing items or experiences in immersive environments. Personalisation is driven by the user and conditional on spend. The market for avatars/IDs is captured by incumbents and there is a diverse market for user-created avatars, experiences, and products.

Potential Implications

In this scenario, there is interoperability for consumers meaning they can choose to port things like avatars between immersive ecosystems, and they are in control of how their data is used and shared (per UK GDPR). Some users may readily spend more in the virtual world than they do in the physical world to benefit from a tailored experience, e.g. by purchasing skins, items, or experiences. Avid users could regularly trade and gamble for skins, a form of 'monetisation through avatars', to achieve a more personalised experience.

It is possible that the market for providing and verifying official avatars/IDs could be captured by incumbents, reflecting a sizeable challenge for small companies to gain trust in a privacy-centric ID market. The verification of official ID may limit the risk of children impersonating their parents or accessing inappropriate content. Some platforms might still be able to exploit financially vulnerable consumers through bias recognition and lead them to spend more, driving some into debt.

Conversely, there might be a much more diverse market for experiences and products to create unique, unofficial digital avatars, personalised by the individual (like a gaming avatar). This might be the key opportunity for smaller players in this scenario, as the provision of avatars does not come with the same considerations for security and complexity as the provision of digital ID.

Here, third parties may be given access to first-party platform APIs and toolkits from which they can create bespoke experiences and features. They may be allowed to monetise these functions, provided a commission to the platform. It may be more difficult to target commercial or political advertising, with insights into users that are not based on a longitudinal understanding of users, but rather limited to their interaction within the current sessions.

In this scenario, users with mobility or other physical disabilities might find it easier to access services, since calibration is only necessary once, and data about restrictions is shared. Some users may find this intrusive, and feel the experience is being restricted.