

eXtended Reality

→ Enriching XR by combining technologies

→ Virtual social interactions are getting more advanced

→ A fragmented ecosystem

→ New gear for new realities

→ An increasing number of ethical concerns



XR Technology

XR, or 'eXtended Reality' is both a technology in its own right as well as a term used for a combination of other reality altering technologies; combinations of virtual reality, augmented reality and mixed reality could all constitute XR. XR continues to be a developing technology in a variety of fields. Education, research, medical training, military, health care and even tourism embrace the technology in different and innovative ways. Whether XR is used to take a classroom of children to a national monument for a virtual field trip or to train practicing nurses how to dissect a virtual human body; XR continues to find new uses in a variety of learning spaces.

The XR technologies are commonly being used to immerse users in a physical-virtual world, now more commonly referred to as a 'Metaverse'. This immersive 3D internet experience has largely grown out of funding from major technology companies who see the future of the internet as something you are always 'in' and not necessarily something you are separated from. In this way, the metaverse does not compete with the internet, but builds on its very foundations. Web3 also represents a possible answer to the question how a new market can emerge within these simulated environments. The concept of Web3 is envisioned as a blockchain-based web including (hyped) products such as cryptocurrency and NFT's.

Of course, large technology firms are increasingly investing in XR devices and platforms and their presence grows as gaming, social communities and educational institutions bring in new headsets or equipment. Engaging with a metaverse or simulations in these domains will create new impact on the social and cultural norms of these institutions. Social norms regarding how professional communities are developing within these digital spaces, how people work together, and what is socially acceptable in these spaces, continue to evolve.

Educational spaces have begun to experiment with XR technologies for learning in new ways, including time-machine effects of learning new

cultures, immersion in learning material, and even virtual rehearsal scenes for presentation skills. Researchers may find new opportunities in fully remote XR research, where a comprehensive experiment framework is yet to be established. Skills and competencies in new learning environments such as lab spaces, equipment protocols and virtual field trips can be effectively applied with promising results. Students and workers that are learning to work with new tools, equipment, medical facilities or laboratories are allowed to break things and make mistakes. They have a safer perspective thanks to a virtual environment before they enter the real one; this opens new doors to virtual places in both work and leisure.

TREND #1

Enriching XR by combining technologies

Public values

 Autonomy

 Justice

 Humanity Social cohesion | Safety | Health and well-being

Readiness

WATCH

PLAN

ACT

Drivers

#Digital economy #Open and online education
#Connectivity #Automation

Several modes of XR are often combined to create a more in-depth experience or layered on top of one another to combine different capabilities. New XR innovations take advantage of combining both digital interfaces and your body, both input and sense of self. Technologies in a variety of industries are being used in combination with XR to create innovative ways of changing a user's experience. Technologies like computing and AI are key enablers for the immersion of XR technology.



Meta's Codec Avatars 2.0 becoming very realistic

At Meta Connect 2022, Meta showed the current state of their Codec Avatars 2.0. These offer very realistic person-like avatars, including realistic facial movement (e.g. when laughing). The avatars are built with the use of advanced machine learning techniques and take a lot of processing power and time to generate.

 [open example](#)




Generative AI for possible digital world creation


By combining XR and generative AI models, XR content may be automatically generated in the near future. Point-E, created by OpenAI is an example case, creating easy, text-generated 3D models that may find purpose in simulated worlds.


 [open example](#)

Remote rendering to enhance digital fidelity and realism

With ‘remote rendering’ the 3D imagery is rendered in a powerful cloud-based server, with only the visuals streamed to the XR headset. Currently there are some solutions for remote rendering on devices, but there is a lack of network capabilities to make this scalable.

 [open example](#)

 [open example](#)

 [open example](#)

IMPACT

With more layering of devices for an XR experience, our digital selves and digital impact become entrenched deeper in both our research and education. With new connectivity and immersion, educators can find more opportunities to take students on virtual field trips, such as new and more adventurous places in our universe. Research could create opportunities through better hardware with more rendering power needed for richer virtual environments. Social cohesion may benefit with more powerful renders with students having more enhanced learning environments and learning materials.

TREND #2

Virtual social interactions are getting more advanced

Public values

- Autonomy
- Justice Inclusivity
- Humanity Meaningful contact

Readiness

- WATCH
- PLAN
- ACT

Drivers

- #Right to be able to work from home
- #Open and online education #Connectivity
- #Internationalization #DEI
- #Research environment

XR is providing users access to virtual digital spaces, where people can meet, interact and collaborate. These new spaces allow people to play, work and train together in the same virtual space. Users can ‘travel’ around the world, without losing the time needed for travel; they may even visit a space station through teleportation at a click of a button. This new way of connecting offers a variety of opportunities, but it may have negative effects as well. For instance how will it affect the way in which we are working now?



Virtual campuses are opening

Ten universities have opened their virtual doors to university students, with some registering as many as 45,000 online-only students. Meta has sent many of these students headsets free of charge and currently doesn't charge colleges involved in the partnership with them.

[open example](#)



How the Metaverse could change our daily work

The emergence of the Metaverse has already changed the workplace. Accenture, for example, is using 60,000 Meta Quest 2 headsets to support on-boarding, while Microsoft is collaborating with Meta to integrate Microsoft Teams and Microsoft365 with the Meta hardware.

 [open example](#)

2 billion dollars to build a Metaverse for children

Epic Games collected investment money to create a Metaverse for children in cooperation with the LEGO Group. The developers will take the privacy, safety and well-being of children into account.

 [open example](#)

Virtual spaces can and will be used for dating

Many people find VR world dating much more inviting and safer than going out to a bar. VRChat alone has 30,000 monthly users that interact in a variety of ways, including dating and working. Users that live in small communities can still date outside their physical boundaries.

 [open example](#)

IMPACT

Technologies that mediate our daily practices are changing behaviour, social norms and values. Students and educators find themselves in front of a screen more often and in forms that were not available before. New international collaborations become possible for educators, students and researchers; these virtual interactions create new educational opportunities. Inclusivity is affected as more people have access to virtual educational materials and places, and work in multidisciplinary teams.

TREND #3

New gear for new realities

Public values

 Autonomy Freedom of education

 Justice Inclusivity

 Humanity Personal development | Safety | Health & well-being

Readiness

WATCH

PLAN

ACT

Drivers

#Connectivity #Digital economy #Globalization
#Dataism

Special gear is needed to gain access to new digital realities. Therefore, XR technology is pushing the development of new hardware by different tech companies. The list of XR devices is currently growing, and wearables like smart eyewear, head mounted display (HMD) and smart glasses are being developed to grant (new) users access. Devices for other modalities, such as touch and smell, are also under development and/or are available as products.



Meta vision of the Metaverse shows futuristic headset design

In June 2022 Meta released a video that shows the new futuristic headset design and fingertip input device. The device is slimmer than the Oculus Quest and probably will be used in combination with haptic gloves or EMG wristbands.

 [open example](#)



Build your XR training scenario with Interhaptics

Unity has developed Interhaptics, which can be used to create large and complex scenarios. One interaction can trigger several events, depending on the rules the developer applies to it.

 [open example](#)

Feeling virtual objects with gloves that provide feedback

Meta microfluidic gloves now provide high-fidelity haptic feedback, which makes for a more immersive and real experience. The gloves can let you feel resistance, texture and shape of objects in XR.

 [open example](#)

Virtual kisses with ultrasonic transducers

A kiss can now be simulated in VR with an off-the-shelf virtuality headset. This headset can recreate the sense of touch, without hardware that is touching the user's face.

 [open example](#)

IMPACT

As XR devices continue to become lighter and user friendly, their use will change. Users will wear their headsets for a longer period of time. Currently, XR is making improvements in training procedural knowledge regarding decision making, though not for motor skills. Haptic gloves and other designs offer more realistic learning possibilities for motor skills. Medical and police communities have found particular interest and effective use cases for XR training simulations. These developments will lead to new research in eye tracking and data collection of whole body movement. New hardware will also increase pressure on interoperability and price as the market becomes saturated with different headsets.

TREND #4

An increasing number of ethical concerns

Public values

-  **Autonomy** Safeguarding of private life and personal data
-  **Justice** Equality | Integrity
-  **Humanity** Safety

Readiness

- WATCH
- PLAN
- ACT

Drivers

#Cyber security #EU legislation #Privacy #Digital literacy & skills #Research environment

Like most mobile devices, XR allows providers and suppliers to collect data. However, with XR more advanced and personal user data can be tracked, both physically and digitally. For instance, the technology allows not only tracking of body movement, but also of eye movements and pupil dilation. These developments raise ethical concerns, in terms of both privacy and data management. What user data is collected, how it is collected, who has access, how is it processed? Perhaps most importantly, for which purposes can that data be used?



Watching your eyes means understanding your desires, and much more...

Tracking a user's eyes using cameras can improve user experience in XR, by allowing one to naturally focus on virtual content by simply looking at it. Eye tracking data can be used to make interpretations about what a person wants or desires.

 [open example](#)




Our bodies could be the new data source for surveillance technology in the Metaverse

XR headsets, hand controls, cameras and microphones allow for a drastic increase in the recording of biometric information. There are as yet few restrictions in place to protect us from unrestricted data gathering.

 open example

The ethics of a brain-computer interface in VR - Digital Bodies

A brain-computer interface (BCI) gives lots of opportunities, like allowing a person with a prosthetic hand to grasp a glass of water with their thoughts. However, brain-computer interface solutions raise profound ethical challenges – and not just in virtual reality.

 open example

The future of advertising in AR/VR

New ways of selling (virtual) merchandise to users of XR technologies are emerging. New experiments focus on keeping the user within the XR experience as much as possible, including Interactive Advertising Bureau (IAB,) which is guiding digital advertising standards and terminology to allow disparate systems and platforms to work together.

 open example

IMPACT

Ethics, regulations and standards will continue to develop as XR technologies challenge current data collecting and usage norms. These new XR technologies also open up new opportunities for security. For instance, eye tracking can be used to identify individuals, allowing it to be used as an authentication mechanism or even as a password. Collecting marketing data and tracking individuals across digital worlds and spaces will likely lead to massive changes in privacy laws. The risks and amount of data that will be collected by XR devices will need to be communicated to stakeholders differently, especially in education, where students and educators lack basic knowledge of new XR capabilities to record nearly every movement and sound.

TREND #5

A fragmented ecosystem

Public values

-  **Autonomy** Independence of education | Freedom of education
-  **Justice** Integrity
-  **Humanity**

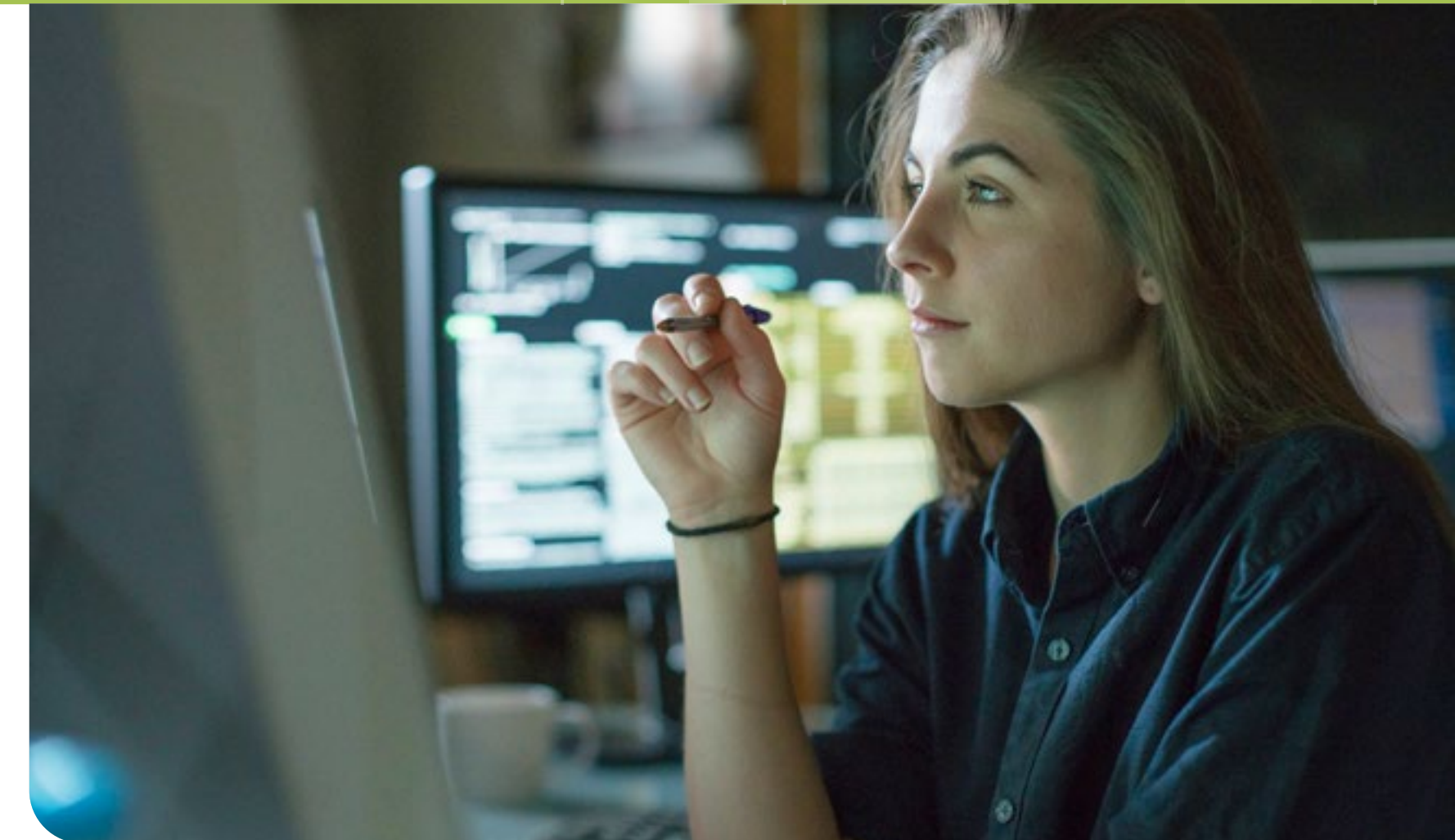
Readiness

- WATCH
- PLAN
- ACT

Drivers

- #Open source development
- #EU legislation
- #Decentralisation
- #Digital economy

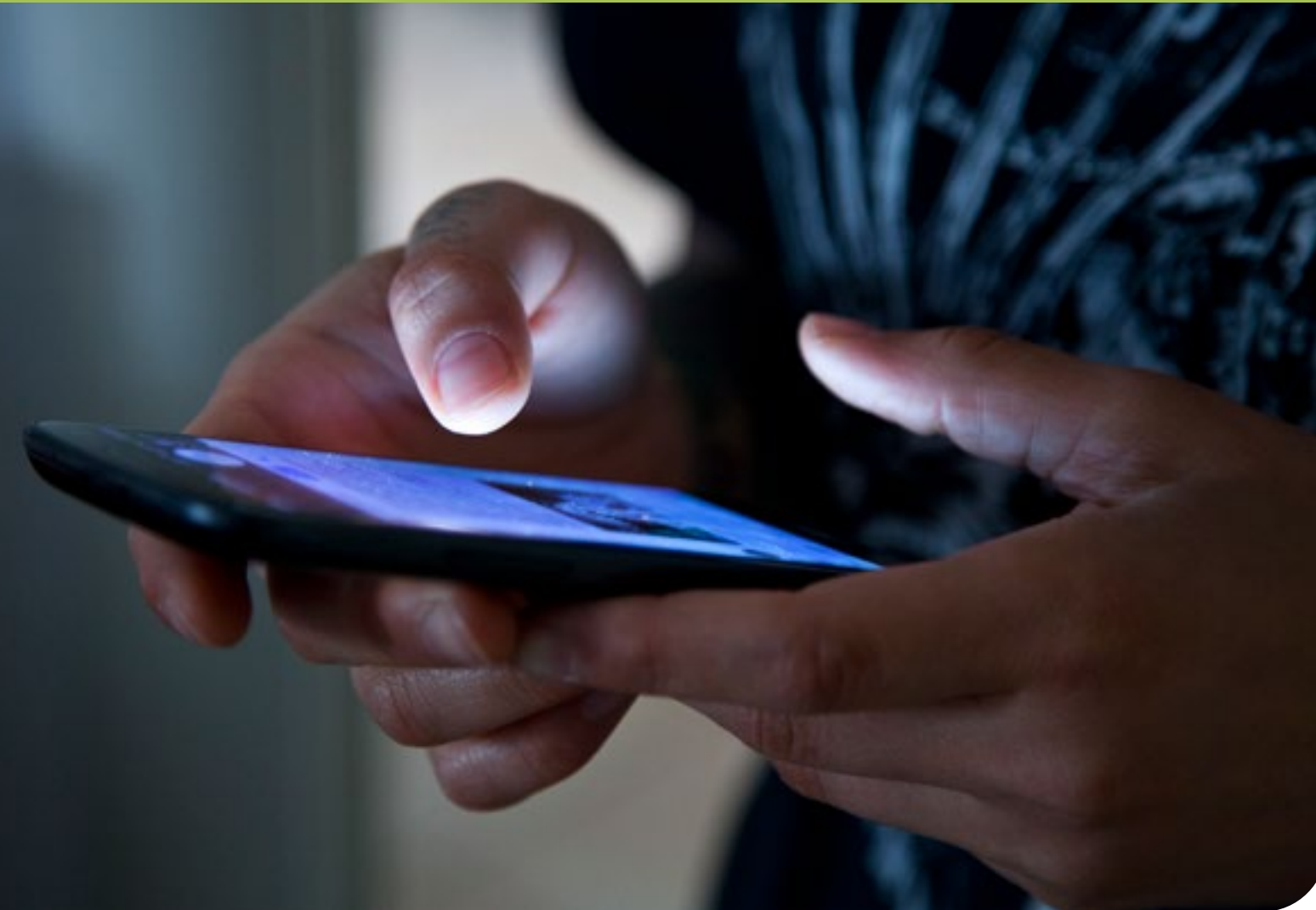
Recently there has been a proliferation of XR devices, platforms, and software tools. Due to a lack of industry-wide standards for many of these virtual realities, capabilities are not yet scalable and interoperable. The technologies and its underlying platforms are not open source, but are controlled by the platform providers. This includes standards for data tracking & collection, storage or standard protocols for linking different platforms. A question for the near future is whether this fragmentation will be a short-term trend, followed by some form of convergence, or whether market forces will perpetuate barriers, effectively leading to multiple ‘metaverses’.



Metaverse Standard Forum

The Metaverse Standard Forum brings together companies and standard developing organisations to provide interoperability within the open Metaverse. This includes a substantial number of standard developing organisations that will be collaborating and cooperating, which is an important step in regulating formats.

 [open example](#)



Rapid growth in technologies accelerate development of Metaverse

To provide an immersive experience, higher requirements on infrastructure should be met. The 5G technology can meet these higher requirements and provide more throughput on the network infrastructure.

 [open example](#)

Meta sparks anger by charging for VR apps

Developers of content for XR devices are frustrated that Meta insists on a charging model for the applications. Charging will diminish the open source character of platforms that VR developers strive for.

 [open example](#)

The XR4ALL Revised Landscape Report 2020

Included in this report are images produced by The Venture Reality Fund, which summarise hundreds of companies of active AR and VR market parties. Providing "... an analysis of the landscape of immersive interactive XR technologies ... in the time period July 2019 until November 2020".

 [open example](#)

IMPACT

A rapid pace of development makes it very hard to plan for the longer term, and thus requires more flexibility. Users have to accept that the current XR ecosystem is not stable. Educational and research institutions struggle with these continual changes; this has implications for proper procurement, scaling up experiments and thus understanding XR usability in education and research. The unstable ecosystem can lead to adoption stagnation. Solutions usually have some form of downside in terms of technical capability, price, openness or compatibility. One option for education and research is to accept the current state of the XR ecosystem. Thereby accepting constant changes in the ecosystem and focusing more on developing standards in both respective fields. A good awareness of requirements is crucial to make the right choice.

More about eXtended Realities

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