WHITE PAPER

ENGINEERING THE METAVERSE FOR MAXIMUM DIGITAL IMPACT

The buzz around metaverse and how it would change the future of the internet began towards the end of 2021. Metaverse, based on Web 3.0 technologies, is a concept still under development but has the potential to solve some of the hardest industry problems. In simple words, a hyper version of immersive and persistent experiences combined will be metaverse. This paper explores metaverse, its technology components, and the kind of industry-specific issues it can solve. Although it is still developing, the applications of this new technology are enormous. Therefore, this paper attempts to demystify the underlying technologies that are core for realizing metaverse and its expected advancements.

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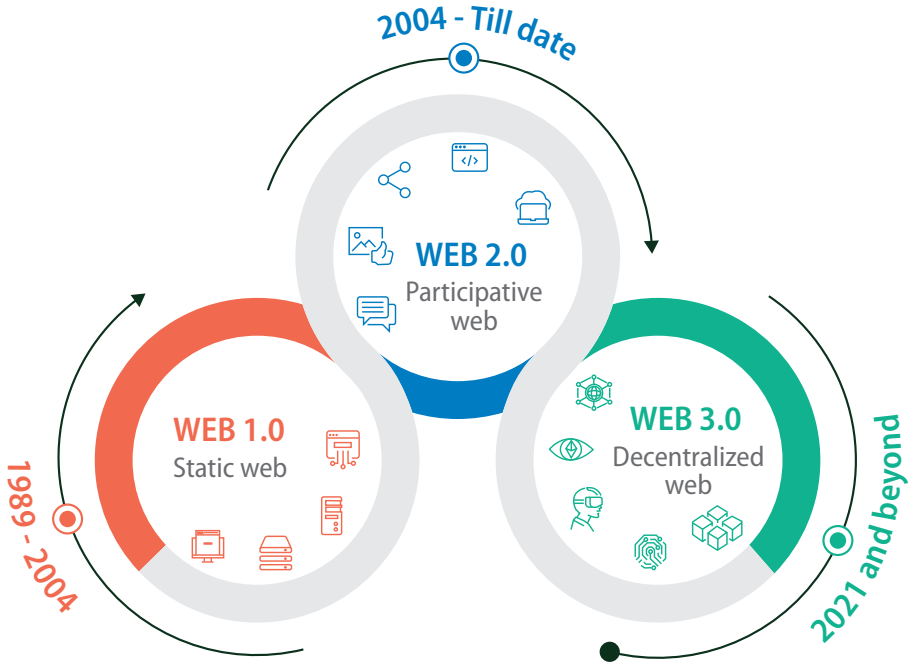
The metaverse evolution

Over the past three decades, the internet has evolved from a static entity to a dynamic one. Web 1.0, or the first avatar of the internet, reigned from 1989 to 2004. It was mostly static, with a few users creating content in the form of web pages that many users consumed. An explosion of mobile technologies, of the emergence of social media and responsive design allowed more users to create content leading to the rise of Web 2.0, also called as participative web, in 2004. Finally, advancements in edge computing and AI/ML technologies and concerns over data privacy led to a decentralized web and the creation of Web 3.0. Metaverse rides on the advancements and technology innovation of Web 3.0.

The key areas of the metaverse where progress is occurring are holographic rendering, user experience layer in two-dimensional and three-dimensional spaces, low-latency transport, spatial mapping and physics of things, along with a special emphasis on zero to low trust protocols for connection establishment, interaction and secure communication.

Figure 1 - Evolution of the Internet



Under the hood – Technologies powering the metaverse

Semantic Web

The semantic web is a concept where algorithms provide the ability to understand and present content to match the customer's needs. The structures help form a knowledge graph needed for Natural Language Understanding going beyond Natural Language Processing. This reliable graph helps present a content match that a customer needs instead of a simple textual search result.

Data is the bloodline of the metaverse

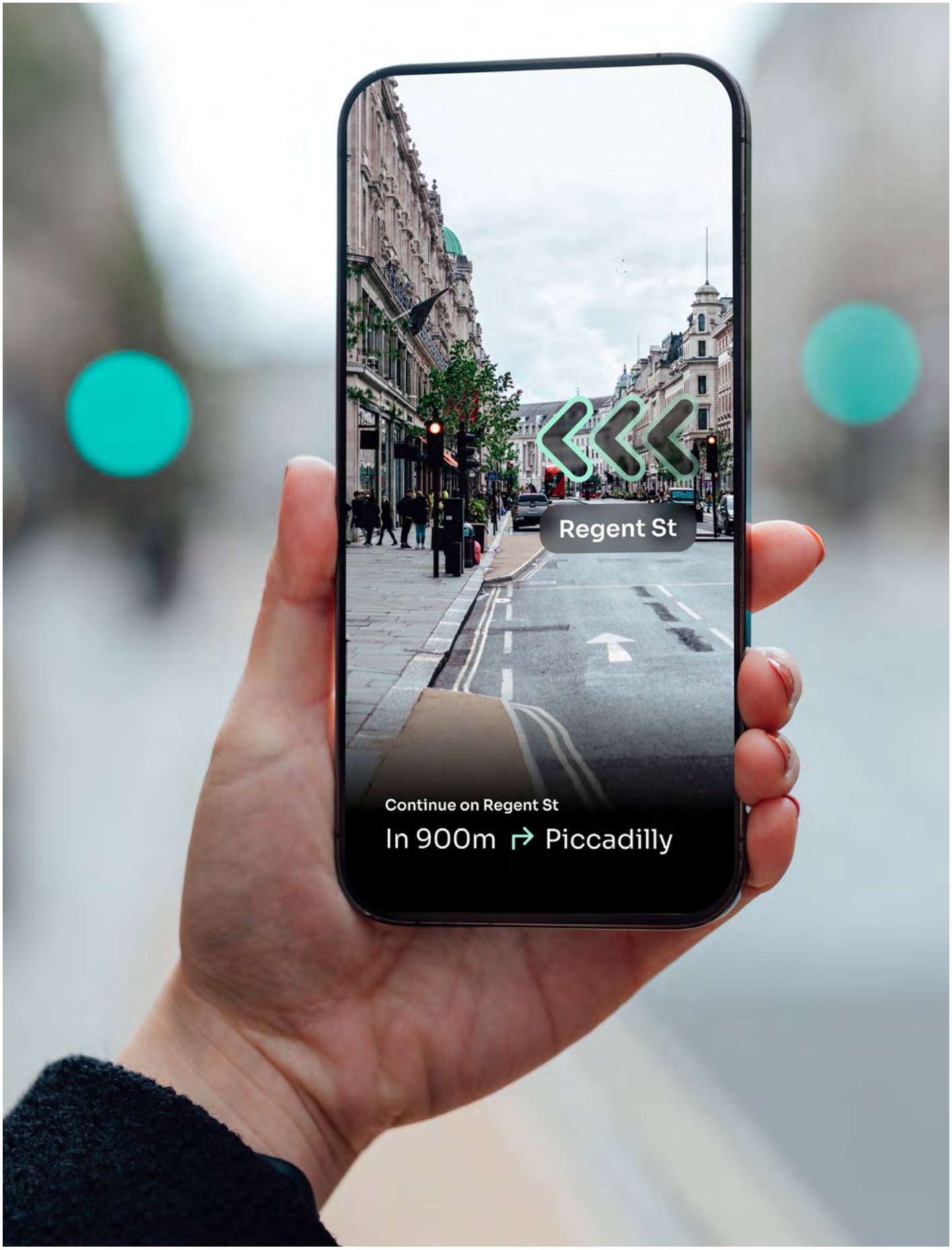
It is similar to IoT, where every edge device is either a producer or consumer of data. This concept refers to data access at every level, the ability to process it and connect to the web, from device standpoint.

AI and 3D Graphics

A key objective of Web 3.0 would be to combine the power of AI and ML to make computers understand and process information more like humans. Coupled with a three-dimensional design with a geospatial context, it would allow content creators to provide immersive experience that could also be viewed in 3D by consumers. These would enable the generation of faster and more relevant results than targeted advertising that forms the bulk of current efforts.

Decentralization of the web through Web 3.0

In the current web 2.0 world, access to information is typically controlled through DNS servers that act as primary gatekeepers to translate what the user knows to who provides the service. This concept in web 3.0 shifts from a small group of centrally located servers to distributed locations or smaller servers distributed across and not shared by a small group of entities. It also prevents the monetization of users' information by some smaller entities and instead allows users to control ownership of their data. In addition to decentralization, Web 3.0 will also be trustless - participants interacting directly without a trusted intermediary and permissions or authorization from a governing body. This calls for community trust and can be derived through blockchains or decentralized peer-to-peer networks, or a combination thereof. These decentralized apps are also known as dApps.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How Web 3.0 complements metaverse

Web 3.0 is a key enabler and provides the underlying foundations for the metaverse. While the metaverse focuses on user interactions in the virtual and mixed reality space, Web 3.0 provides the underlying protocols to make it happen.

L0 Layer – Protocol layer and platform neutral language describing a zero-trust and p2p internet overlay protocols combined with a language definition that is OS/Platform neutral allows disparate entities to talk seamlessly. This is fundamental to multiple entities establishing a secure way of interaction in the metaverse through Zero/Low trust interaction platforms.

L1 Layer – Data distribution, interaction, and messaging layers deal with how interactions happen, data distribution amongst entities and transient messaging between them, including presence detection. This layer is essential for data sharing securely for interactions in the metaverse.

L2 Layer – Collectively called Second Layer Protocols, this layer deals with data storage, states, computation, secret management, and Oracle's data injection mechanism using smart contracts. This layer allows codification of contracts and secret management to allow users to store data securely, collaborate and get/provide computational power for metaverse apps.

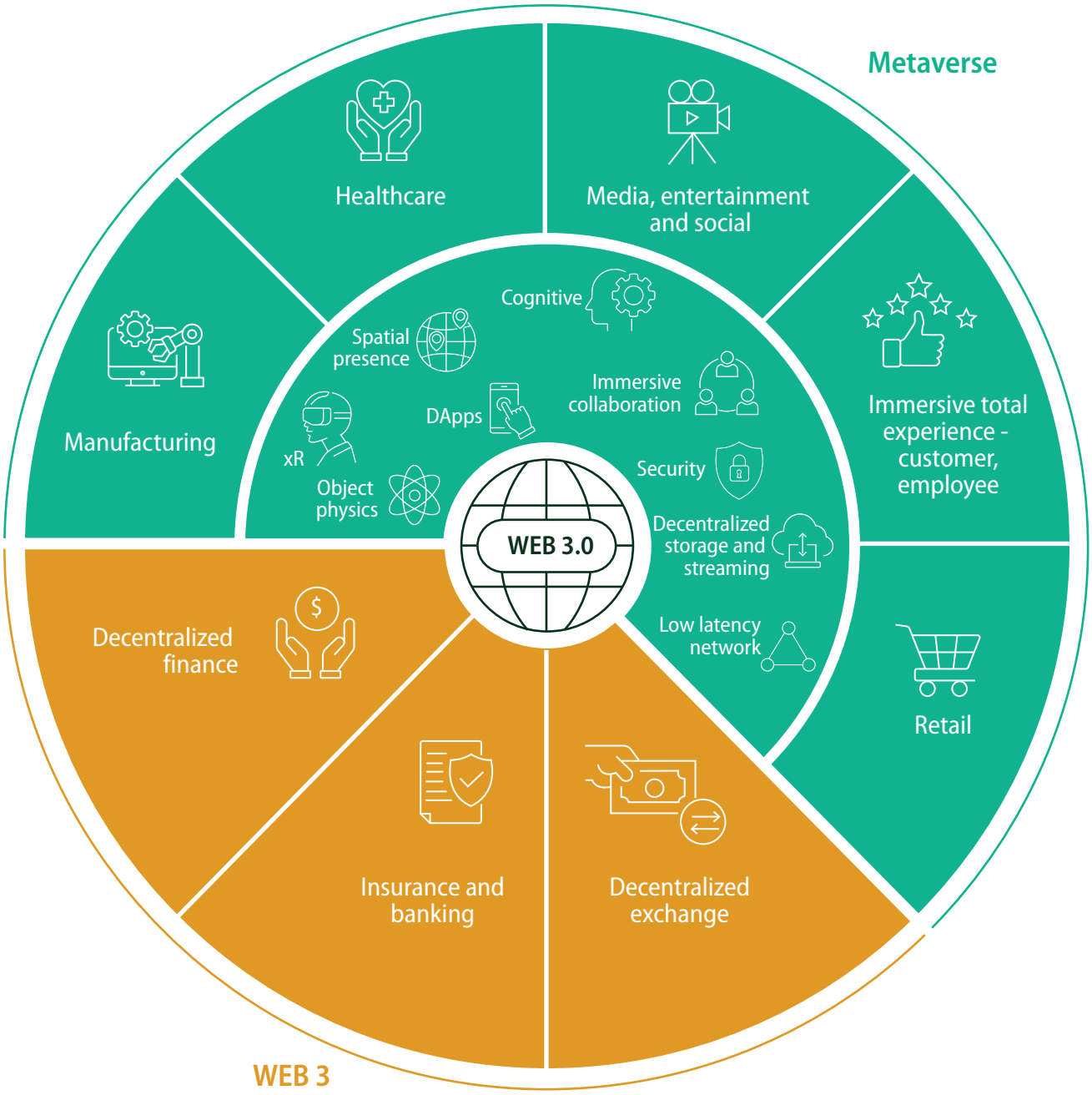
L3 Layer – A library of abstraction layers that extend the protocols and provide an API interface for developers to create Web 3 applications and, by extension, to metaverse applications

L4 Layer – A User interface layer typically with browsers and future interfaces users would use. This would be an interesting layer that portrays how end users experience the metaverse in two-dimensional, three-dimensional and mixed space.

Figure 2 - Web 3.0 Technology Stack

Web 3.0 framework for next - gen internet

Figure 3 - Metaverse realm - Human interaction in Virtual / Physical / Phygital



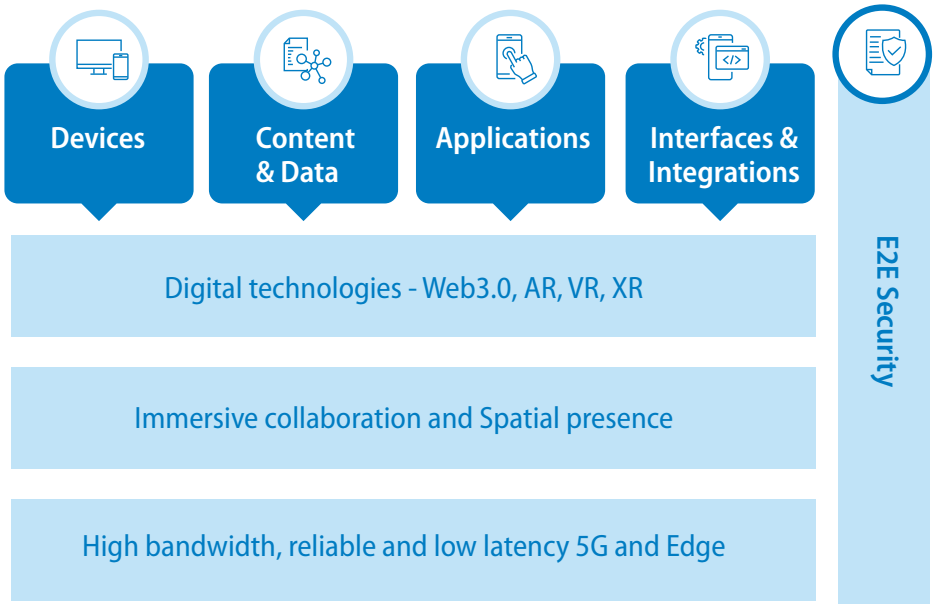
Web 3.0 - A technology platform powering metaverse and other decentralized applications

Metaverse impact on the digital ecosystem

Web 3.0 technologies combined with AR-VR, spatial presence, immersive collaboration aided by AI/ML for cognitive experiences and a low-latency 5G/SD-WAN network will induce many industries to adopt metaverse. As a result, the way people socialize, consume content and be entertained moves from central storage to a decentralized one. Moreover, this will be launched in the enterprise space in the form of phygital immersive collaboration.

Engineering the metaverse

As we have seen, the metaverse is a multi-disciplinary and multi-technology integration. Therefore, Infosys believes that the building blocks must be first engineered for the metaverse future.



1. **A network that offers high bandwidth, resilience and reliability, and Edge**

   The network must be high bandwidth up to the user device level for the immersive content and additional digital data to be transmitted. With user mobility, the network should be highly reliable, and for the closed loop feedback to work, the latency must be ultra-low. 5G is looked upon as the next generation connectivity answer for this. With the decentralization of the web, Edge process and Multi Access Edge Computing (MEC) will be necessary for the metaverse.

2. **Next generation collaboration**

   The future is all about virtual collaboration centers, virtual operation centers and fully virtual meeting rooms. We see this progressing more with metaverse, in which virtual collaboration areas are being used for avatars and hybrid human/avatar interactions. The contact center will progress towards phygital channels like virtual stores, avatars of CC agents and virtual trials etc. The current collaboration platforms must be engineered and abstracted, and integration layers must be built for this virtual collaboration future.

3. **Advanced Digital Technologies**

   Experience is the core of metaverse use cases. The expectation is how close the experience will be to reality in a virtual world. Technology has evolved and matured in the XR space, including the devices, head mounted, holographic and projectile displays. The AI engine drives the personalization of the experience. Immersive and AI technologies have rapidly developed in the last few years. Further engineering advancement is required such as the mainstreaming of XR, developments in 3D Graphic Accelerator, spatiotemporal présence and user interface innovations for better présentation layer.

4. **Device, Content, Applications and Integration**

   Metaverse requires immersive devices to be cheaper, more accessible and must support XR technologies. This requires reengineering. The content will become a combination of current digital, immersive with human participation in the form of avatars. Hence the content storage, distribution, streaming and multicasting systems require revamping.

A wide range of work being carried by Infosys Engineering in product development, mixed reality, industrial IoT, collaboration, network engineering areas and Web 3.0 provides ample opportunities to develop concepts of the metaverse, build solutions using metaverse and web 3.0 technologies to solve industry problems.

Further development or enhancements in Metaverse will involve developing Android or IOS apps on an existing Android or IOS platform. Like the Android studio, some of the popular metaverse creators offer SDK. Infosys envisions infinite possibilities, such as in the field of medicines, where patients can visit doctors in the metaverse. Also, buying/selling platforms such as the Facebook marketplace can be recreated in the metaverse where lifelike replicas of items on sale can be recreated through mobile cameras with technologies such as the Lidar scanner. The endless opportunities and development of advanced functionalities in the metaverse will constitute most of the technological evolution in the upcoming decade.

Conclusion

As with any emerging technology, the hype on metaverse is already present. Significant investments are being made by not only technology giants but also by enterprises, academia and even governments. The hype is bolstered by marketing campaigns about the "art of possible" with metaverse, stoking the innovation and ideation of possible use cases. We have studied different industrial and enterprise use cases to gauge the unprecedented change in the experience.

This paper realistically explores the state of the technology that drives metaverse. However, these technologies must make more progress, including Web3.0, AR/VR, blockchain, devices, and connectivity. While industries have already started visualizing use cases that currently look like a fantasy world, the velocity of underlying technology evolution would determine the practicality of these.

Metaverse is a multi-technology integration and hence requires an ecosystem. Hence, we must expect multi-faceted challenges in the seamless integration of these technologies, like non-compatibility standards, data security and multi-vertical handling. Infosys, with its rich experience in some of the foundational technologies of the metaverse, namely 5G, MEC, collaboration, AR/VR, IoT, blockchain and security, will be looking forward to solving some of these industry challenges and thereby helping immensely to bring this ecosystem together swifter.

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