

The Metaverse Technology Framework



The metaverse promises to transform industries ranging from tourism to fashion. But the metaverse is not developing by magic. An immersive metaverse needs several building blocks to realize its potential, including artificial intelligence, extended reality, blockchain, edge computing, and more. Major product developments from companies such as Apple, Google, and Meta have cast a spotlight on these technologies.

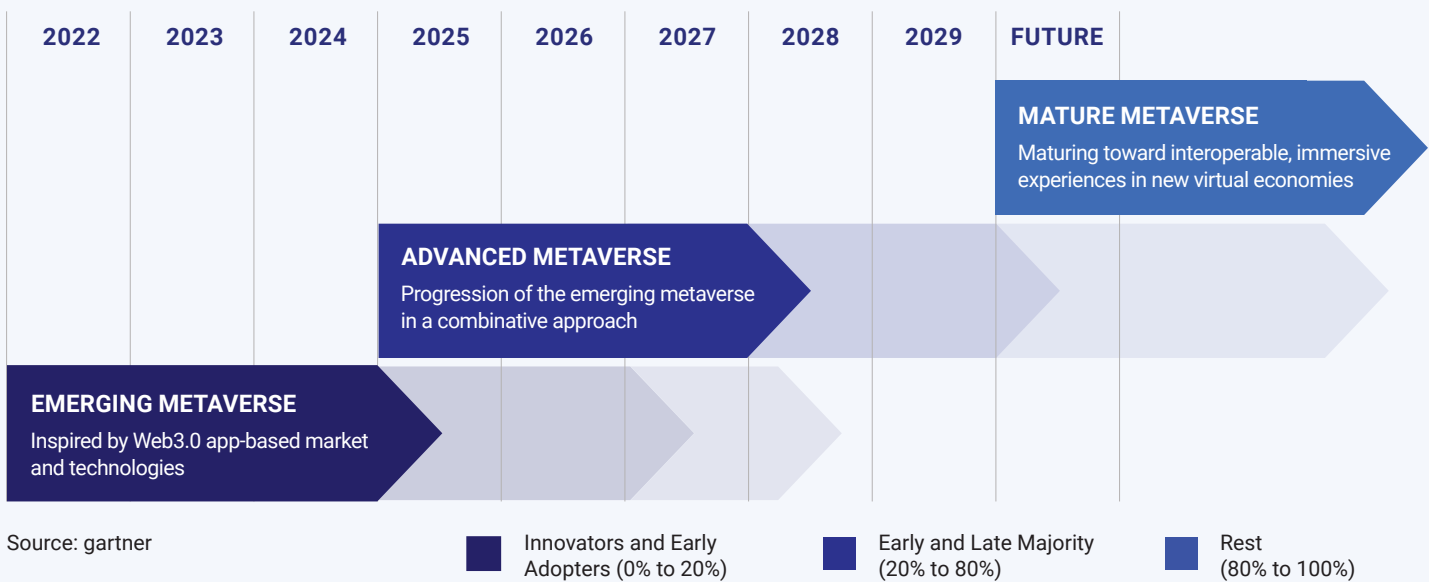
This paper discusses the key technologies fueling metaverse and each technology layer in detail. We welcome your comments and questions.

According to CB Insights' Industry Analyst Consensus, the metaverse could represent a **\$1T MARKET** by the end of the decade.

Phases of the Evolution of the Metaverse

The evolution of the metaverse is happening in a phased manner, according to Gartner (as shown below). The metaverse will not be mature before 2030. But Gartner says that business leaders must start evaluating the opportunities by creating strategic plans and infrastructures. We agree. In our view, planning for the metaverse requires understanding its strategic value and creating the right infrastructure by using the building blocks of the metaverse. Our previous white paper focused on strategy. Now let's discuss on building blocks of the metaverse.

EVOLUTION SPECTRUM FOR THE METAVERSE



PHASE 1 – EMERGING:

Through 2024, the market will explore the potential use cases of metaverse that can create long-term value.

PHASE 2 – ADVANCED:

The years 2024-2027 will be crucial as it may see a lot of opportunities focusing on tools and technologies to understand the interplay between physical items and digital content; build interoperable frameworks; lay down protocols, and more.

PHASE 3 – MATURITY:

From 2028 onward, the vision will be clear and the functionalities of the metaverse will be broadly understood. There will be significant opportunities in the infrastructural layer to bring potential transformations.


The Metaverse Technology Framework

The metaverse framework can be aligned to five distinct technological layers, which are the key building blocks of metaverse. The framework will help understand each of the technology stack and its sub-components that are essential for the metaverse landscape. The framework will evolve as the metaverse evolves.



User Experience

- Working remotely
- Lucrative healthcare opportunities
- Learning/training
- Shopping




Hardware Interface

- VR Headsets
- AR Smart Glasses
- Haptics
- Holographic



Virtualization Engine

- 3D design engines
- 3D modeling
- Avatar creation
- Volumetric videos



Economic Infrastructure

- Payments
- Crypto exchanges
- Crypto wallets
- NFT



Infrastructure

- 5G
- Cloud Infrastructure
- Chips and Processors
- Edge Computing

User Experience

In the metaverse, people interact with each other as they would do in a physical world. This includes the use of digital avatars to represent themselves, connect, and virtually establish a community. They may also purchase virtual clothing and video game accessories such as weapons and shields. Or they might simply roam through the metaverse for leisure with no specific objective in mind. The user can interact in the metaverse in multiple manners using devices such as virtual reality (VR) headsets and controllers.

The metaverse experience layer will continue to evolve with more emerging use cases. It's only a matter of time for the metaverse to touch all the areas of our lives and become a normal part of the real world. There are a few prominent use cases in the metaverse that are engaging users with their enticing experience.

Working remotely

The remote work trend gained massive acceptance and triggered a new work culture. In the metaverse, the peer-to-peer connection in the virtual world via digital avatars promotes a productive work environment through collaborations and interactions. A few companies have already implemented this use case to set a new standard for web communication

Lucrative healthcare opportunities

The metaverse can diminish the barrier of geographical inaccessibility. It can connect people around the world to the best healthcare institutions. In the metaverse, the medical staff can interact with patients to better understand their health conditions. Moreover, medical training, education, surgical room preparation, and operative procedure training are prominent use cases of the metaverse in healthcare .

Learning/training

The metaverse has the potential to revolutionize the education system and take learning to the next level. A few universities are already using such platforms to offer an exceptional learning experience. These innovations will not only have a positive impact on the education system but on society, too.

Boosting tourism

VR can inspire travelers to get a first-hand experience of their chosen destination before they plan to visit the place in person. In addition, AR and VR technologies combined with the metaverse can help travelers experience potential hotels before booking.

Shopping

Retail in the metaverse can build engagement, awareness, and brand loyalty among customers across the world. Brands such as Gucci, Hermes, and Dolce & Gabbana are collaborating with gaming platforms to sell NFTs to customers from different parts of the world in the virtual world. Using AI can help gather insights on purchase history, seasonal and demographic trends, etc., to tailor the shopping experience per customer preferences.

Real estate

During the pandemic, the real estate sector took a plunge into the latest technologies like 3D to give potential buyers a closer look into the properties without stepping out of their houses. Navigating buyers virtually through a property can amplify the experience and facilitate decision making.

Agriculture

The metaverse can help farmers manage farms remotely. AR and VR combined can provide a better look at the state of the farm, its inventories, storage, weather conditions, and many other parameters. The real-time monitoring of farms can lead to advancements in the agricultural sector.

Extended Reality Hardware Interface

Extended reality will uplift the user experience in the metaverse through metaverse-focused devices like augmented reality (AR) smart glasses, haptics, hologram displays, and virtual reality (VR) headsets. Such devices can facilitate numerous physical services in the virtual world and help users steer through the metaverse smoothly. XR is powered by AR and VR. XR can unlock possibilities fueling potential use cases in the fast-emerging metaverse.

VR Headsets

These devices are significant metaverse components applications that provide immersive audio and visual experiences using computer vision, eye tracking, and hand tracking. Special mention: AR smart glasses and contact lenses can also enable immersive experiences, taking social engagements to the next level by blurring the lines between the real and the virtual world.

Haptics

Haptic, derived from the Greek word for “touch,” is a technology that gathers information through a sense of touch. Haptic gloves are designed to feel the pressure and texture of virtual objects the same way as real objects. The haptics can also help control climate in the virtual world.

Holographic

Holographic displays use light technology to seamlessly integrate 3D content into the physical world. Be it characters or objects, the digital information in the right depth is projected into the physical world. 3D has really caught on in gaming. 3D will become more common other industries to create immersive experiences that merge the virtual and physical worlds.

Omnidirectional Treadmill

This is a 360-degree flat surface mechanical device allowing users to have any directional movement. It provides an interaction mechanism that allows users to touch VR objects with their feet, kick items, trace a path, and so on.

Virtualization Engine

The virtualization engine encompasses the programming engines, computational engines, virtual platforms, and other tools that help in developing the metaverse.

Artificial Intelligence (AI)

AI applications in the blockchain-powered metaverse will help augment the experiences by creating precise virtual worlds. Moreover, AI can aid in capturing numerous data from user activities to provide insights that can help ameliorate the virtual world environments and experiences.

Computer Vision

Computer vision is a branch of AI that extracts useful information from digital photos, videos, and other visual inputs, and executes actions or makes recommendations based on the data. Computer vision allows XR devices to recognize and understand visual information of users' activities and physical surroundings. It facilitates user interactivity within the metaverse universe.

Avatar creation

Turning selfies into avatars allows to personify the metaverse users and enables them to maintain an identity in the virtual world engagements. Fashion brands are using hyper-realistic avatars to create a brand impression and conduct virtual fashion shows. Corporations can allow peer-to-peer collaboration in the virtual workspace by creating avatars of their employees.

Volumetric videos

Real videos are captured from all angles and processed to make a 3D asset, which resembles the real video detail-by-detail. Such videos are called volumetric videos. This technology can be used for streaming live concerts, gaming, dance performances, and other VR-based content, on a virtual stage.

3D design engines

A few companies develop tools like game engines that enable designers to create metaverse-like elements with exceptional 3D visual effects. Currently, the 3D design engine acts as a building block for creating high-profile games for the gaming industries.

3D modeling

This technology is predominantly used by e-commerce platforms and real estate. The e-commerce platforms are using the technology to help their customers understand products better, and, as noted, real estate uses 3D modeling to give customers a better look at property without stepping out of their houses. The 3D modeling platforms allow users to upload 3D designs or scans and create 3D visuals offering a 360-degree view of the products, thereby enticing their customers with such immersive experiences.

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Economic Infrastructure

The metaverse is accompanied by a strong creator economy, wherein the digital tools are used to build digital assets that can be traded or sold through digital currencies. This is all powered by blockchain technologies.

Blockchain

Blockchain is the key component to maintaining the economic ecosystem in the metaverse. Every transaction in the metaverse is recorded on a digital ledger, which is not controlled by anybody, and the records cannot be altered or deleted by anyone. Blockchain allows one to have the ownership of nonfungible tokens (NFTs), which are unique digital assets that someone can take along anywhere in the metaverse. Blockchain facilitates the decentralized economy and ensures the protection of virtual goods/properties in the metaverse.

Digital and cryptocurrency

The metaverse based economy needs digital currencies and cryptocurrencies to function. A digital currency is e-cash that doesn't need any special method to encrypt it. Cryptocurrency is a type of digital currency secured via encryption technology – the blockchain. Cryptocurrencies are stored on a blockchain, and the coins themselves are stored in wallets that offer a much higher degree of cyber security.

Crypto wallets

To enter decentralized world, users need crypto wallets that are used as login credentials. The crypto wallet acts as a personal account for a user with a unique ID. Moreover, crypto wallets provide users access to digital assets in the virtual world.

Payments

Digital payment platforms and operations are set up in the metaverse to support digital currencies and decentralized financial services. Most companies will leverage blockchain technology to focus on decentralized financial (DeFi) applications and cryptocurrencies like bitcoin, ether, etc.

Crypto exchanges

These platforms enable users to buy or sell crypto that is native to the decentralized world. For example, MANA, the cryptocurrency used for Decentraland, can be purchased on Kraken, Coinbase, and other platforms.

NFT

Nonfungible tokens (NFTs) are the backbone of economic infrastructure in the decentralized world. They are digital assets in the form of avatar clothing, videos, tweet, and virtual lands, which can be sold, bought, or traded using cryptocurrencies. Some companies are developing specific NFT marketplaces that cater to NFT trading in the decentralized world.

Infrastructure (Computing and Network)

A huge data inflow is a crucial factor for the metaverse. To support the data and low latency, there needs to be a processing and computing infrastructure set up. The following technology components will play a vital role in offering a seamless metaverse experience.

5G networks

The metaverse is about the immersive world and experiences with high-resolution applications. The devices using the metaverse-like applications will be supported by low latency and 5G networks for a lag-free experience. The network bandwidth will improve with 5G reducing any network discord. Telecom companies can offer a 5G network for building immersive training and learning applications and to support seamless experiences in AR.

Users have often had problems with their network while engaging in the metaverse due to slow rendering and data transfer speed because of the unavailability of a high-speed Internet. However, with the advent of the 5G network, this problem seems to be fixed. The decentralized nodes in blockchain provide the services, architecture, and development of the metaverse. It offers a consensus mechanism, which promotes high-level security, and it also facilitates user interactivity and transactions that are done in the metaverse.

Cloud Infrastructure

The companies working on the metaverse will need cloud infrastructure to host the virtual world and to store the immense data generated and aggregate information from the huge data stream. Moreover, cloud computing can help in processing high-resolution graphics and AI over remote servers and then streaming it to metaverse-focused AR and VR devices.

Chips and Processors

Metaverse-related devices like VR headsets and AR glasses will require chips and processors that can support high-fidelity graphics and AI on lighter devices. As the metaverse involves high computational efficiency, there will be a major requirement for powerful chips and sensors to power low latency networks. The leading companies in the chip development space are hugely investing in the XR space to power the metaverse.



Edge Computing

As cloud computing can handle workloads with minimal latency, edge computing can provide quick responses to user's action inputs like player movements in games and loading new objects into the game. Thus, edge computing offers cloud computing services to the network, thereby offering ultra-low service latency and providing a superior user experience. In metaverse applications, edge computing can support situations when information needs to be applied in real-time based on information from AR/VR device sensors or actuators, or gaming commands. Moreover, edge computing can save bandwidth, secure diversified data, and bring better insights from local data.

IoT/Robotics

When deployed in the physical world, internet of things (IoT) devices can collect data from the physical environment that can be used to update the virtual world. Sensing service providers (SSPs) can share a live feed to virtual service providers (VSPs) to upgrade and maintain the virtual world.

Metaverse Benefits

 <p>INCREASED REVENUE</p>	 <p>EFFICIENT OPERATIONS</p>	 <p>COST REDUCTION</p>
 <p>NEW ECONOMIC INFRASTRUCTURE</p>	 <p>MARKET REACH</p>	 <p>ACCESSIBILITY</p>



Increased Revenue

Increased brand awareness and market reach for businesses will help them increase their sales over the metaverse by connecting with people across the world. In addition, companies can save on office space rents and furniture by setting up a virtual workplace for people from across the globe to collaborate.



Efficient Operations

Unlike the current virtual working environment of calls, employers can track employees' digital footprint in the metaverse, which ensures better productivity at work.



Cost Reduction

Business collaborations, meeting, and discussions can happen in the virtual world without flying to different places in the world. Organizations can thus minimize the overhead costs of the company.



New Economic Infrastructure

In the decentralized digital world, the cryptocurrencies and the NFT marketplace will cater to goods trading, thanks to blockchain technology.



Market Reach

The metaverse offers a potential platform for the companies to spread brand awareness and reach people from different geographies.



Accessibility

Customers will have the flexibility to discuss business in the virtual offices without personally visiting the offices, which saves a lot of travel time.

Takeaway

As the metaverse matures, more and more use cases will emerge to disrupt industries. The metaverse is still at nascent stage. However, given the prospective benefits of its use cases, we believe the future will see its mainstream adoption. Pactera EDGE can help business succeed in the evolving metaverse in three ways:



Develop a business transformation strategy that links the metaverse to your company's growth objectives. The metaverse is having far-reaching impacts in all industries and all applications ranging from product development to the customer experience. We can help you define a road map to business transformation with the metaverse.



Design experiences in the metaverse with people at the center. Our research, design, and development experts rely on tools such as design thinking to ensure that all immersive technologies, including the building blocks of the metaverse, meet human wants and needs.



Develop the computing infrastructure that powers the metaverse, including enabling technologies such as AI and computer vision discussed in this white paper.

Pactera EDGE strives to serve its customers with innovative and efficient solutions to help them run faster in the digital transformation journey. We have a far-reaching vision to help our customers leverage the power of metaverse to explore opportunities and expedite their business transformation. [Contact us.](#)

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