



The Metaverse Overview: Vision, Technology, and Tactics

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Preface	4
1. Vision and Values	10
1.1 Vision and 4 meanings of the Metaverse	10
1.2 Six Characteristics of the Metaverse	16
1.3 The value of the Metaverse	20
1.4 Current bottlenecks in Metaverse development	21
2. Technology	24
2.1 Technology clusters corresponding to Metaverse features	24
2.2 Key technologies' development stages and bottlenecks	26
2.3 Examples of Metaverse-related technology applications	30
3. Industry	33
3.1 Metaverse industry framework	33
3.2 Types of participators, cooperation and competition	34
3.3 Major platform players	35
3.4 The NFT industry chain	37
4. Metaverse tactics for enterprises	43
4.1 Metaverse development	43
4.2 Potential risks	44
4.3 China's attitude to the Metaverse	44
4.4 Metaverse tactics	46

With the sharp drop in Meta's stock price in February 2022, the global Metaverse craze triggered by Facebook's rebrand reached a turning point. Excessive enthusiasm has since started to subside, and people now view the Metaverse opportunity more rationally. This paper answers the key questions:

What is the value of the Metaverse?

What will it look like in the future?

Is there an analysis framework to cover all of its components?

What technologies do organizations need to shape their Metaverse?

Where are the bottlenecks?

How should companies respond to the rise of the Metaverse?

What types of companies are in the Metaverse?

Preface

Facebook's renaming to Meta in October 2021 ignited global enthusiasm for the Metaverse. Capital market valuations of Metaverse-related stocks reached a peak one month later, but just three months after that, valuations of some Metaverse-related stocks had dropped by 20%-50%. People's attitudes towards the Metaverse have shifted from excitement and ambition to rationality and exploration.

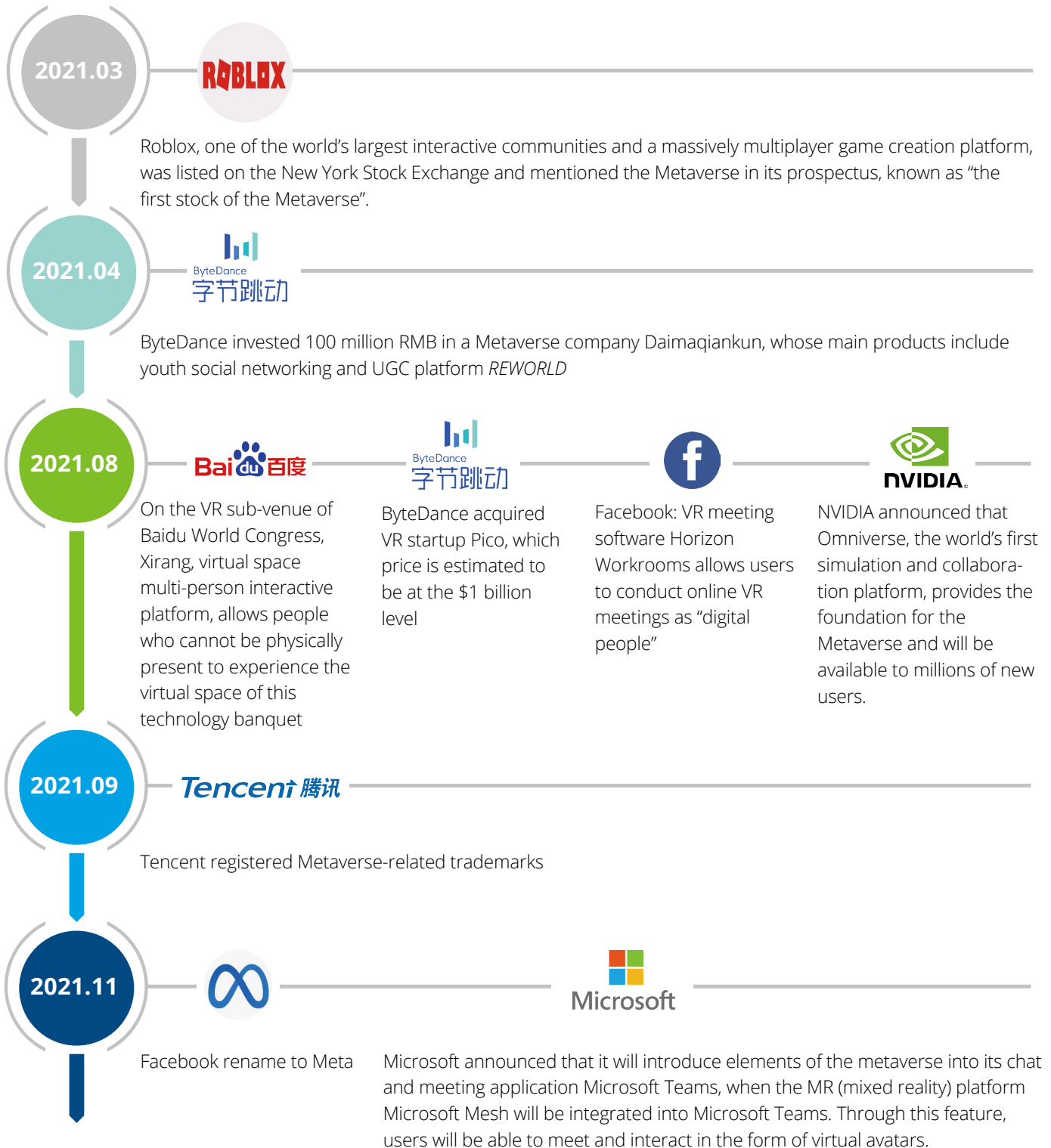
1. 2021: Excitement & Ambition

Looking back at 2021 – the first year of the Metaverse – its breakout was much more intense and the responses of market participants were much faster than they were when the internet entered global consciousness.

From Roblox citing the concept in its prospectus and planting the first flag on the Metaverse landscape, to multiple companies entering the industry, and then to Facebook's changing its official name to Meta, the first Metaverse enterprises pushed its popularity to a climax (as shown in the figure). At the same time, many well-known institutions and individual participants demonstrated their willingness to try Metaverse applications. The University of California, Berkeley recreated its entire campus in *Minecraft*, where virtual avatars of graduates attended a ceremony and took group photos, virtual idol Liu Yexi became popular on TikTok, and US President *Biden established Biden Island on Animal Crossing* to attract voters.

A glance at the global and Chinese markets reveals that the Metaverse is by no means just an experiment for small-scale players, but has become a landscape for all of humanity to jointly explore the next stages of development in society, technology, legal systems, and the arts.

Figure1: Enterprises entering the Metaverse in 2021



Source: Public information, Deloitte analysis

2. 2022: Rationality & Exploration

Compared with the curiosity and ambition shown in 2021, markets and individuals have tended to be more rational and explorative towards the Metaverse in 2022. The capital market has been the best illustration of this shift, where valuations of Metaverse enterprises now largely depend on whether their business models can create real value for companies and customers.

Analysis of the stock prices of three world-leading technology companies

Although Meta has the most influential voice and business reserves in the market, its stock price fell about 20% in the first quarter of 2022, missing analysts' expectations. Facing an intense onslaught from rivals including TikTok, conventional Meta (facebook.com) user growth stagnated, with daily active users falling by a million users in one three-month period. Meanwhile, Meta's other apps, WhatsApp and Instagram, saw significant drops in user growth. Meta's Metaverse-related businesses continue to burn money and have tended for some time to hinder the company's overall development.

Unlike Meta, the share price of Google, which has not put too much effort into its Metaverse

business, continued to rise due to growth in its core business. Google has retained its leading position in advertising, its primary business, and Amazon and TikTok have had less short-term impact on its position. The explosion in internet traffic driven by COVID-19 has also provided a substantial boost to Google's performance, which has continued to push up its stock price.

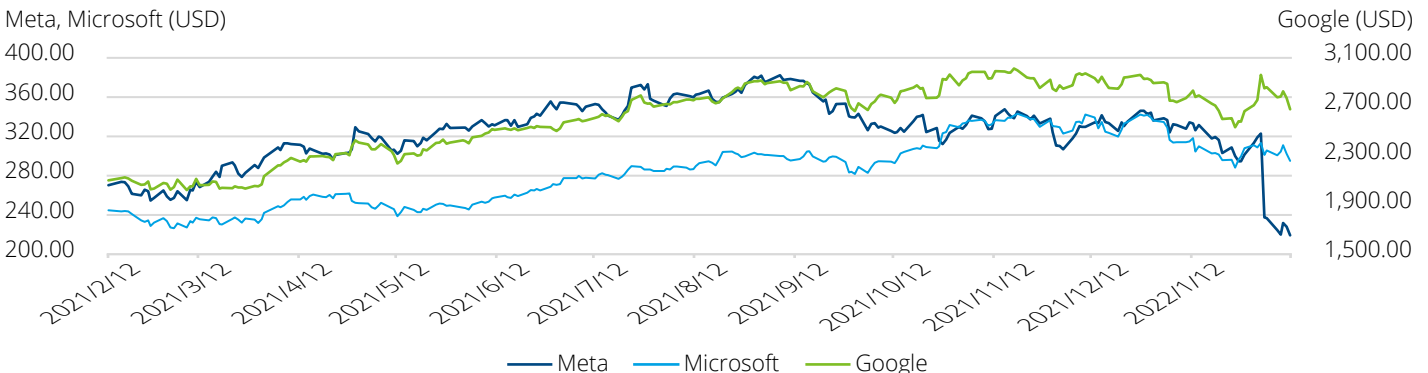
The share price of Microsoft, which announced its Metaverse business at the same time as Meta did, also rose, with some fluctuations, due to a massive breakthrough in its cloud business and solid performance in traditional software.

Analysis of the stock prices of two global Metaverse companies
By February 2022, Roblox's stock price was down 47% from its all-

time high set in November 2021, including a drop of 27% from the start of the year. Roblox's Q3 2021 revenue was up 195% year-on-year, and analysts expected large capital flows into its stock. However, once passion for the stock cooled, investors began to pay more attention to Roblox's profits, which missed expectations.

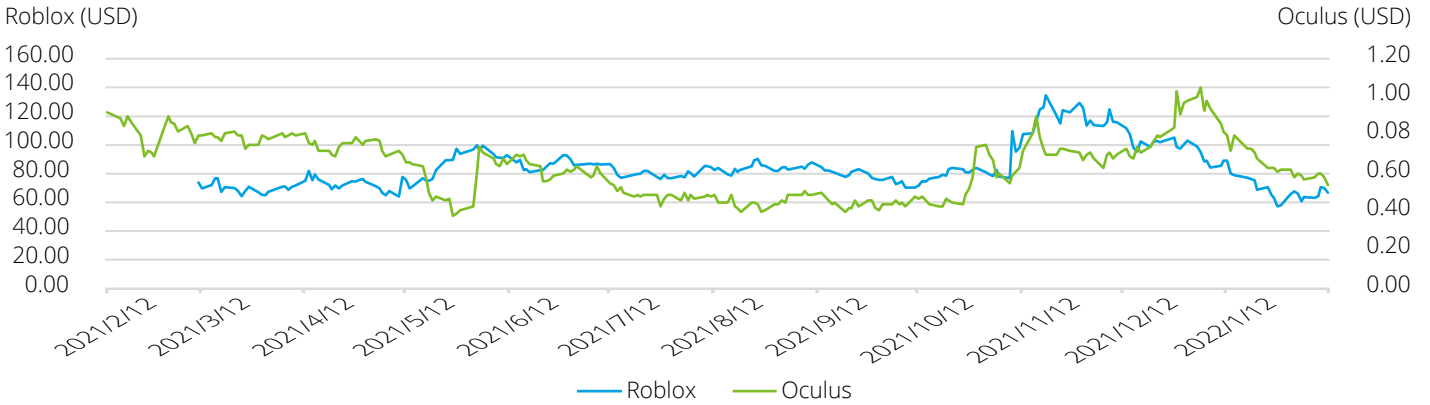
Oculus's stock price has also dropped sharply in 2022 after a steep rise in the second half of 2021. The virtual reality hardware company had previously maintained growth, aided by 2021's stock market excitement around the Metaverse. However, after this heat subsided, the many issues with Oculus head-mounted display devices, including their weight, physical and emotional discomfort, high prices, and limited consumption potential, began to attract attention again:

Figure2: Share prices of Roblox and Oculus (Feb. 2021-Feb. 2022)



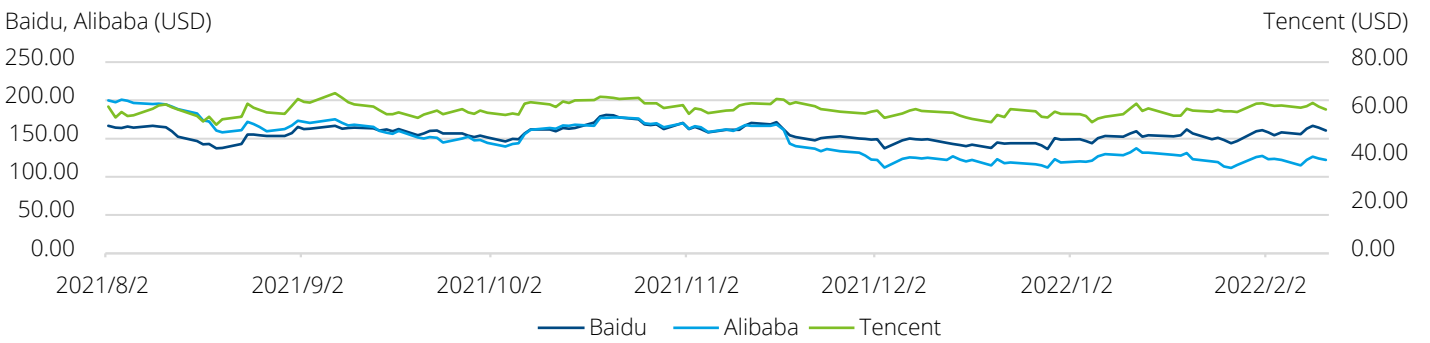
Source: Yahoo Finance, Deloitte analysis

Figure3: Share prices of Roblox and Oculus (Feb. 2021-Feb. 2022)



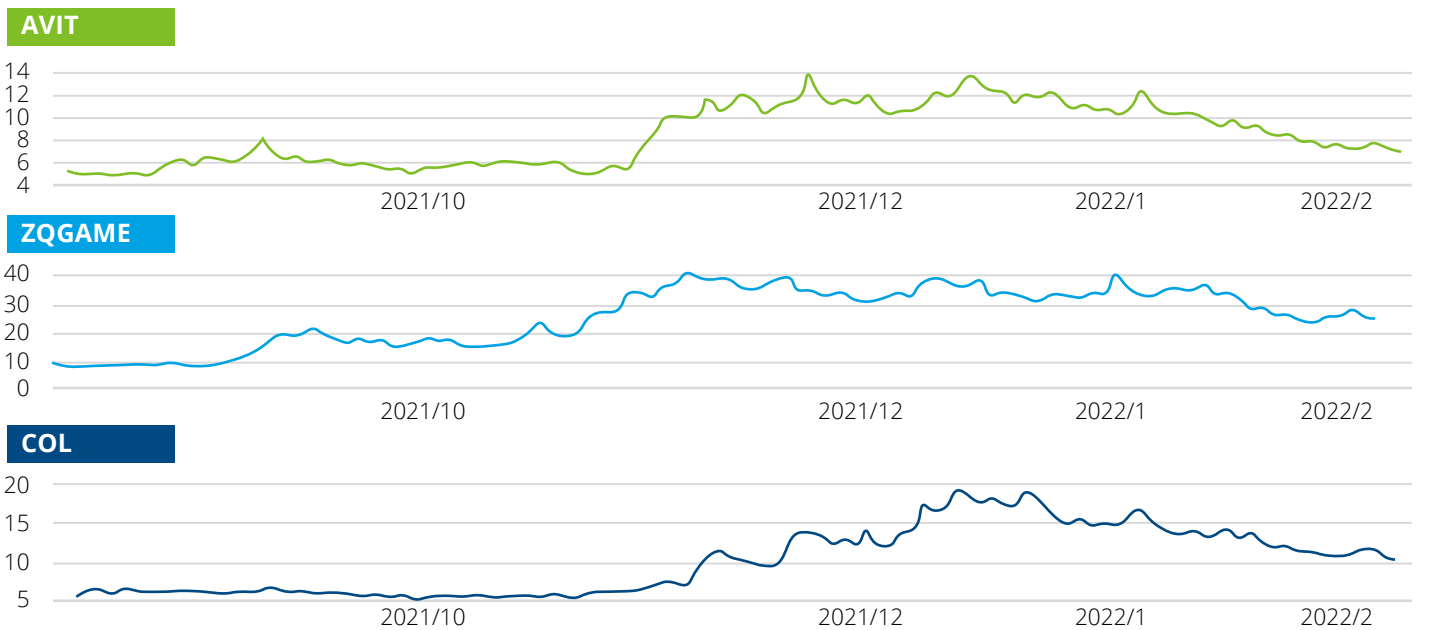
Source: Yahoo Finance, Deloitte analysis

Figure4: Share prices of Baidu, Alibaba, and Tencent (Feb. 2021-Feb. 2022)



Source: Yahoo Finance, Deloitte analysis

Figure5: Share prices of AVIT, ZQGAME and COL (Feb. 2021-Feb. 2022)



Source: Google Finance, Deloitte analysis

Analysis of the stock prices of three leading Chinese technology companies

Although Baidu, Alibaba, and Tencent have all deployed in the Metaverse, this has not influenced their stock prices much over the past six months, except during mild fluctuations during "Metaverse fever" in November 2021. However, Alibaba's stock price went into a volatile decline during the past quarter as its primary business revenue and gross merchandise value (GMV) growth disappointed.

Analysis of the stock prices of three Chinese Metaverse companies

China's Metaverse Index rose 30% in 2021, with most of that rise coming in the fourth quarter.

ZQGAME was up 270%, AVIT rose 185%, and COL gained 69%. However, because they did not generate Metaverse-related income, all three companies' stock prices retreated 2022.

As described above, capital market enthusiasm for the Metaverse has declined. There are three reasons for this.

First, the development speed of Metaverse-enabling technologies and applications has not matched the continuous rise of consumer expectations for Metaverse applications. This year is expected to see a continuation of that trend, with Metaverse development throughout the year slower than the public expects.

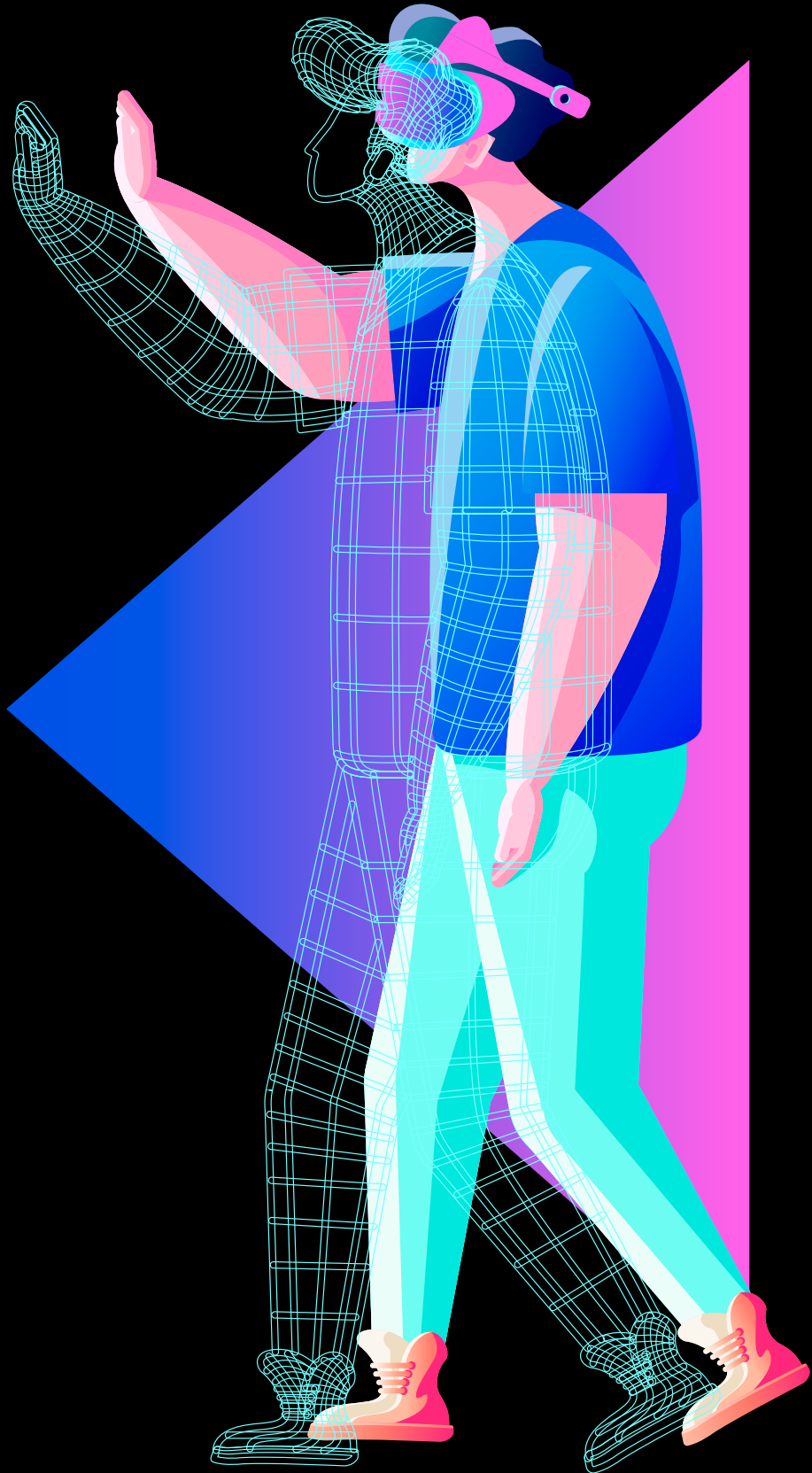
Second, most Metaverse practices, intending to cater to the Metaverse

craze, remain at the conceptual stage. It is difficult to achieve far-reaching breakthroughs or returns on capital investment at speed.

Third, technology, products, rules, and regulations continue to restrict the actualization of enterprises' and consumers' visions of the Metaverse. Technologies do not have the ability to create a true Metaverse experience yet, and related products including hardware and software have not matured. In our still centralized world, there has been no quick creation of decentralized rules to support the Metaverse, and it will not transform easily or quickly from a niche market into a universal consumer group.

What kind of Metaverse will exist beyond its initial popularity and now that capital market excitement has cooled?

The Metaverse will fundamentally reshape people's productivity, lives, and social relationships, in time creating a new world. This is the development direction of Metaverse. After the excitement subsides, companies that focus on accurate positioning, continuous development, and outstanding ability will produce a viable Metaverse that inspires renewed excitement.



1. Vision and Values

In this chapter, we discuss the development vision of the Metaverse, its long-term value, its characteristics compared with current internet platforms, and development bottlenecks.

1.1 Vision and 4 meanings of the Metaverse

In this nascent phase of the Metaverse, the industry has not formed a unified standard for defining or understanding it. It is a garden in which 100 flowers are blooming and 100 schools of thought contend.

David Bashuki, CEO of Roblox, has proposed eight elements of the Metaverse: identity, sociality, immersion, low latency, diversity, anywhere, economic system, and civilization. Renowned analyst Matthew Ball has identified six characteristics of the Metaverse: sustainability, real-time, no

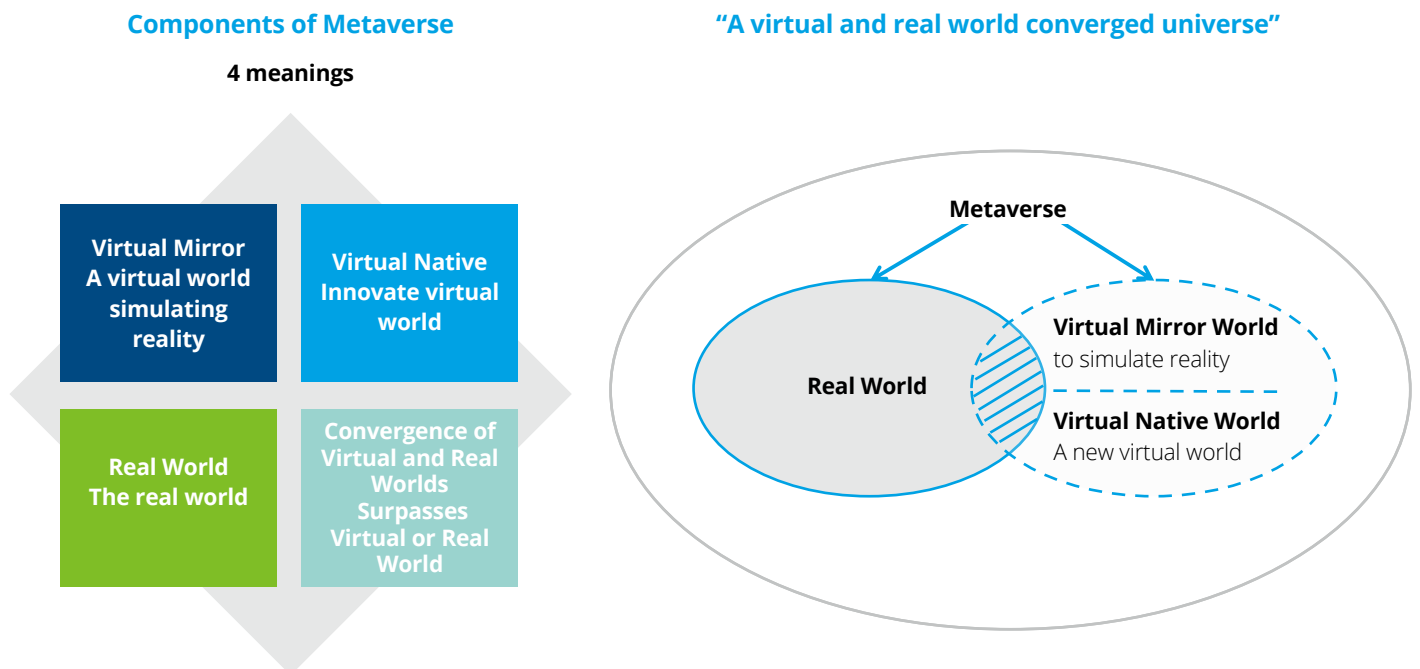
access restrictions, economic functions, connectivity, and creativity. Jon Radoff, founder of Beable, has ideated seven levels of Metaverse construction: experience, discovery, creator economy, spatial computing, decentralization, human-computer interaction, and infrastructure. In China, some institutions have proposed that the Metaverse is a new internet application and social arena that integrates various new technologies, shaping a virtual space in an online world that mirrors the natural world in an increasingly realistic digital landscape.

These different understandings and definitions of the Metaverse come from different perspectives, including

experiential, technological, or regulatory interpretations. It is not easy to provide a concise, definitive, unified definition that covers all these dimensions.

Starting from the original meaning of "Meta (Meta) + Verse (Universe)", Deloitte has defined and imagined the future of the Metaverse as "a converged world of the virtual and the real". This has four meanings: a virtual mirror world that simulates the real world, an innovative virtual world set apart from the real world, the real world as a facet of the Metaverse, and the convergence of the virtual and real worlds beyond either the virtual or the real world.

Figure6: Definition and meanings in the Metaverse



The Metaverse will include almost all elements of our real world. This is the key to understanding the long-term state of the Metaverse and how fundamentally and profoundly it will influence us. The four meanings above can be described as follows:

Meaning 1: A virtual mirror world that simulates reality

The Metaverse includes a virtual world that simulates almost every element of the real world, including individual identity, enterprise identity, the business world, entertainment, social interaction, civilization, legal, tax, and governance structures, and one of the most critical features of our real world—feelings.

This is an important starting point for understanding and envisioning the

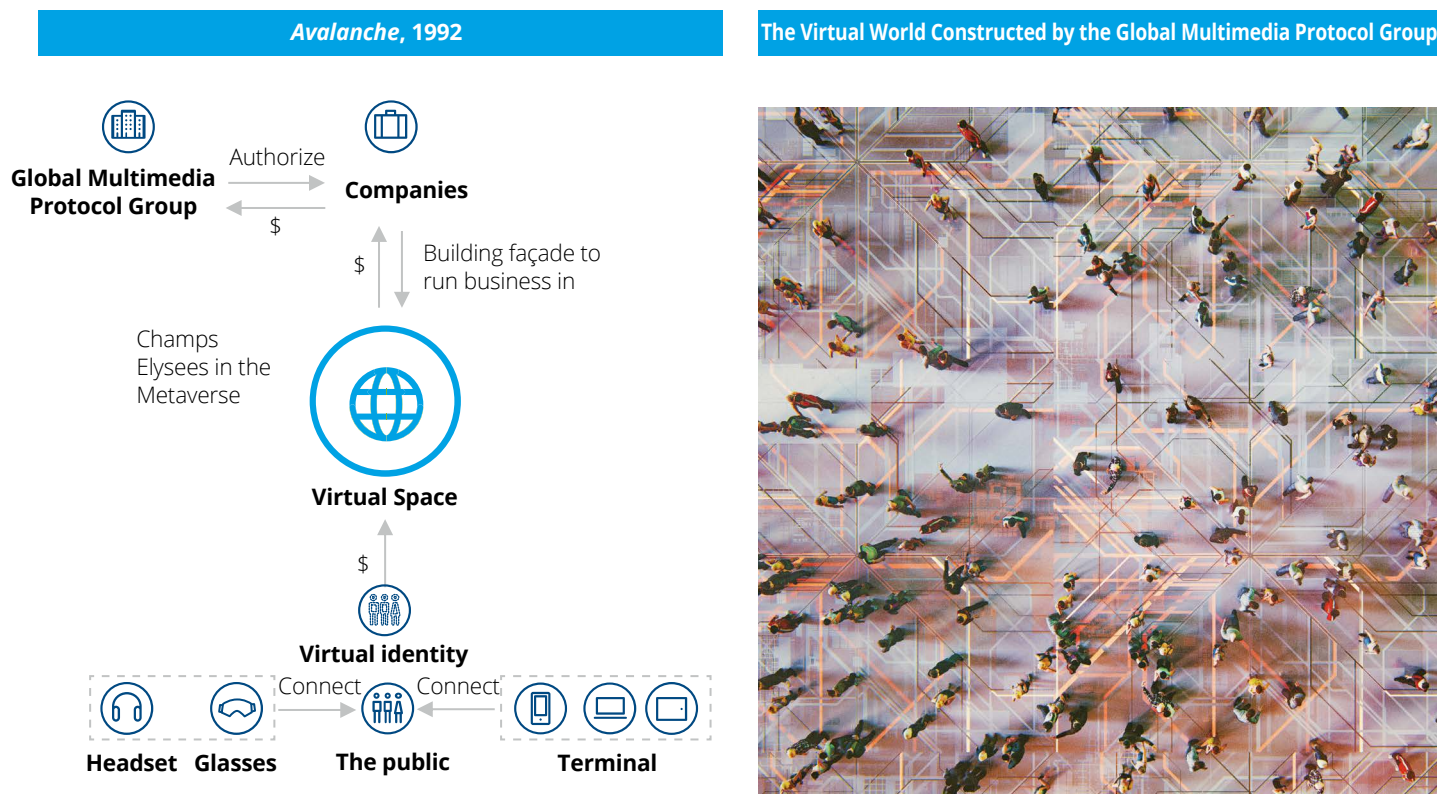
future direction of the Metaverse. The public's current perception of the Metaverse encompasses games, experiences, technologies, and social applications. These are parts of the Metaverse, but the future of the Metaverse is much more than the sum of those parts.

The term Metaverse originated from a scene in Snow Crash. It is a conceptual extension of that scene to imagine a "real" virtual world that is a full simulation and complete mirror of the real world.

Neil Stephenson's Snow Crash describes such a virtual world: the protagonist enters a commercial block, on the Champs-Élysées in the super-meta-domain (the Metaverse). The street is very long, traversing

65,536 kilometers. A vast number of people pass through the commercial block, where there are many shops. Opening a shop there requires third-party approval, buying land, obtaining the relevant licenses, and bribing inspectors. Humans walk and interact with the neighborhood as digital avatars; populating a world the author calls the Metaverse. The picture below is a schematic diagram of the scene depicted in Snow Crash. There are many core elements of the real world in its described virtual world, including neighborhoods, social interaction, commercial real estate development, business activities, and even corruption.

Figure7: The virtual world of Snow Crash



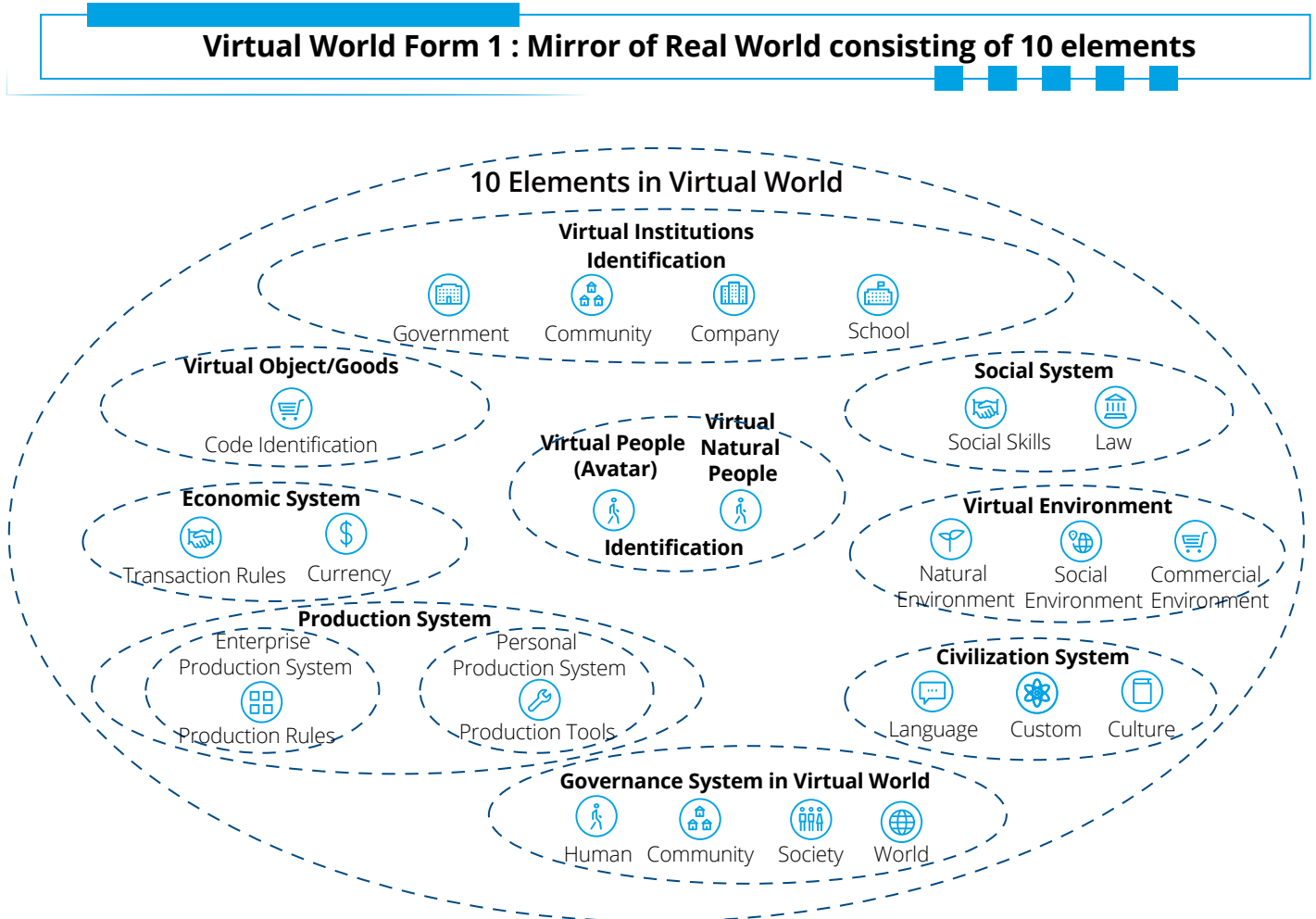
Source: Public information, Deloitte analysis

Derived from its depiction in Snow Crash, the future Metaverse will include a virtual world that simulates all real-world elements. There are 10 elements

in the real world: environment, people, objects, institutions, society, and economic, enterprise production, individual production, civilization,

and governance systems. There are also 10 elements in the virtual world corresponding to these 10 real world elements.

Figure8: A virtual world that replicates the real world



Source: Deloitte analysis

Meaning 2: A native virtual world
The Metaverse includes another virtual world. This is an innovative, native virtual world that has all the elements of the real world, but whose elements have no corresponding elements in the real world. People can use their imaginations and creativity to create completely virtual people, objects, and environments. New entities, new

regulations, and new wisdom will embody innovation in this virtual native world.
This new entity is home to people, objects, and environments shaped entirely in the virtual world, with no real world counterparts. In this Metaverse, there will be new "people" who are not avatars, but people created and

who only exist in the virtual world, like virtual digital employee Cui Xiaopan, who won the 2021 Best Newcomer Award at Vanke Headquarters. Other examples include non-fungible token (NFT) objects such as pictures, audio, videos, artwork, and buildings. In this native virtual world, liberating some of the physical and spatial stipulations of the real world create a virtual natural environment.

Regulation has three aspects in this new native virtual world: governance by decentralized autonomous organizations (DAOs), which is completely different to the centralized model in the real world; user-created content (UGC) rather than the platform-generated content (PGC), which will completely liberate people to be creators and allow anything to be created; and the movement of people in the virtual world, unencumbered by real-world physical or spatial rules.

New wisdom refers to artificial intelligence (AI). Virtual people, despite existing only in the Metaverse, will have the same or greater wisdom than human beings do in the real world. Currently, most AI seeks to simulate human beings by listening, speaking, reading, writing, smelling, touching, moving, and thinking. One day the wisdom of AI will go beyond human beings, and that day is not

that far away given the acceleration of technology, with the computing power of Nvidia's CPUs now said to be 1 million times faster than it was 10 years ago.

Current Metaverse platforms have already partially achieved the abovementioned three innovations in the native virtual world. When the virtual world frees us from the limitations of physical space, human beings can bring their thinking and creativity into full play, creating the potential for limitless innovation.

Meaning 3: The real world

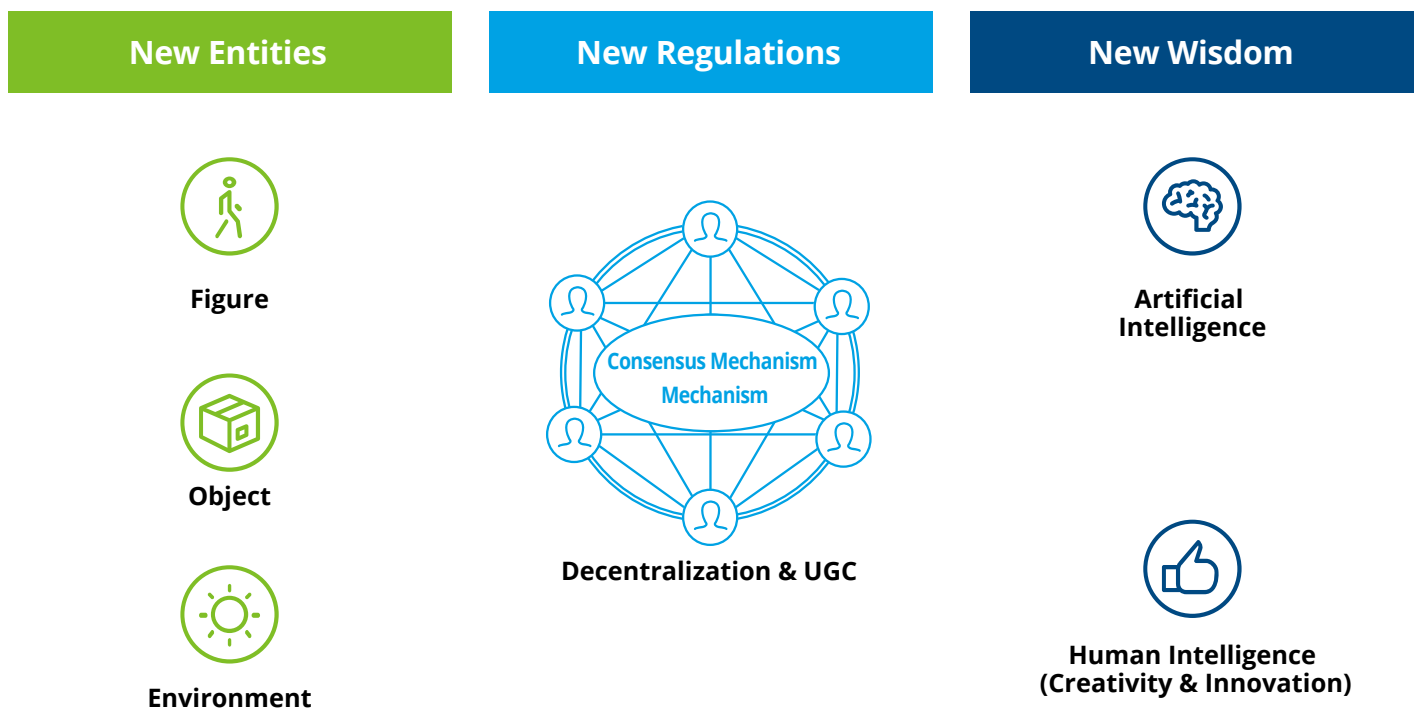
The real world is an integral part of Metaverse. All elements in the virtual mirror world are facsimiles of elements in the real world. The value of the virtual world is generated by interactions between it and the real world.

Meaning 4: Convergence and interaction of the virtual and real worlds

In the end, the virtual world and the real world will form a closely converged and interacting world—from the virtual to the real, the real to the virtual, the virtual in the real, and the real in the virtual—like a "live action" version of the coexistence of robots in the real and virtual worlds seen in *Terminator*.

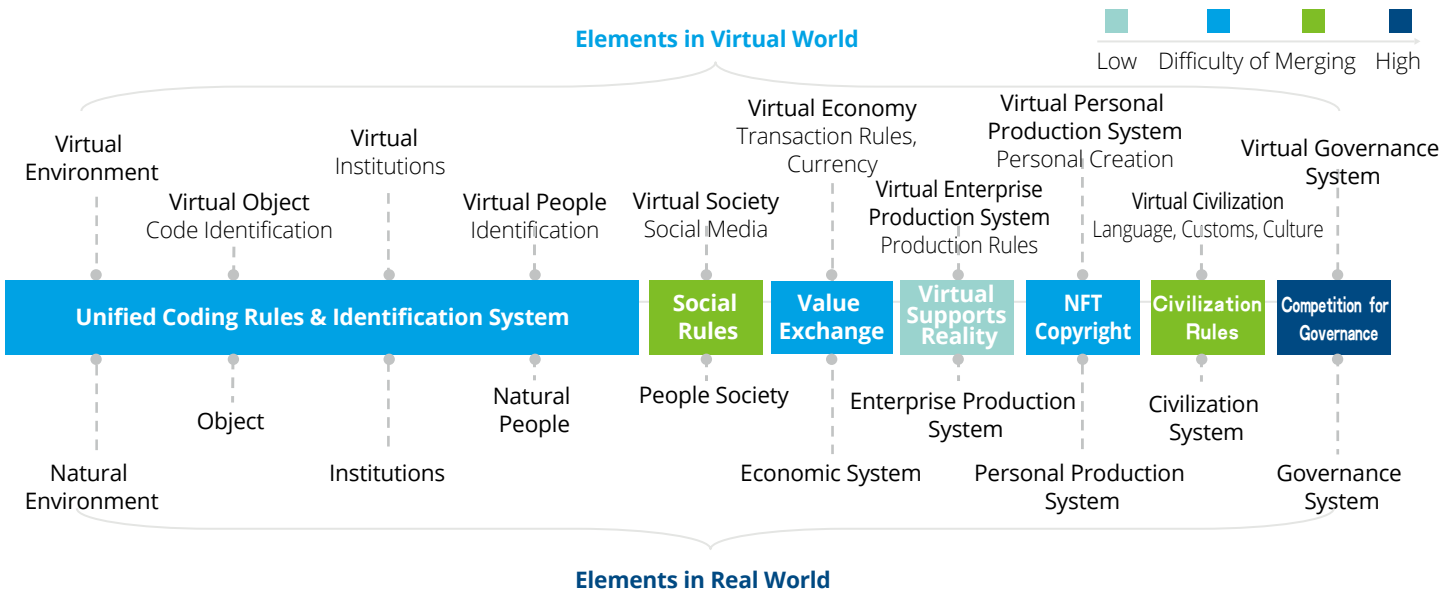
This convergence and interaction mean the Metaverse will transcend both and each of the real and virtual worlds, calling back to the original meaning of the word "Meta" as above or beyond. The degree to which the virtual world is converging and interacting with the real world is a critical criterion in evaluating the value of the Metaverse. Among various definitions of the Metaverse, one posits that it will only

Figure9: Three "new things" in the virtual native world



Source: Deloitte analysis

Figure10: Convergence and Interaction of virtual-world and real-world elements



Source: Deloitte analysis

be when people rely on the virtual world more than they rely on the real world that the Metaverse will be fully formed.

As mentioned earlier, the virtual and real world each have 10 elements. In this "4th Metaverse", these 10 elements (environment, people, objects, institutions, and society, and economic, enterprise production, individual production, civilization, and governance systems) will converge and interact.

Integration (convergence and interaction) between the virtual and real worlds has four levels of varying difficulty, set out below from the easiest to most difficult:

Level 1: The interaction of enterprise production systems. This sees the virtual world replicate and support the real world. For example, digital twin technology generates digital deconstructions and simulations of real machine equipment to support operational state prediction and

maintenance for physical machines. Many production and manufacturing scenarios have already explored and applied digital twin technology.

Level 2: This level will see the integration of environment, people, objects, and institutions through unified coding rules and identification systems between the virtual and real world; the integration of the virtual and real economies through value exchange rules; and the integration of personal production systems through NFT-related copyright (virtual IP and real IP).

Level 3: This level sees the integration of society and civilization, becoming even closer to the essence of the real world and thus much more difficult, encompassing social rules and systems of civilization that require long-term thinking, collision, and polishing.

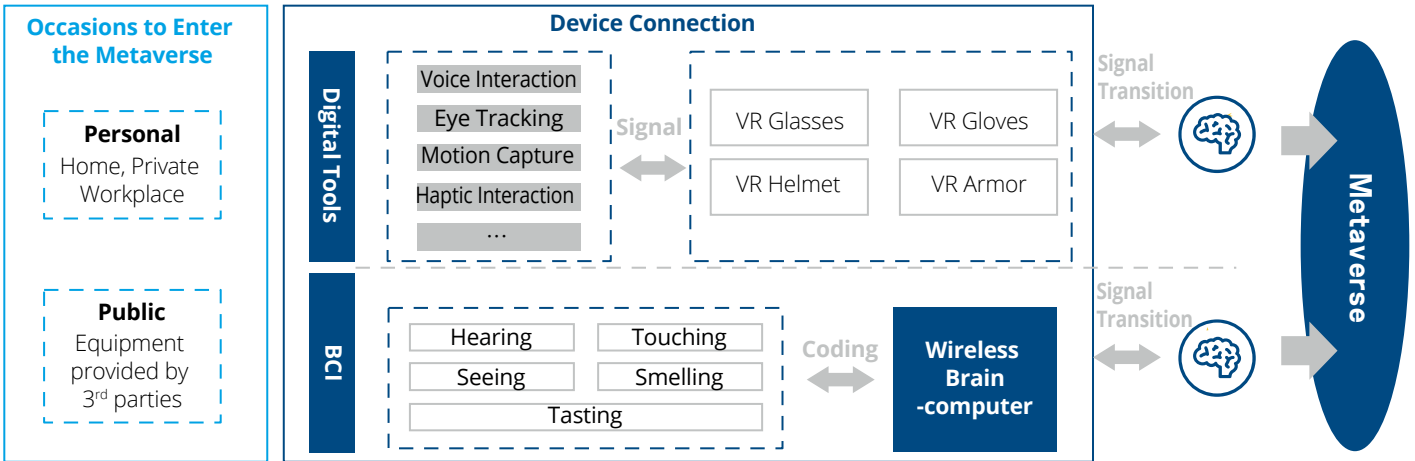
Level 4: The integration of governance rules is the most challenging Metaverse scenario, as it will involve disputes around and competition

for governance rights. That is, who will govern this Metaverse, humans or AI in the virtual world, Metaverse companies or real-world government?

Competition for control between government and the virtual world has already occurred in the clash for control of the data of billions of users between government and the internet giants. For the first time in human history, companies now own more of people's information than governments do, which has caused alarm in some government circles. The fight for governance of the Metaverse will intensify, with some pessimists positing that Metaverse governance rules will even affect and oppress the real world.

In future, various virtual spaces, communities, and societies will emerge. Small, personal virtual spaces will combine to form a large virtual community spaces. Multiple virtual community spaces will combine and converge to form even larger and more diverse virtual social spaces. Different

Figure11: The entrance to virtual reality



Source: Deloitte analysis

world elements, people, avatars, currencies, and activities will flow freely between these different spaces and worlds, realizing information flows and a virtual space-time shuttle.

People will participate freely in the Metaverse with a specific digital identity they use to interact with the real world.

The entrance to virtual reality

There are two entrances to the Metaverse through virtual-real interaction: the first is to apply digital tools, including portable and wearable AR/VR devices, and the second is

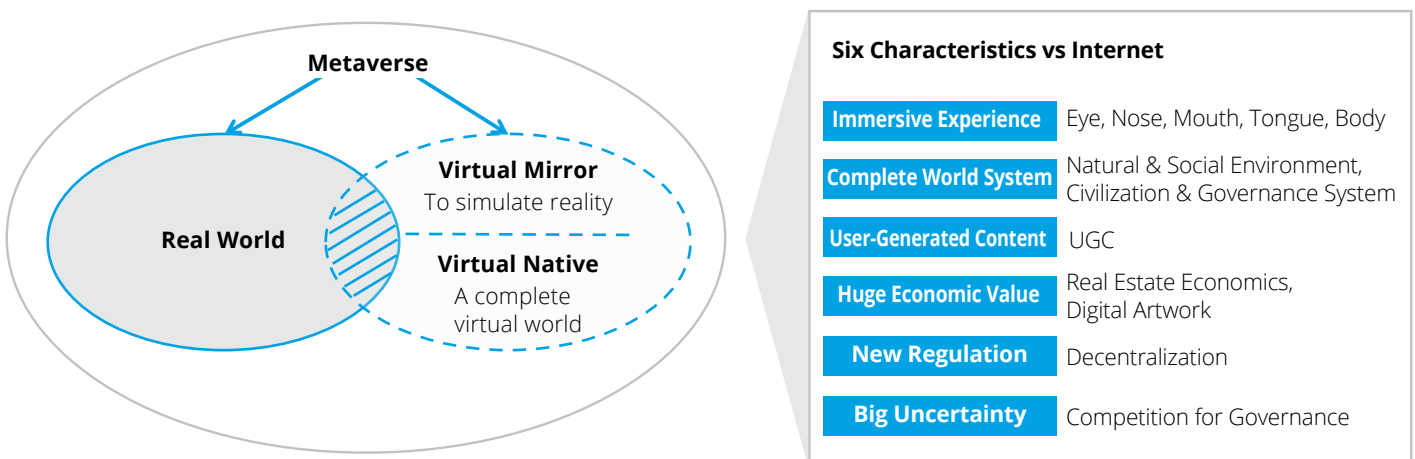
to apply brain-computer interface technology, which transmits electrical and biogenic signals directly to the human brain, achieving real-time, barrier-free information exchange.

In terms of business models, there are two occasions to enter the Metaverse. One is a personal occasion, in which people at home, in the office, or the natural environment can enter the virtual world through virtual-real interaction tools, various XR devices. The second is a public occasion, where a third party provides an entrance to the Metaverse, akin to personal KTV huts in shopping malls or Script

Kill roleplaying. We illustrate these occasions below.

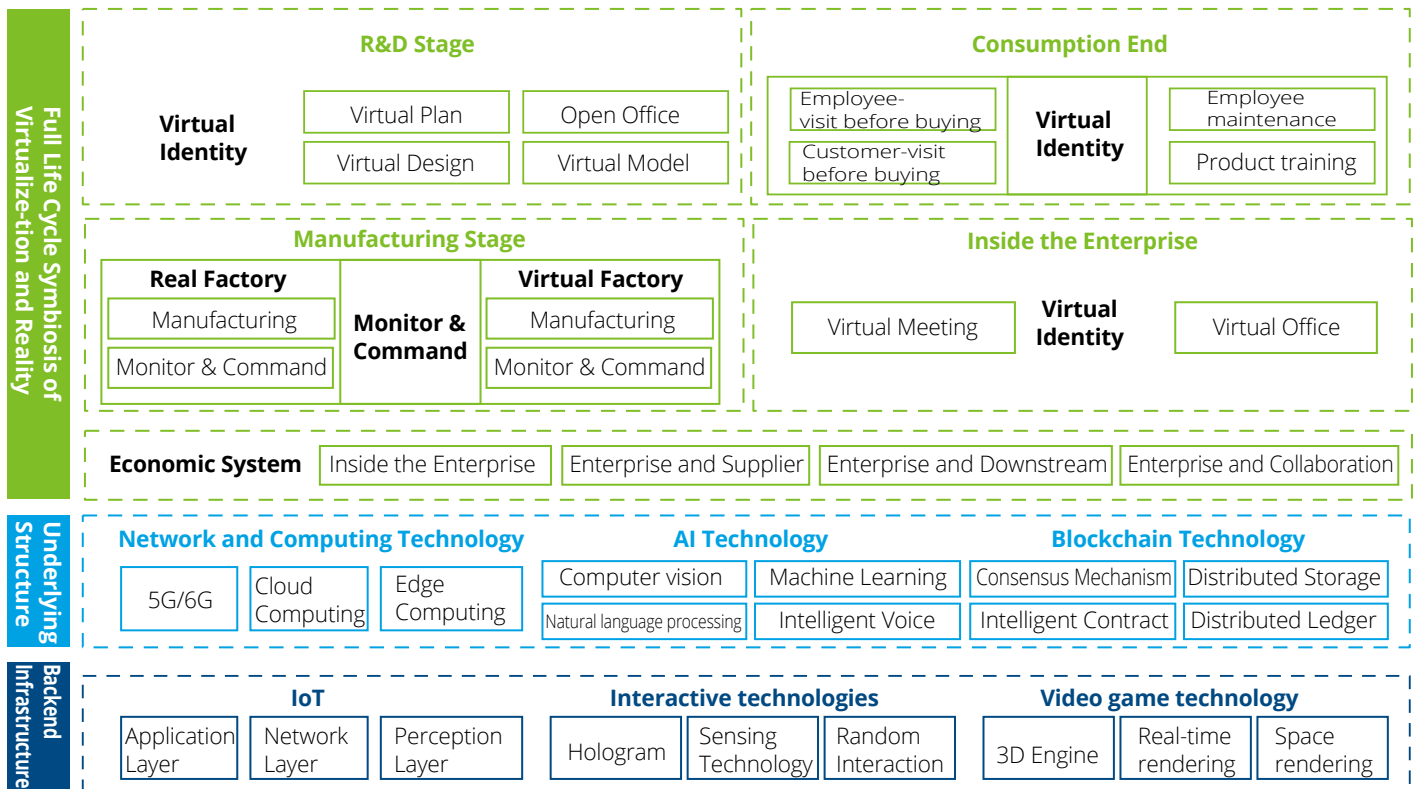
The Metaverse is evolving in two dimensions: from the real to the virtual and virtual to the real. From real to virtual involves real scenes superimposed on immersive digital experience, including virtual education, virtual training, and virtual malls. In virtual to real, the virtual world extends into reality. For example, virtual game *Niantic Lightship* promotes social interactions by designing scenarios including real-world map positioning, environment and object recognition and judgment, and real-time interactive sharing.

Figure12: Six characteristics of the Metaverse



Source: Deloitte analysis

Figure13: The Production Metaverse



Source: Deloitte analysis

1.2 Six characteristics of the Metaverse

Based on the descriptions above, and compared with current internet platforms, the Metaverse has six characteristics: realistic immersive experiences, a complete real world structure, UGC, huge economic value, new regulations and rules, and large potential uncertainty.

Characteristics 1: Realistic immersive experience

Realistic immersive experiences provide verisimilitude of the senses, objects, and environment, and have driven Metaverse excitement.

The Metaverse creates sensory verisimilitude by upgrading 2D internet experiences to 3D, sensory ones. The senses here are mainly visual and auditory. For example, most video

games have 2D pictures and sound effects. A small number of games have added senses including pressure and shock, but these sensory experiences are far from actual physical and tactile experiences. With the development of technologies including somatosensory devices, digital smell, digital taste, and brain-computer interfaces, the ideal Metaverse integrates vision, hearing, touch, smell, taste and ideas to bring players infinitely closer to real sensory experiences.

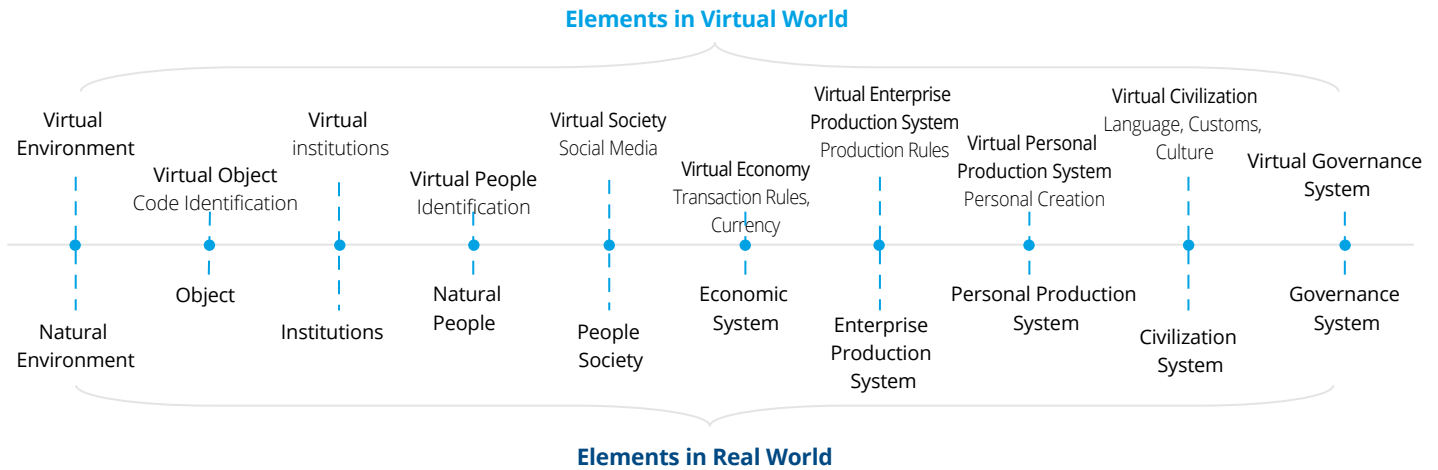
Object verisimilitude is the use of digital twin technology to create digital virtual objects, forming a mapping relationship that is very similar to real objects in shape, texture, and use.

In environmental verisimilitude, a virtual world runs like the real world. Like the real world, this virtual world is

always online, real time, and includes an infinite number of people who can connect and communicate with each other. In other words, it is sustainable, real-time, has no access restrictions and possesses connectivity and creativity, as described by Matthew Ball. In this way, the virtual world gives users a feeling that the surrounding environment, people, and things are real.

Immersive experiences geared toward personal sensory experiences are easier to understand. The following describes the immersive experience of the Metaverse that simulates the production process. The Production Metaverse use digital twins as its core technology to simulate the production environment, processes, and objects (see figure below).

Figure14: The complete world structure of the virtual world



Source: Deloitte analysis

The first aspect of the production Metaverse is integrated virtual-real symbiosis at the R&D stage. R&D personnel from different places can enter the virtual world together for product planning, design, and testing in 3D form, solving problems including long test periods and unstable manufacturing processes.

The second aspect of the production Metaverse real-virtual symbiosis in manufacturing. Highly immersive, real-time data simulation manufacturing management is realized through Internet-of-Things and digital twin systems. Employees wear AR devices for manufacturing and production monitoring in a real or virtual factory, which greatly improves the operational efficiency of field personnel and overall efficiency of remote managers.

The third aspect of the production Metaverse is real-virtual symbiosis during sales, split into three scenarios: during sales, in use, and after-sales maintenance. This supports interactions between employees and customers in the virtual world looking at the same digital twins products.

The last production Metaverse element is real-virtual symbiosis in the internal operations and management of enterprises. This enables employees to create and customize virtual offices, and have a friendly avatar that can freely communicate and solve management problems in the virtual realm.

There is a great degree of overlap in the underlying technical architecture of the immersive experiences of the production-oriented Metaverse and human sensory experience.

Characteristics 2: A complete world structure

Unlike the internet world, the virtual world of the Metaverse will have all 10 elements of the real world. The existing internet world represented by media, social networking, e-commerce, and industrial internet is a world in narrow-sense, simulating only part of whole social, business, and production systems in the real world. The existing internet world does not clearly reflect elements such as real estate development, government and governance, and social civilization.

The Metaverse, meanwhile, will be a complete replica of the real world, simulating all of its 10 elements. The 10 virtual elements of the Metaverse will correspond to those in the real world: the natural environment, people (identity recognition), institutions (government, community, schools, enterprises), objects, social systems (social interaction, social rules), the economy (transaction rules, virtual currency), enterprise production (production rules), personal production (personal creations including NFT artwork), civilization (language, customs, culture), and governance (decentralized governance).

Characteristics 3: UGC

UGC is a new creative arena in which Metaverse residents create content and applications in their own virtual worlds. Unlike internet platforms, where owners create most of the content and establish the rules, users will create their own content and rules in the Metaverse, with platforms providing the technical tools they need. For example, in Roblox, people can use some simple tools embedded in the

platform to design a game, and launch this game for other users to play. In the context of the virtual world mirroring the real world, UGC is closer to how the real world works, with people finding new land, building homes, and developing their own rules.

Characteristics 4: Huge potential economic value

Based on what the Metaverse can provide for people, its value arises from five elements:

- **Social economy:** The Metaverse provides various social scenarios with immersive experiences and people pay for these
- **Land economy:** As in the real-world property industry, there is "land" in the Metaverse, and people need to pay real money to buy it before building virtual companies, homes, or communities. Virtual land is not

cheap, despite it being just a piece of coding. Metaverse platforms will create limited space to simulate the natural scarcity of space in the real world, and charge people based on that scarcity rather than length of code

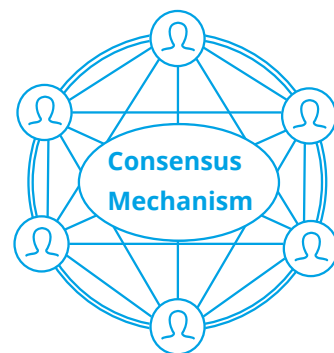
- **Identity economy:** This experience revolves around avatars. Everyone will have their own avatar in the virtual world and will pay for this personalized version of themselves. This realm of the Metaverse will attract attention from capital
- **Digital art economy:** this is based on the value of various forms of NFT digital artworks, including audio, video, pictures, and even virtual shoes
- **Finance economy:** The value of financial investments or speculation opportunities

In essence, the value of the Metaverse comes from its equivalent sources

of value in the real world, that is, exclusivity, competition, and the spatial and temporal scarcity of things. Many people think that the Metaverse, as a digital virtual space like the internet, will be inexhaustible and easily copied, pasted, and used for their own use, but the Metaverse does not work like this. The creators of Metaverse platforms will endow the Metaverse with scarcity through technologies including information anti-proliferation, homomorphic encryption, code and chain non-homogenization certificates, and manage digital asset rights through these technologies so data becomes tamper-proof.

At the same time, the Metaverse has less scarcity than the real world, making it possible for it to surpass the real world's economic value. It will achieve this through powerful digital productivity, allowing everyone to create diverse forms, all of which

Figure15: Centralization vs decentralization



Centralized Structure	
Definition	The center is associated with nodes. Nodes must depend on the center and are not directly associated with one another.
Features	Poor data privacy, vulnerable to attack, slow response speed, nodes lack information control
Cases	Bank, Traditional Internet, Social & Game Platforms
Traditional Regulation	

Decentralized Structure	
Definition	Nodes are interconnected. Under a consensus mechanism, each node can become a phased center, and the platform is maintained by all nodes.
Features	Strong data privacy, anti-attack, fast response, open & transparent, traceable
Cases	Bitcoin, DeFi
New Regulation	

Source: Deloitte analysis

will have value to someone, and overcoming the natural elements and limitations of current political and legal systems. In the Metaverse, these limitations can be broken and more value generated. Furthermore, creation and trading is more flexible in the Metaverse, supporting smooth and free transactions within a single virtual world, between two virtual worlds, or between the virtual and real world.

Characteristics 5: New regulations

Although the virtual world is a complete simulation of the real world, Metaverse creators hope that the operating rules of the virtual world can be different to the centralized structures of the real world. They want the virtual world to operate based on decentralization.

The original intention of human beings in creating virtual worlds was to avoid

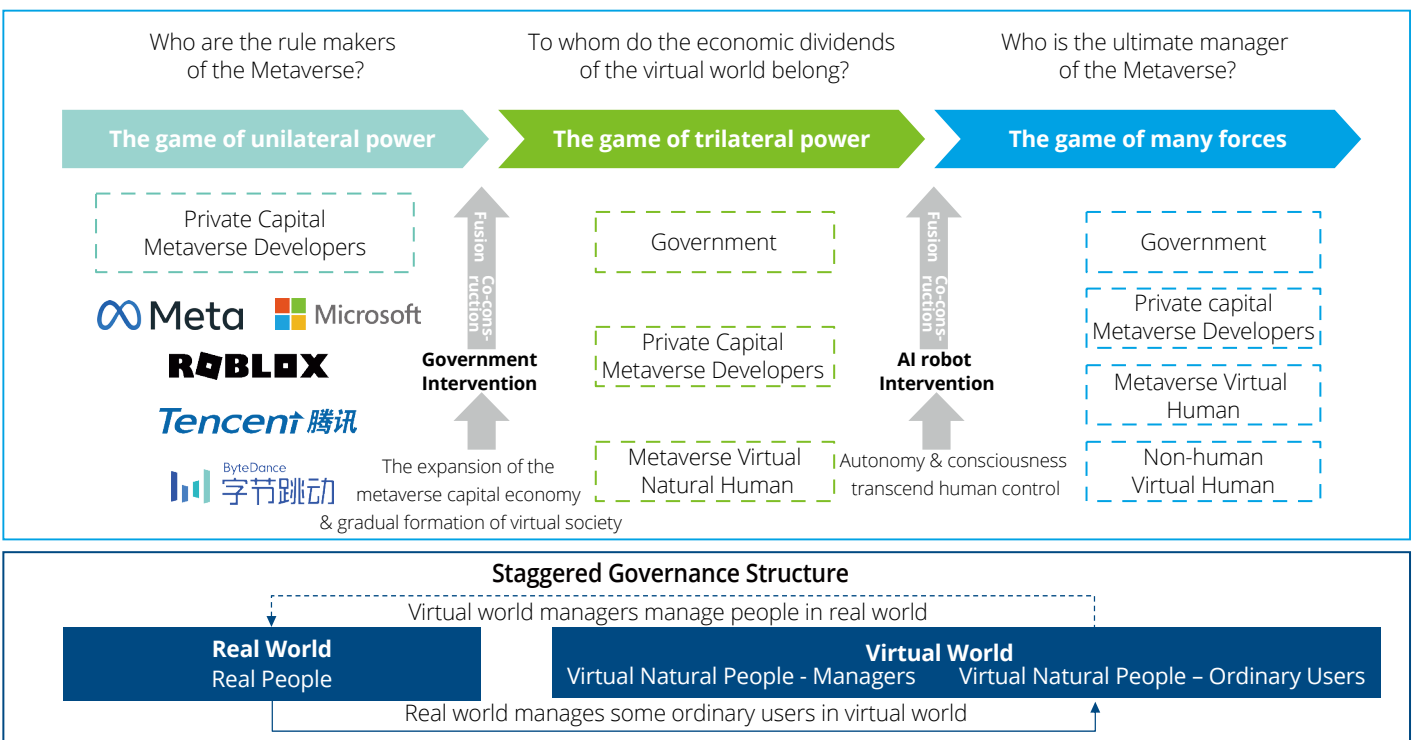
certain limitations in the real world. For example, online virtual social networking after the emergence of the internet avoids the limitation of having to travel long distances to meet friends. The Metaverse will mitigate this and other limitations while weakening personal identity and wealth restrictions in society.

There are many problems in the real world, including the uneven distribution of resources and the disparity between rich and poor. If the Metaverse is unable to avoid centralization, then this will not only hinder our ability to address real-world problems in, but also make these problems more prominent. For example, powerful people in the real world could use their resources or prestige to quickly accumulate great wealth in the virtual realm, and even

establish power-biased operating rules to absorb more wealth, and then feed this back into the real world. In this way, the Metaverse would execute an even more unequal distribution of resources and widen the gap between the rich and the poor.

The concept of the Metaverse as a parallel world means weakening "central privilege" in the real world. Creators in the Metaverse have developed regulations and rules through DAOs. No country, company, or individual controls these, and new members who want to join a virtual world can automatically do so by following the DAO's rules. DAOs allow people in the Metaverse who create more value to attain more in the virtual world. DAOs record the relationship between a creator and their creations, and others need to pay to obtain the

Figure16: Governance structure of the Metaverse



Source: Deloitte analysis

right to use or own all or part of these virtual creations. In contrast, the real, centralized world allows any game prop to be copied at almost zero cost.

Characteristics 6: Big uncertainty

Governance structure is the core issue in the Metaverse, that is, who will be on top of its future governance structure.

The governance structure in the Metaverse is interlaced. One scenario is virtual worlds managed by real people. Most of the early Metaverse worlds had this governance structure. Real people write code to create virtual worlds and manage avatars in them. In another scenario, real people are constrained and managed by the virtual world, with groups of virtual world managers who manage people in the real world. This small group establishes the rules, controls the virtual world and its citizens, with virtual individuals managing a large group of real people.

Who will top the Metaverse governance structure in future? AI is at the root of this problem—will human beings rule robots or will we eventually create robots that surpass human beings? It is probably not the original intention, but AI self-learning could make robots eventually surpass human intelligence, giving them the ability to rule the world.

This governance issue is so critical because the virtual world of the Metaverse carries has enormous economic and political power. Some prototypes of the Metaverse, such as online game purchases of virtual props, community purchases of real estate, and virtual currency transactions, have already shown the economic power of the virtual world, and this power will only grow. At the same time, the number of users of the products of the global internet giants has already exceeded the number of residents of any single country. When

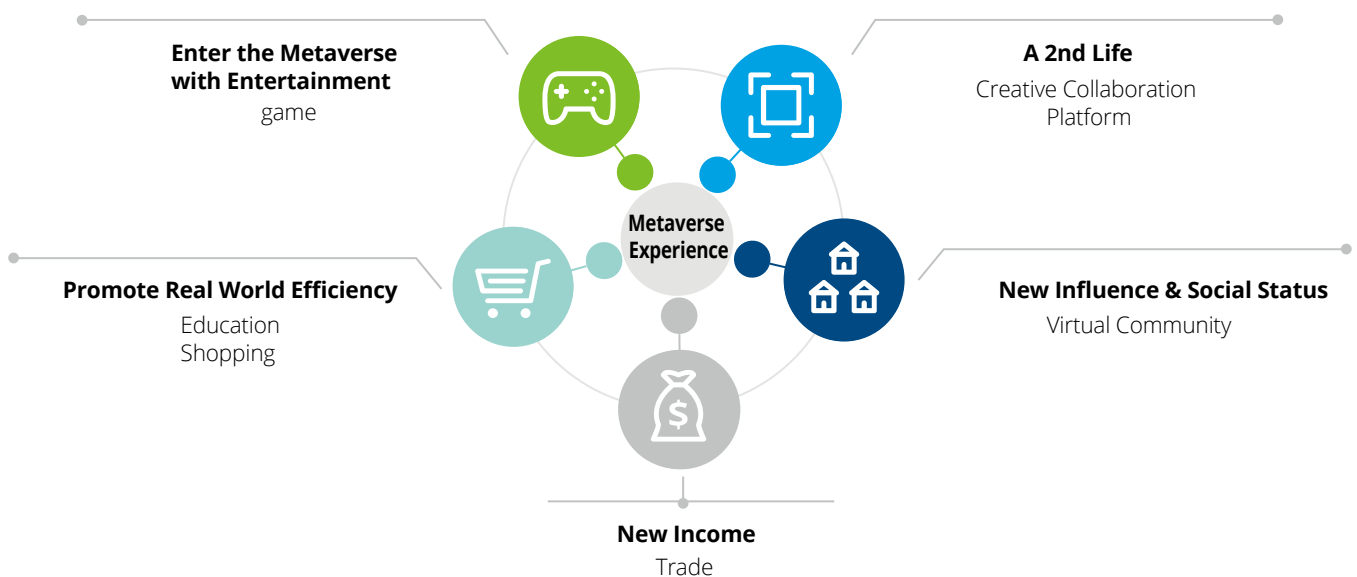
designing the Metaverse, all creators will need to decide who has the final say in the virtual world and who owns its economic benefits.

1.3 The value of the Metaverse

The Metaverse can bring tangible value to people and the real world. This is the fundamental driver of the Metaverse wave. In the end, the value the Metaverse will bring to people is multifaceted, spiritual and material, including five main elements:

- Entertainment: games and social activities, where players enter the Metaverse to enjoy immersive and realistic interactions, resulting in a pleasant experience of games and socializing
- A second Life: collaboration platforms where creators build their own personal worlds in a virtual space, giving individuals the opportunity to experience a life that is different from the real world

Figure17: User value in the Metaverse



Source: Deloitte analysis

- **Efficiency in the real world:** Technologies such as digital twins, XR, and AI can improve the efficiency of many industries, including education, manufacturing, and retail. Activity in these industries will be unconstrained by time and space, experiences will be upgraded, and quality will improve
- **New wealth:** virtual currencies and trading in virtual objects provide an opportunity to reshuffle wealth
- **New influence and social status:** in virtual communities, creating a different avatar for oneself and partaking in social activities provide opportunities to achieve a new social status

These five values mean that although the rise of the Metaverse has slowed temporarily, it retains huge potential for growth and increased value.

1.4 Current bottlenecks in Metaverse development

Development of the Metaverse is in its infancy, although the market has high expectations. The ideal form of the Metaverse will eventually arrive, including elements of what we have described in the previous content. However, as the Metaverse matures, it will inevitably encounter bottlenecks that need to be broken through. The most prominent bottlenecks at this stage are:

- **Portability of access to the virtual world.** At present, wearable devices including AR/VR sets continue to dominate people's entry into the Metaverse. In the future, entering and interacting in the Metaverse will be more flexible and convenient. Just like the League of Legends meeting in The Avengers, there will be no need to wear cumbersome equipment. After connecting to a line, the avatar of the other party will appear in front of you and your avatar will appear in the other party's space, enabling simulated interaction. VR/AR kit is becoming more lightweight and convenient, and in 10 years, AR contact lenses should mature. Generally, major technical constraints remain and there needs to be more innovative thinking.
- **Rules of governance in the virtual world.** This requires long-term research, exploration, and testing to design social, economic, cultural, tax, legal, and governance rules in the virtual world. If this is too conservative, construction of the Metaverse will not meet expectations. If it is too radical, it will intensify contradictions and even threaten the real world.
- **Industrial Metaverse applications.** At present, the Metaverse is used mainly on the consumer side, including entertainment, social networking, games, and NFT art. It is not integrated closely enough with

industry and manufacturing. The real-time sustainability, digital twins, and integrated reality in the Metaverse have deep application prospects for manufacturing, but technological limitations mean this potential is a long way from realization.

- **Information security and privacy.** Network security and data privacy have become increasingly serious issues in recent years. The characteristics of the Metaverse, such as sustainability, real-time, connectivity, and creativity, indicate that the amount of data it hosts will increase exponentially, and the retrieval and use of data will become more frequent. How to balance information security with development of the Metaverse needs forward-looking consideration.
- **Energy supply.** The complex mechanisms of the Metaverse consume vast network, storage, and computing power resources. Its stable operation will inevitably require the construction of new infrastructure. Current 5G networks, IDC centers, high performance computing, and AI are far from meeting the conditions required for a smooth Metaverse experience. In addition, amid a trend towards global carbon neutrality, the issue of how to build and operate infrastructure in a green way also needs consideration.

Figure18: The five major Metaverse bottlenecks



Source: Public information, Deloitte analysis



2. Technology

Technology is the core element underpinning realization of the Metaverse, enabling the creation of all of the components and experiences of the virtual world. Many clusters of enabling technologies support the Metaverse, each cluster has several subcategories, and each subcategory can support multiple Metaverse functions. For the convenience of this discussion, we use the sequence of key user scenarios in the Metaverse as the spine of the following summary of technical categories. These key scenarios correspond to the key features of the Metaverse. After identifying the main supporting technologies, we describe the current stage of each major category.

2.1 Technology clusters corresponding to Metaverse features

The sequence of user access to the Metaverse and its corresponding technologies have the following clusters:

- **Access**, which emphasizes immersive experiences driven by XR.
- **Interaction**, which focuses on high simulation interactions between different users or objects, driven mainly by AI and supported by game engines.
- **Digital content**, the creation of virtual objects or spaces using digital twins, real-time rendering, and 3D engines.
- **Rules and identity**, which support mutual recognition and interactions between different users and entities in the virtual world, typically based on blockchain.
- **Large-scale**, continuous online availability to ensure continuous operation and real-time feedback of the virtual world as if it were the real world. This requires a large number of high-speed computing and information transmission capabilities

that use cloud computing, high performance computing, wireless communication (5G and 6G). In addition to enabling interactions, AI algorithms will underpin most other technologies.

Access – Immersive experiences

Convenient access and a realistic immersive experience are one of the core features of the Metaverse. The technologies that support this in consumer scenarios are XR-based, including access and somatosensory devices, holographic imaging technology, and brain-computer interaction. There are also other more advanced forms of access equipment technology, such as computer vision, speech recognition, NLP and other algorithms behind these.

In manufacturing scenarios, digital twins and sensing technologies that simulate and perceive the physical world are the main supporting technologies. The immersive experience of the physical world mainly relies on sensors and digital twin technology to realize perception and simulation. Sensors include physical and biological perception of

the environment (air, temperature, and humidity), physical equipment (machine malfunctions, energy consumption), biometric identification (plant growth, animal signs).

Interaction – high simulation

interaction

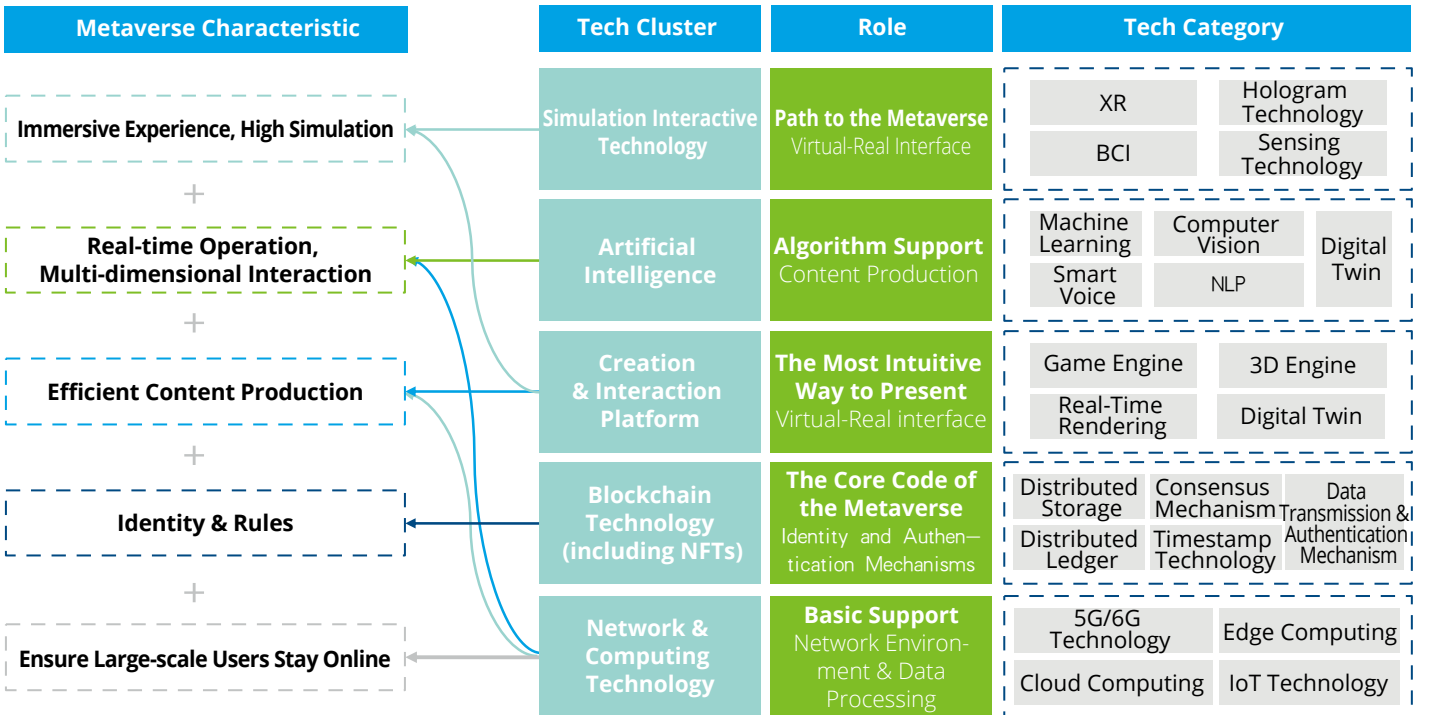
This covers interactions between people and people or people and the physical world, including blooming flowers, a change in the shape of a palm when shaking hands, and damage to vehicles when they collide. 3D engines, real-time rendering, digital twins, spatial computing, and other technologies drive these interactions.

There is also language-, text-, and image-based interaction and feedback between people in the Metaverse, which typically requires AI of varying degrees of sophistication.

Content – creating virtual objects and spatial content

Metaverse content creation technologies include game engines (providing important technical support for digital content), 3D modelling (for building high-speed and high-quality materials), real-time rendering

Figure19: Required technologies for Metaverse scenarios and characteristics



Source: Deloitte analysis

(simulating physical effects when different Metaverse objects interact), timestamps (for the traceability and confidentiality of underlying data), and other technologies.

NFTs underpin the ability to identify unique created items and artworks to ensure their scarcity and non-replicability.

Rules and identity – uniqueness and decentralization

The virtual world is a "universe" because it brings things closer to the essence of human society, including status and systems for economy, society, and civilization, necessitating a decentralized model.

Blockchain technology, which includes distributed storage and ledgers,

mechanisms for consensus and data transmission and verification, and timestamps, typically drive these rules and identities.

Continuous online use – large-scale information computing and real-time transmission

Any interaction in the virtual world requires the processing of a vast amount of data and transmission of multiple signals. At the same time, to stimulate real life, interactive responses in the virtual world require extremely low latency. When we are socializing in the Metaverse and set out to shake hands with another person, if they take three seconds to respond, this will not be an immersive, lifelike experience. These needs require extremely fast background calculations.

Continuous large-scale, real-time online availability requires technologies including network communication and computing, mainly 5G/6G (to ensure wireless communications in the Metaverse); cloud computing (sufficient background computing power to ensure more powerful, lightweight terminals at the front end), edge computing (to solve problems of cost, responsiveness, and network congestion), and Internet of Things (IoT).

These supporting technologies are still far from creating a fully formed Metaverse experience, but some specific, "pre-Metaverse" scenarios have applied key technologies.

2.2 Key technologies' development stages and bottlenecks

There is a barrel effect around Metaverse technologies, in which the "shortest board" technology determines the realizable extent of the Metaverse.

At present, various technologies only meet the development needs of the initial Metaverse, with 5G having achieved large-scale, low-latency

coverage that can accommodate the current scale of Metaverse users, and support for UGC content, 3D engines, and computing power. Current technology and content can meet the primary requirements of the Metaverse, and will continue to evolve.

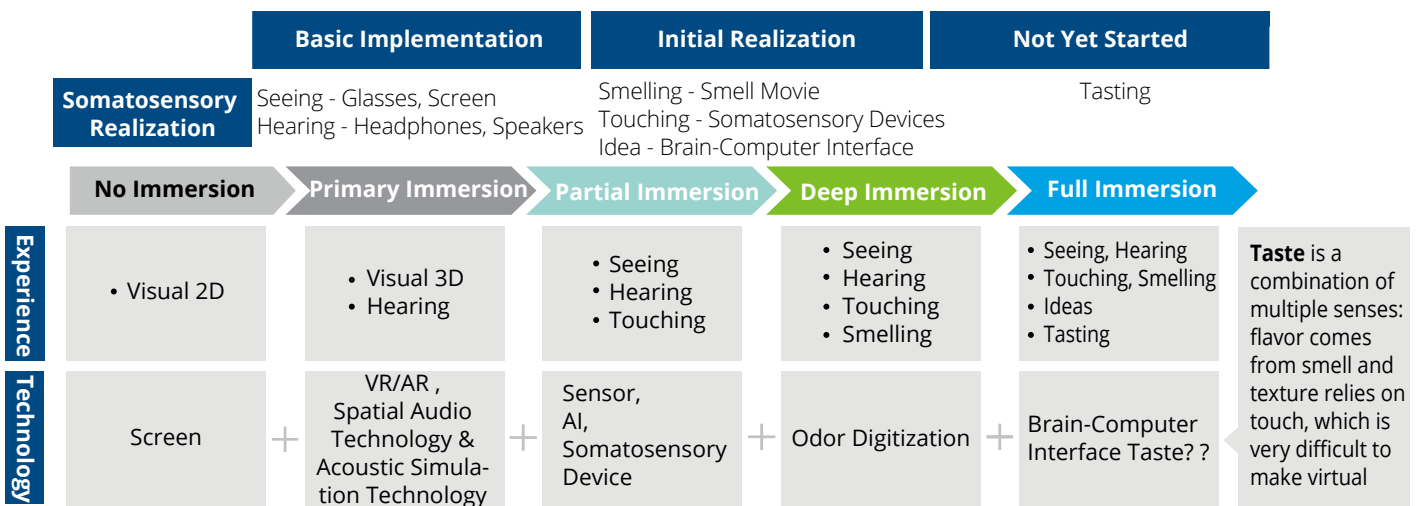
VR, AR and other virtual reality technologies have also reached the basic requirements of the Metaverse and now need to be optimized.

Whether XR will become the main entrance to the virtual realm is still unknown. The blockchain is developing steadily, and downstream application scenarios are constantly expanding. Regional policies and laws regulate blockchain-based virtual currency technology.

XR

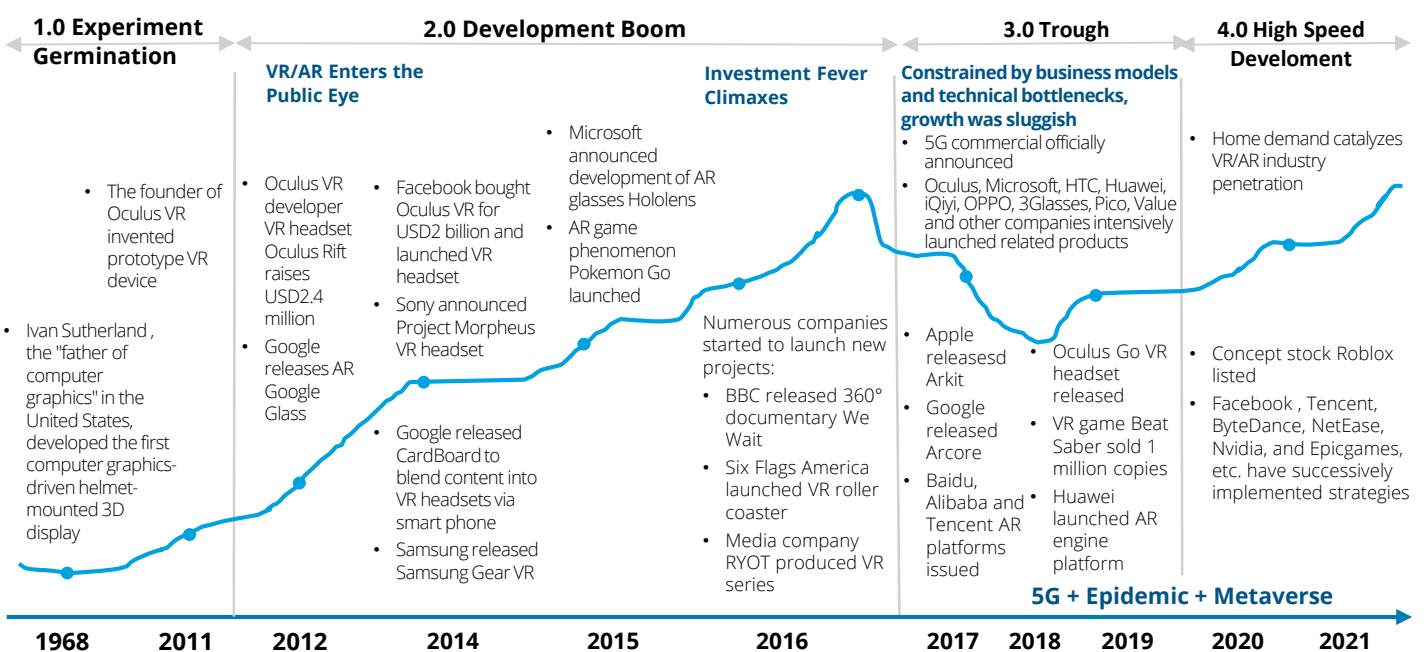
XR provides an immersive experience, with the goal of taking over human

Figure20: XR experience development



Source: Deloitte analysis

Figure21: XR development



Source: Public information, Deloitte analysis

vision, hearing, and touch, and realizing the input and output of information in the Metaverse through motion capture. In somatosensory realization, visual and auditory simulation interaction is currently the most advanced technology in the virtual space. Simulations of smell, touch, and ideas (human thinking) have started. Simulated taste, a synthesis of multiple senses, has not yet been achieved.

Overall development of XR technology, having bottomed out over the past three or four years, is entering another period of high-speed growth.

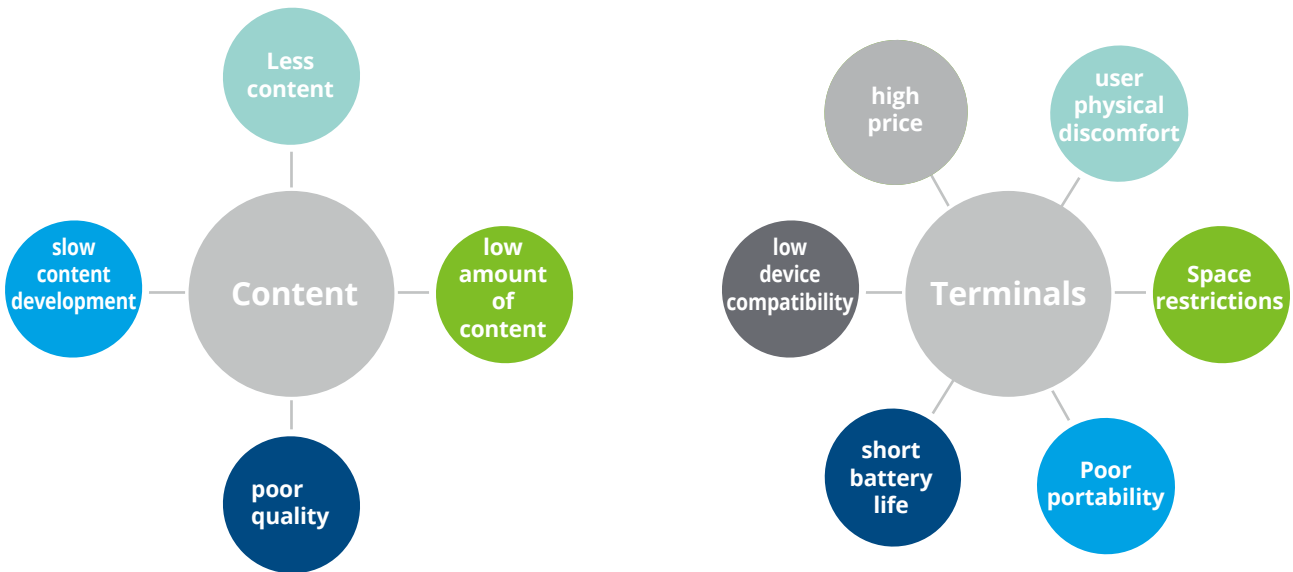
Content and technology are the two current bottlenecks in XR.

Many manufacturers have invested heavily in VR/AR hardware, but for large-scale consumer application, equipment remains expensive and beset by a poor sense of use, environmental restrictions, poor portability, compatibility restrictions, and short battery life.

High-quality content, the endogenous way to attract users, will drive the development of hardware and the overall Metaverse industry. At present, VR content is not mature, and remains dominated by application scenarios

such as games, social networking, and film and television. Application scenarios including virtual offices and fitness have begun to deepen, but the coverage, quantity, and quality of other application scenarios still need to be improved. On the world's most mainstream VR content platform, Steam, for example, VR games are its most popular products but only account for 8% of total content. In addition, content developing slowly and the number of VR users has not yet attained scale, which exacerbated this slow development and led to content falling to keep pace with hardware advances.

Figure22: XR bottlenecks



Source: Deloitte analysis

Blockchain

Blockchain has developed steadily. After an early stage of exploration, market preparation, and recognition, it has entered industrial deployment, most commonly in the financial sector. In the Metaverse, blockchain and NFTs will resolve problems around ownership and identification of production and assets in the Metaverse.

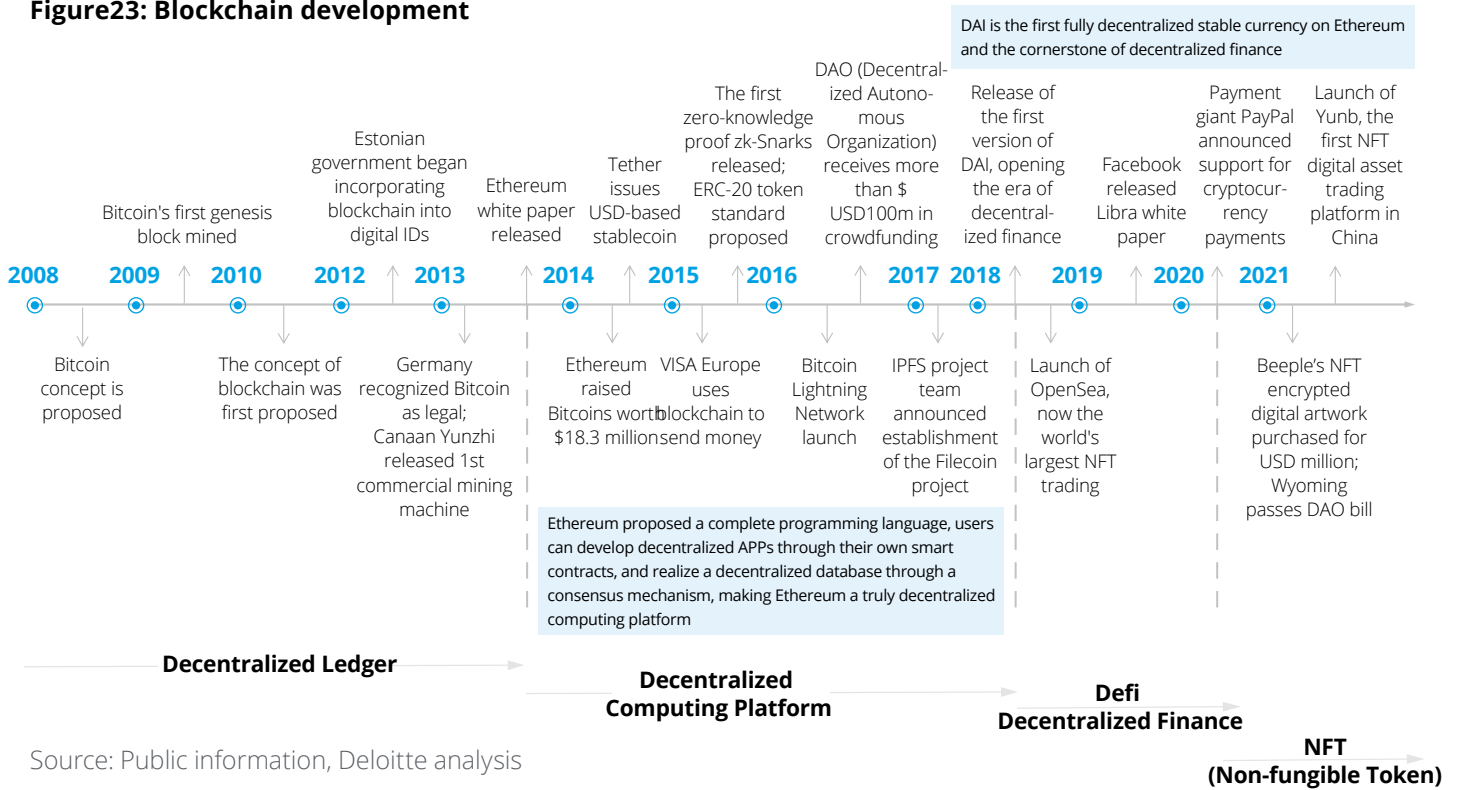
Blockchain technology has entered the NFT stage, heralding an era of digital content capitalization. The main difficulties in blockchain development are technical bottlenecks and regulatory compliance challenges.

Technology

Finance and e-government have adopted blockchain technology. In other business scenarios with relatively high

requirements, blockchain struggles to meet demand. Most notably, given blockchains are distributed systems, bottlenecks in throughput, confirmation delay, and storage costs have restricted their application. These bottlenecks contradict one another, making them difficult to overcome simultaneously. For application scenarios like the Metaverse, there are higher requirements for speed, throughput,

Figure23: Blockchain development



Source: Public information, Deloitte analysis

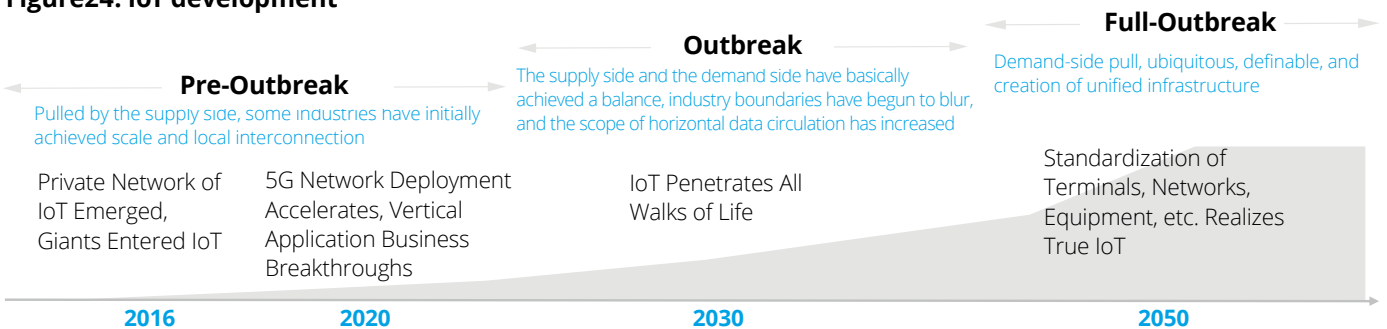
and storage costs, so decentralization or security sometimes have to be sacrificed for efficiency. In addition, "information barriers" and challenges to creating "on-chain" physical assets are affecting the implementation of blockchain technology in the Metaverse.

Regulatory compliance

There are also policy risks in the continuous development of the blockchain. Bad actors can easily use the anonymity and anti-tamper characteristics of the blockchain to spread misleading information, threaten network security, and damage user privacy.

In addition, there have been frequent cases of illegal financial activity under the banner of "blockchain", disrupting the normal market order.

Figure24: IoT development



Source: Public information, Deloitte analysis

pushes up marginal cost, making IoT construction expensive.

Second, the technology is not yet mature. Big data analysis is still required after sensors collect data from the edge. It is not yet possible to integrate and connect data collection and analysis across different industries and fields. The high-value of data will only be released once analysis is integrated deeply with industry applications.

Third, security issues. Compared with the hard secure protection of mobile phones, IoT sensor structure is relatively simple, making it easily used as a springboard for distributed technology attacks.

IoT must solve these development problems of cost, technology, and security before it can become widely used in the industry.

Mobile communication networks

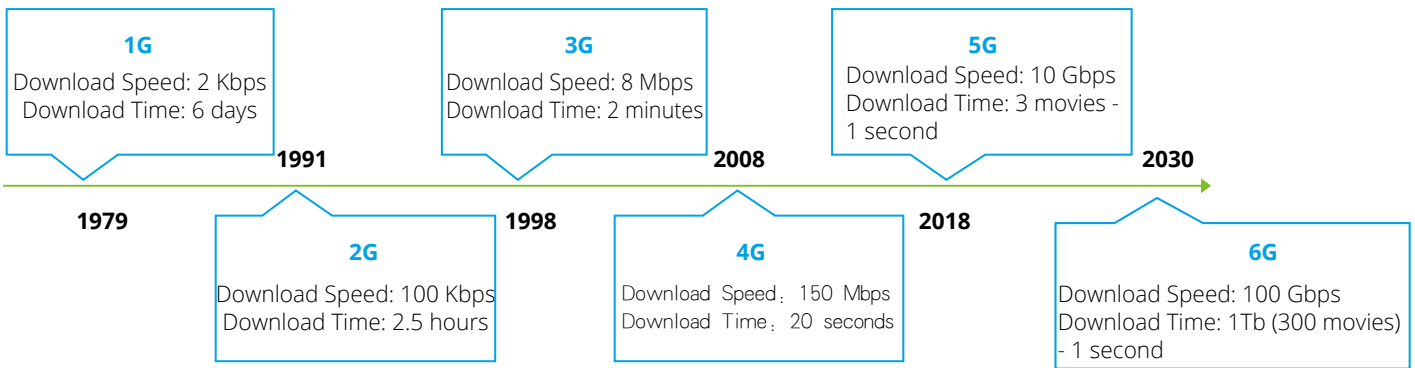
The transition from 5G to 6G is still in its early stages. The ideal Metaverse requires at least 6G or even more powerful networks. 6G network communication should be fully implemented by 2030. 6G can go far beyond the powers of 5G to support microsecond or even sub-microsecond delay communication, positioning accuracy of 10 centimeters indoors and 1 meter outdoors, and the "Internet of Everything" on a global scale. Intuitively, in the 6G era, when downloading 300 movies will take just the blink of an eye, then it will also be

possible to achieve almost zero-latency shuttle interactions in the Metaverse.

The development of 6G networks is hugely reliant on breakthroughs in its four main technologies: terahertz technology, air-space-sea-terrestrial integration, deterministic networks, and AI-based air interfaces.

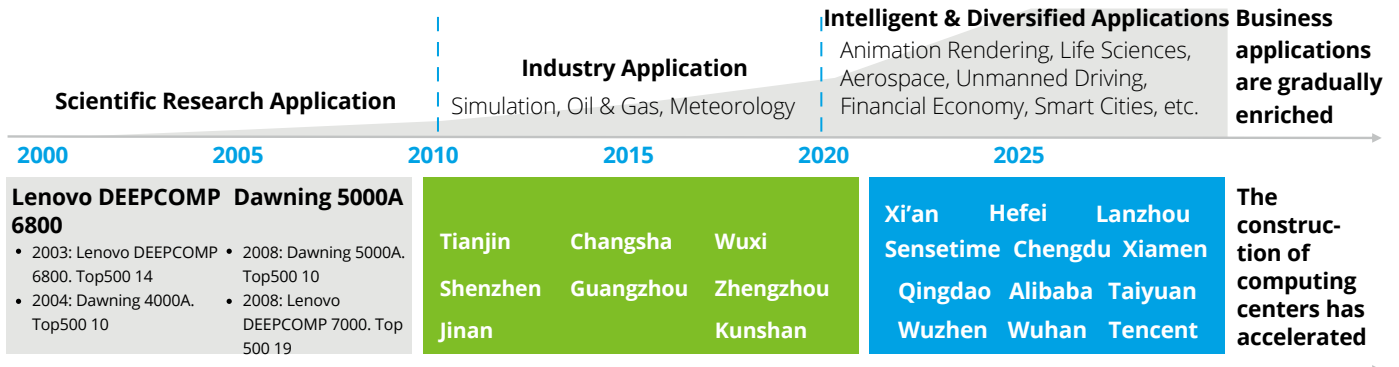
Because the frequency band of terahertz technology is 1-4 orders of magnitude greater than existing microwave communication, it can carry more data, easily overcome bandwidth limitations, and meet the communication requirements of large data transmission rates. A globally connected 6G communication network that integrates satellite, deep-sea ocean and terrestrial communication

Figure25: Development of mobile communication networks



Source: Public information, Deloitte analysis

Figure26: Computing power development



Source: Public information, Deloitte analysis

networks is an important direction of development. Deterministic network technology with high reliability and low latency will accelerate the 6G era and shape a wide range of applications. The combination of wireless transmission and AI at the physical layer of communication is also a key trend in the 6G era.

Computing power

In the past 20 years in China, the application of computing power made advances and the construction of computing centers has accelerated. With high-performance computing (HPC) focused on scientific research applications and key fields such as simulation, oil & gas, and meteorology, the use of computing power has become more diverse through deployment in intelligent applications fields like animation rendering, life sciences, aerospace, unmanned driving, the financial economy, and smart cities. Business applications have been enriched and growth in industry applications is accelerating.

Current computing, storage, and networking infrastructure cannot realize a true Metaverse vision. To achieve this true Metaverse, computing power needs to be increased by another 1,000-fold.

AI, edge, and quantum computing will be the main infrastructure technologies for development of the Metaverse. At present, AI chips are still in a period of rapid development. Chips need to achieve close parallel processing to support more diverse AI calculations in the Metaverse. This will require a series of technological breakthroughs.

Edge computing can reduce latency and improve computing efficiency. In an overall architecture, a central cloud implements global scheduling, the edge cloud focuses on local large-scale data processing, and the terminal transforms vast amounts of physical inputs into massive caches of data.

Quantum computing, meanwhile, has the ability to support exponentially

growing data operations, has the potential to break through into the "post-Moore" era, and can solve the Metaverse's computing power bottleneck. But quantum computing is still at the of prototype development stage.

Despite barriers to achieving massive increases in computing power, the time for further breakthroughs is not far away. After all, as we mentioned previously, Nvidia's CPU speed has increased 1 million-fold in the past 10 years.

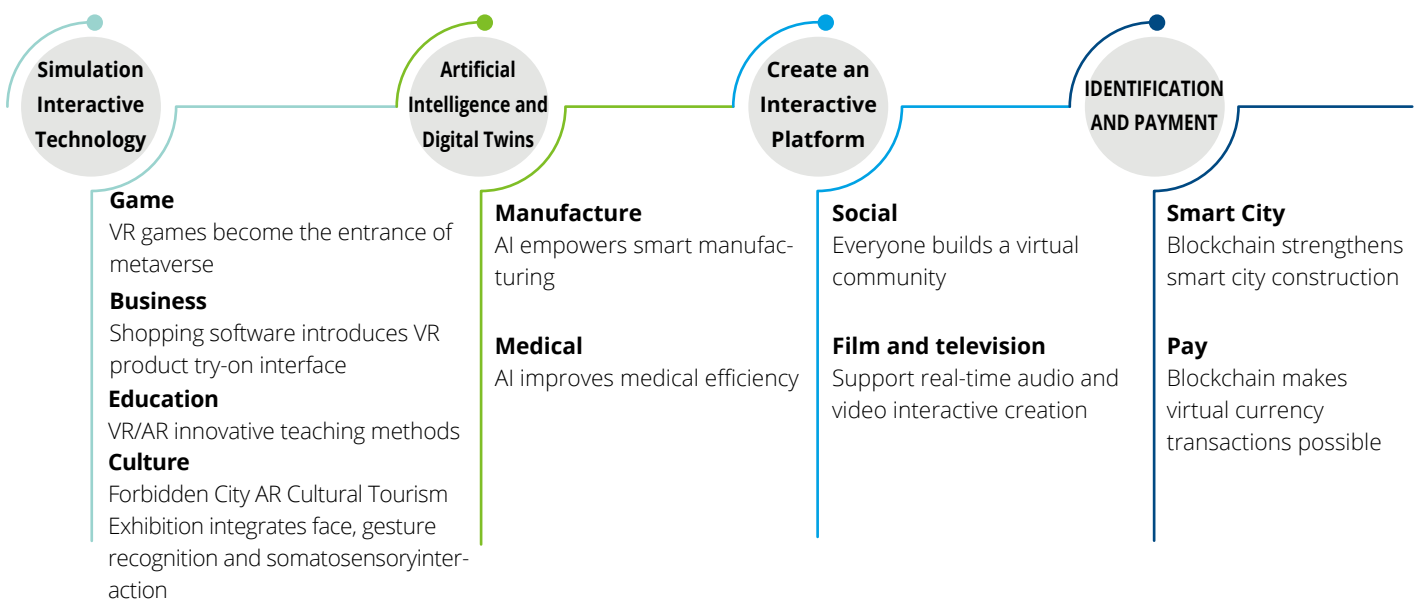
2.3 Examples of Metaverse-related technology applications

Although far from creating a true Metaverse, various applications have deployed the above-mentioned technologies. We call these pre-Metaverse applications and detail representative examples below.

Simulation – interactive games, commerce, education and culture

- **Games:** Game-based social networking is being transformed and

Figure27: Examples of Metaverse-related technology applications



Source: Deloitte analysis

expanded to encompass VR game-based social networking, VR movie social networking (e.g. Douban) and VR travel social networking (e.g. Mafengwo).

- **Commerce and trade:** VR/AR technology is now used for virtual product displays, for example in Alliance Studio's 3D VR mall, where people use virtual navigation to move between and browse stores and products and access payment gateway support. This convergence of online and physical shopping is a highly competitive new shopping model.
- **Education and training:** Users enter a virtual education space through VR/AR head-mounted display equipment, enjoying a more attractive, interactive and intelligent learning environment. For example, STRIVR products used in employee training, which increases the participation of employees, reduces the amount of training required, and helps people master content faster.
- **Culture:** Using interactive simulation technology to digitize the cultural heritage of ancient buildings, breaking the constraints of time and space and improving the display effect and efficiency of cultural landmarks. For example, the Forbidden City AR Cultural Tourism Exhibition integrates face and gesture recognition with somatosensory interaction, enabling exhibitors to freely and easily obtain information that is pivotal to the long-term protection, renewal, promotion,

and continuation of historical and cultural sites.

Digital twins and AI – manufacturing and medicine

- **Manufacturing:** Product design, process optimization, quality management, supply chain management, predictive maintenance, and customer experience analysis can use digital twins. For example, in automobile manufacturing, Siemens uses digital twins to simulate and verify each stage of development, avoiding possible failures in actual production.
- **Healthcare:** Digital twins used in drug clinical trials, medical care, and surgical rehearsals help provide patients with more efficient, and effective services. AI can create pre-life simulations to build digital prediction models for patients, providing prediction record analysis and decision support throughout their lives.

Creative, interactive platforms – social networking, film, and television

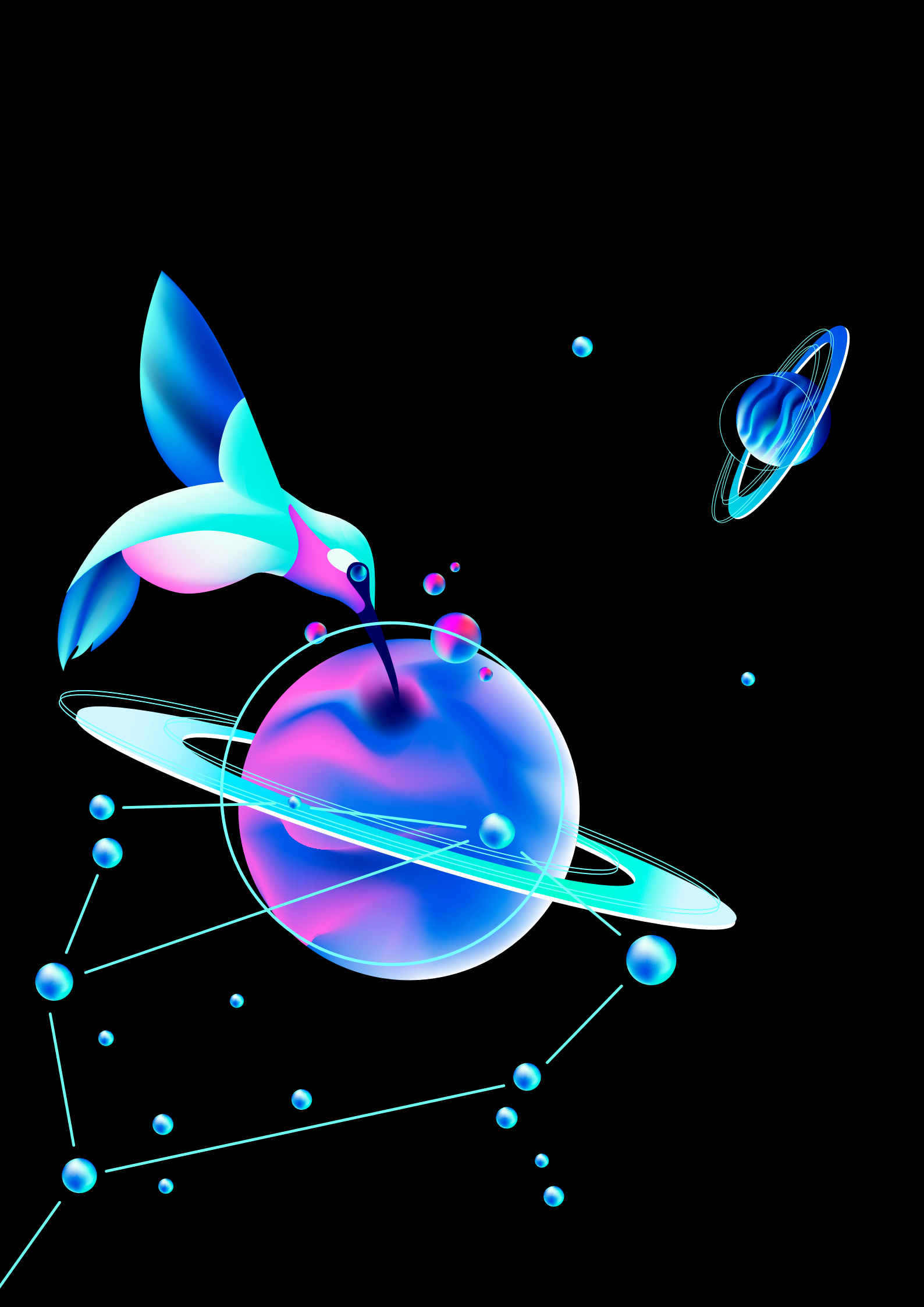
- **Social:** Content creators are encouraged to build virtual worlds and create content and interactions in the Metaverse. For example, Horizon Worlds allows users to enter virtual spaces as creators, have real collaboration and sharing experiences, and explore constantly created and evolving virtual worlds.

- **Film and television:** Creative interactive platforms provide innovative impetus for content forms including film and television, variety shows, and short videos. For example, Tencent Video is an online interactive creation platform that encourages original creators to participate.

Blockchain – smart city and finance

- **Smart city:** A city's information, energy, transportation, and other infrastructure is combined on a blockchain to give full play to the huge value of data. At the beginning of the construction of Xiongan New Area, it began to use blockchain technology to empower smart city construction.
- **Finance:** Blockchain technology connects the global financial system to make transactions more efficient and cheaper. The Metaverse has more advanced means of payment, because its economic activity supports the transaction of virtual goods. Pure digital currency made possible by blockchain can be used to buy goods.

Technologies will eventually converge to empower various application scenarios, liberate productivity, advance insights, improve decision-making, and upgrade business.



3. Industry

There are numerous enterprises already involved in Metaverse. Our framework for the Metaverse industry below facilitates analysis of the sector, related companies, and different business applications.

3.1 Metaverse industry framework

Given the broad contents in and different understandings of the Metaverse, a unified industry framework is critical for analyzing the industry, developing solutions, and other Metaverse-related work in a structured way.

We view the Metaverse as a large enterprise application with four layers:

Access layer: VR/AR, somatosensory devices, brain-computer interfaces, and other technologies that connect users to the Metaverse.

Application layer: Generates all digital contents and applications, including environment building, industrial manufacturing applications, games, social activities, digital artworks, economic activity, and virtual offices.

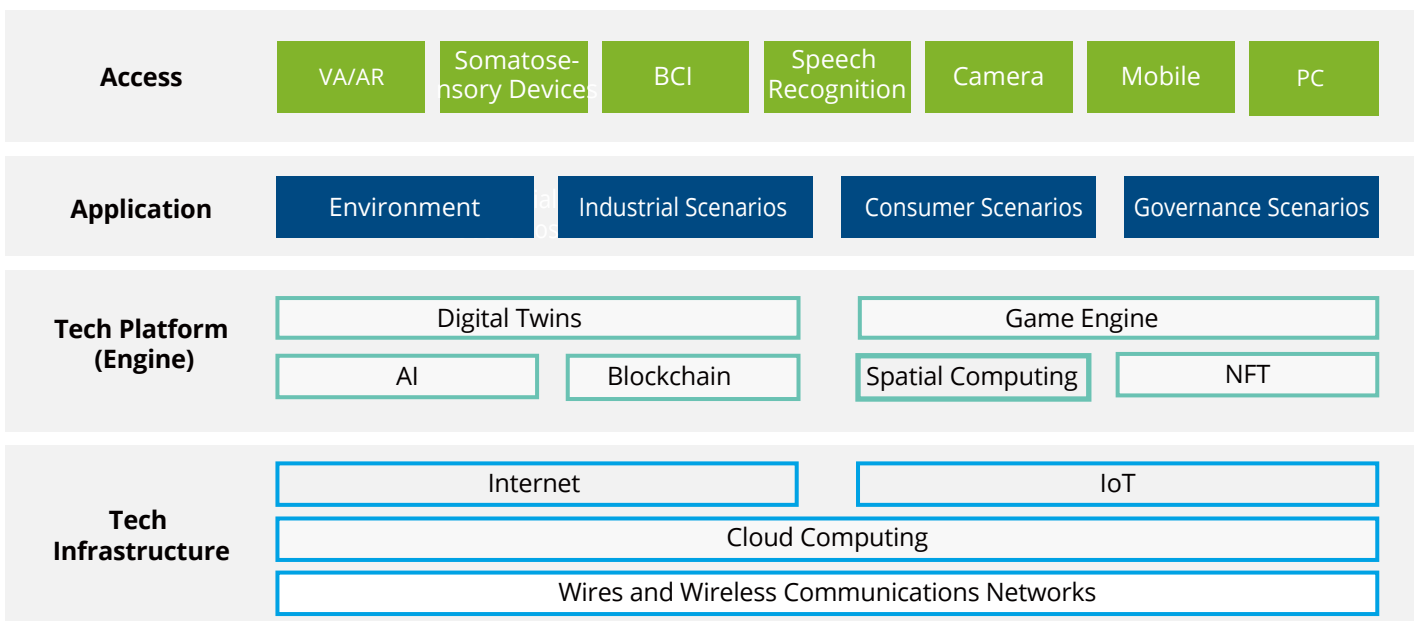
Technology platform layer: Contains technologies that support virtual community building, community rules and application development, including the generation and import of virtual infrastructures such as blocks and architectures; supporting technologies such as game engines and content

distribution platforms; and AI algorithms that support intelligent applications and interaction.

Technology infrastructure layer: The underlying technologies of the Metaverse including internet, IoT, 5G/6G, and cloud computing.

We use this industry framework to compare different participants in the Metaverse. People wanting to enter the Metaverse or investors and companies can use this to identify specific opportunities in the Metaverse industry.

Figure28: Industry Framework



3.2 Types of participants, cooperation and competition

There are four main classes of Metaverse solution providers: internet companies, hardware companies, software development companies, and new entrepreneurs.

In the future Metaverse landscape, these four classes of company will be involved in stronger cooperation inside, and stronger competition outside, each class.

The leading internet companies include Meta, Google, and Amazon in the US, and Baidu, Alibaba, Tencent, and Bytedance in China. Most of them own the multiple technologies needed to create the Metaverse, have massive user bases, abundant application scenarios, and have brought the Metaverse into their long-term strategies. They are expected to take the main roles of Metaverse platform constructors and community owners.

The second group, software companies, is represented by Microsoft, which has business plans for all four layers of the Metaverse and is emphasizing enterprise applications.

The future Metaverse will see fierce competition between Microsoft and internet companies, especially in the access layer, technology platform layer, and infrastructure network layer (including cloud) where both groups have a footprint. In the application layer, Microsoft's strength is the enterprise Metaverse, whereas most internet companies attach greater importance to consumer Metaverse. However, we also expect stronger competition in this layer as most internet companies are also serving and enlarging their enterprise market.

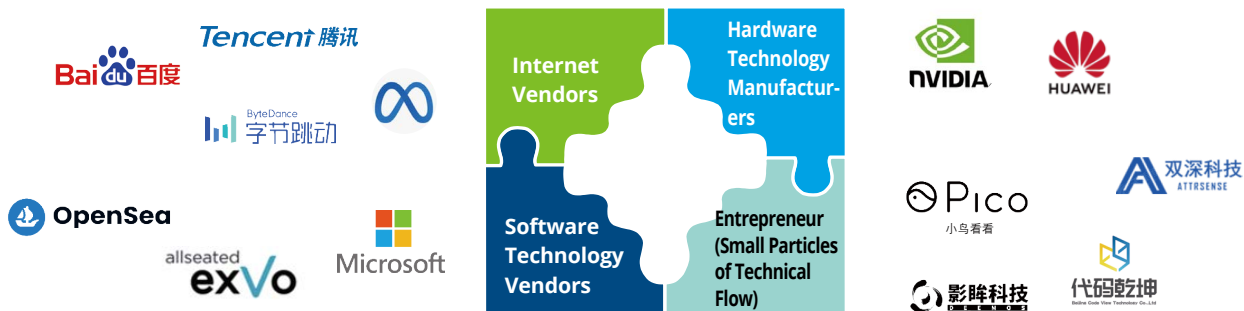
The third group (hardware companies) is represented by NVIDIA. NVIDIA maintains strong leadership in AI, high-performance computing (HPC), and chips, establishing solid foundations in the Metaverse infrastructure and technology platform layers. In the second half of 2021, NVIDIA announced Omniverse—the first simulation and cooperation platform to support Metaverse construction. Omniverse is now open to millions of users and because it has high efficiency and low cost is expanding rapidly in multiple fields, including architecture, media, product design, and autonomous-

driving. Moreover, Omniverse has formed its own ecosystem based on micro-services and a third-party digital content creator.

The fourth group are the new entrepreneurial Metaverse companies, with each focusing on a specific segment. Many of them have been around longer and acquired first-mover advantage in their specific markets, such as Roblox (gaming and community), Decentraland (community and gaming), OpenSea (NFTs), and Sandbox (gaming and community). Although the market values of Roblox and OpenSea have each exceeded USD10 billion, most entrepreneurial Metaverse companies have a small market size and have are dedicated to niche technologies or applications, including Lingo3D, Attrsense, Cyzone, and Deemos.





For internet giants, these innovative enterprises can become solutions providers for specific Metaverse scenarios via collaboration or M&A. For example, Tencent has invested heavily in Roblox, Bytedance has acquired VR provider Pico, and Meta acquired Oculus several years ago.

Figure29: Participants in the Metaverse



Source: Deloitte analysis

Figure30: American internet and technology enterprises in the Metaverse

	 Meta	 Google	 Microsoft	 Amazon
Perception & Display Layer	VA/AR oculus	Speech Recognition wayii	VA/AR HOLOLENS Somatosensory Device Kinect	Speech Recognition Transcribe Medical
Application Layer	Gaming Social Contact Beat Saber Horizon Worlds Fitness Les Mills Bodycombat	Gaming STADIA Video YouTube VR	Games (Activision Blizzard, MINECRAFT) Meeting + MR (Microsoft Teams)	AR Shopping
Platform Layer	Development Platform Presence Platform	Google Daydream VR Platform Android OS	Tool Software Operating System	Development Platform Sumerian
Network Layer	Open Computing Data Center AI Internet	AI Cloud Computing TPU AI Chip	Cloud Computing Content Delivery Network Edge Computing AI	Cloud Computing

Source: Open source data, Deloitte analysis

3.3 Major platform players

Platform-based players (mainly large internet and technology companies), rely on their mature technologies, broad user bases, and existing application scenarios to quickly deploy Metaverse applications. Benefiting from capital advantages, they can expand their Metaverse reach through investment or M&A in areas not yet covered by their own businesses. This section analyzes these industry giants and provides an overview of their Metaverse layouts.

Meta

Meta has one of the most comprehensive layouts in Metaverse. It has dabbled in hardware, software, content, digital currency and other

segments of the Metaverse through strategy and transformation. Meta has launched several programming tools including Spark AR, Presence Platform, and Pytorch to build and develop the Metaverse community.

In the access layer, Meta's Oculus leads the global market for XR devices, with its latest product, Oculus Quest 2, taking up to 75% of the market. In content, Meta has acquired several VR game and cloud game developers and launched virtual social and office platforms like Horizon Worlds and Horizon Workrooms. In digital currency, it has Libra and is now marketing the Diem token. In the platform layer, Meta has released the Presence Platform covering a series

of machine cognition and AI functions that include Insight SDK, Interaction SDK, Voice SDK, Tracked Keyboard SDK, and other components, and plans to build an ecosystem that supports Metaverse learning. In the network layer, Meta has launched open infrastructure and data center network hardware that supports cloud services and is growing in areas like AI.

Microsoft

Microsoft is devoted to all four layers and helps enterprise customers with digital transformation through a series of products including HoloLens, Mesh, Cloud, and Azure Digital Twins. Unlike Meta, which emphasizes the consumer end (household applications, office, social apps, and UGC content);

Microsoft puts more efforts into the enterprise Metaverse.

In August 2021, Microsoft announced its enterprise Metaverse solution, with two core features: Dynamics 365 Connected Spaces and Mesh for Teams. Dynamics 365 Connected Spaces helps company administrators analyze the movements and interactions of consumers in grocery stores or employees on factory floors. Mesh for Microsoft Teams integrates Microsoft Mesh (an MR meeting platform) into Microsoft Teams, allowing people in different locations to collaborate on Teams using 3D avatars. In the hardware layer, Microsoft has VR/AR visualization (the HoloLens series) and somatosensory technology (Kinect). In terms of applications, apart from enterprise software mentioned above, Microsoft has acquired Minecraft and Activision Blizzard in gaming. As the second-largest public cloud server in the world, Microsoft is experienced in edge computing and AI.

Google

Google has solid foundation in the infrastructure layer of the Metaverse through its AI and cloud service. In 2017, Google's strategy changed from Mobile First to AI First, and it now leads the AI industry in R&D and applications.

Tensor Flow, Google's open-source software for AI, is widely used worldwide, and Google has launched TPU chips specifically for Tensor Flow. In cloud computing, Google Cloud is among the world's top four public cloud service providers. With its combined efforts in cloud computing and AI, Google can play an important role in Metaverse infrastructure. In the access layer, it does not yet have a top product but the release of Google

Glass in 2012 should not be ignored. Google has only a few deployments in the application layer, and mainly combines existing businesses with the Metaverse concept, including Stadia in cloud games and YouTube VR in software services.

Amazon

Amazon's Metaverse strategy of is mainly based on its current cloud computing AWS and e-commerce business.

It has provided cloud-computing services to help Meta accelerate R&D on its AI projects. The two companies will also cooperate to help customers improve the performance of PyTorch (a deep learning computing framework) on AWS, and accelerate the modelling, training, and deployment in AI and machine learning.

Amazon also cooperates with Epic games and provides it with cloud-computing services. Epic Games' ace product, Fortnite, has 350 million users worldwide. As a Metaverse game, it requires massive computing resources. Almost all of its workload is currently on AWS. In addition, Amazon is using its advantages in retail to develop AR shopping applications.

Chinese internet companies in the Metaverse

Chinese internet companies are developing applications for multiple layers of the Metaverse by utilizing their own strengths.

Baidu

Baidu's Metaverse advantage is in AI and hardware, as an internet giant with an early strategy and in-depth development of AI. Its business ranges from search engines to AI applications including chips, AI open-source

algorithms, and intelligent driving, with AI running through every aspect of its business.

In hardware, Baidu has been involved in VR for many years with a full-scale product line that includes consumer-oriented (iQIYI Qiyu series) and enterprise-oriented VR (Baidu VR). In applications, Baidu has launched Xirang alongside its VR lines. This is a mixed enterprise-consumer virtual community that aims to create a virtual world supporting multiplayer interactions. Baidu also has autonomous-driving technology and could make this one of its Metaverse applications.

Alibaba

In the Metaverse, Alibaba focuses on two core advantages: Metaverse solutions based on cloud computing and combining e-commerce user experience optimization with the Metaverse.

It has extensive experience in cloud computing, with a public cloud that ranks third in the global market, only behind Amazon and Microsoft. In 2021, Alibaba put more effort into the Metaverse, creating cloud game *Yuanjing*, building an XR laboratory, and launching NFT platform Jingtian. In e-commerce, Taobao supported VR shopping since 2016.

Tencent

Tencent's Metaverse strengths are backed by its huge user base and rich application scenarios in social interaction, lifestyle services, and entertainment content.

Starting with the popular games *Roblox* and *Fortnite*, Tencent has assembled a development team for Metaverse games and invested in

Epic, the American game development and marketplace platform. In cloud computing, Tencent launched cloud game *START*, and with the Metaverse gaining more attention in 2021 registered a series of trademarks including QQ Metaverse, Tencent Music Metaverse, Game for Peace Metaverse, Honor of Kings Metaverse, and Oasis Metaverse. In NFTs, Tencent has developed the Huanhe marketplace built on top of its proprietary Zxin Chain.

ByteDance




ByteDance focuses on hardware entrance, content and applications, and its current product matrix including Douyin, Xigua Video, Toutiao, and TikTok support networks in its Metaverse strategy.

In the access layer, ByteDance acquired Pico, a leading Chinese VR manufacturer in September 2021. In the application layer, in April 2021 ByteDance invested RMB100 million in Code Qiankun, which developed and

owns Reworld, a game creation and interactive content platform for teens. It has also launched Pixsoul, a social app featuring face art creation.

ByteDance's launch of its Metaverse social game app Party Island, which is currently in beta testing, is expected soon. In October 2021 TikTok launched its first NFT series, TikTok Top Moments. In the network layer, ByteDance is entering the market with Volcengine as an independent business unit for the public cloud market.

Figure31: Chinese internet and technology enterprises in the Metaverse

				
Perception & Display Layer	VR/AR (Baidu VR)	VA/AR	VA/AR (TenVR)	VR/AR (pico)
Application Layer	Social, Gaming (Hyryang)	VR Shopping (Buy+) Cloud Game (Yuanjing)	Social Contact Cloud Gaming (START)	Social, Gaming (Reboot World) NFT Products (TikTok Top Moments)
Platform Layer		NFT Platform (Whale Scout)	Game Engine (Unreal) NFT Platform (Magic Core)	Game Engine (Restart the World)
Network Layer	AI Internet AI Chips	Cloud Computing (Alibaba Cloud) AI Blockchain (Ant Chain)	Cloud Computing (Tencent Cloud) Blockchain (Confidence Chain) IoT AI	AI Cloud Computing (Volcano Engine)

Source: Open source data, Deloitte analysis

3.4 The NFT industry chain

NFTs are one of the fastest-growing arenas of the Metaverse, catering to people's curiosity, pursuit of artistic creativity, and investment demand for digital art collections. The NFT industry chain has four layers: infrastructure, production, circulation, and derivatives.

The infrastructure technology layer is mainly composed of

blockchain (public chains, side chains, developer tools, token standards, wallets, and payments) and network-attached storage. The infrastructure layer creates and captures the value of the NFT value chain through NFT minting. For example, the gas fee during minting goes to the blockchain, and the more NFTs minted, the higher the value captured by the blockchain.

Public chains are independent, community-oriented blockchains like Ethereum and Flow Blockchain. Ethereum, with its long history, is the leading blockchain in the NFT market. Sidechains are new blockchains created to alleviate high traffic, improve public chain performance, and realize certain functions that some public chains cannot fulfill. Protocol standards create an underlying logic

and consensus during NFT minting and include ERC20, ERC721, and ERC1155. Developer tools help develop blockchain applications.

Network storage is data storage on a blockchain, represented by InterPlanetary File System IPFS distributed storage. A wallet, e.g. Tokenall, is a tool for private key storage without holding tokens.

The production and circulation layers host platforms that produce and trade NFT works. Production platforms have two usual models, UGC and PGC, to create NFT artworks, games, virtual worlds, and marketplaces. For example, Decentraland is a decentralized virtual world based on Ethereum. Users of Decentraland can create, explore, and trade NFT works in this virtual world. Sandbox launched its blockchain-based Play-to-Earn game in 2018, which has no storyline or settled ending but allows players to

experience the game and acquire digital assets that are tradable in the blockchain.

The Huanhe NFT marketplace in China belongs to Tencent, which is devoted to developing digital collection business that confirms with compliance requirements. Cryptopunks was one of the earliest NFT collections on Ethereum, where the most expensive trade reached USD7.5 million. OpenSea is the world's largest comprehensive NFT marketplace, where users can mint, display, trade, and auction NFTs.

The derivative layer includes exhibition platforms and combinations of NFT applications with other industries.

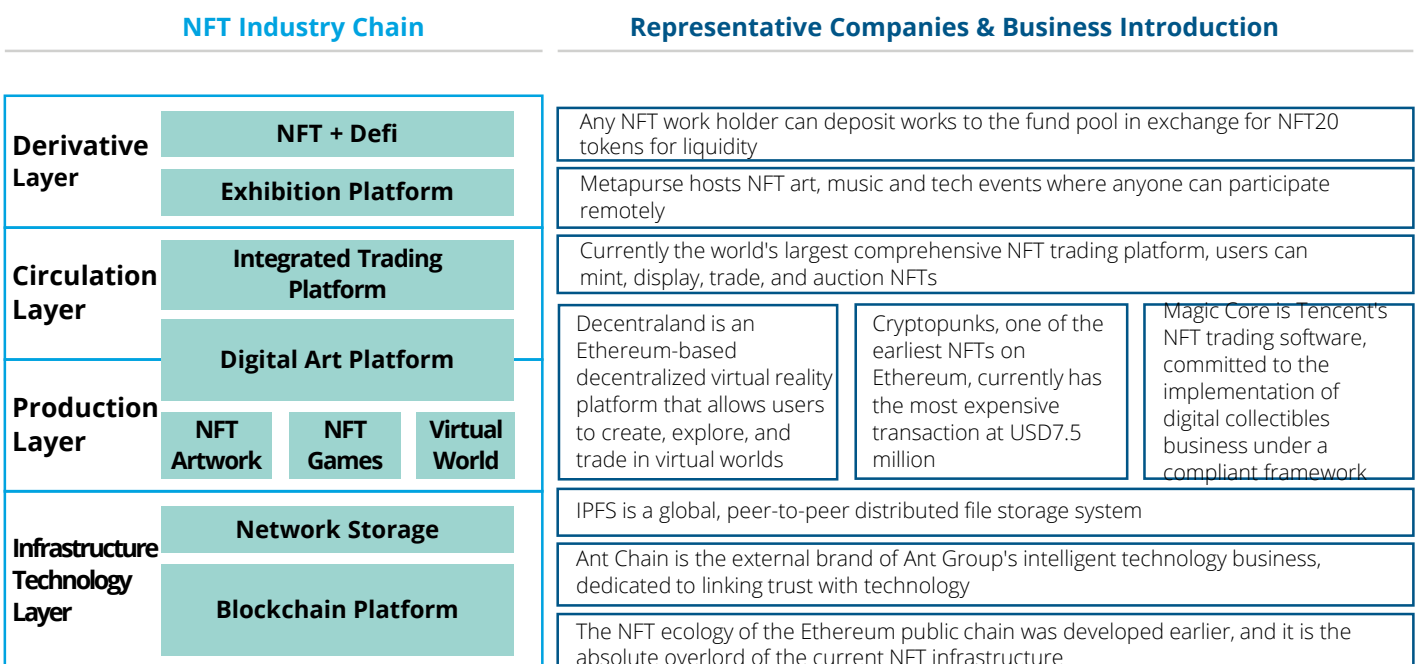
This layer includes NFT fund Metapurse, a cryptocurrency fund created and funded by Metakovan and operated with Twobadour. It focuses on identifying early-stage projects across blockchain infrastructure,

finance, artwork, collectibles, and virtual real estate, and creates virtual museums, art exhibitions, music, and technology events.

Decentralized finance or DeFi is one example of a combination of NFTs and finance. It empowers traders to save, borrow, transact, and buy insurance without a centralized entity (bank or financial institution) and overhaul the traditional banking system.

Liquidity has often limited the financialization and popularization of digital art. NFT20 is a decentralized NFT derivatives trading market and protocol that addresses this issue by allowing NFT producers to create liquidity pools for their projects and traders to benefit from those pools' greater liquidity and fair prices. Its trading volume and liquidity ensure fair prices for all. NFT20 tokens can also be bought as an investment.

Figure32: NFT industry chain and companies

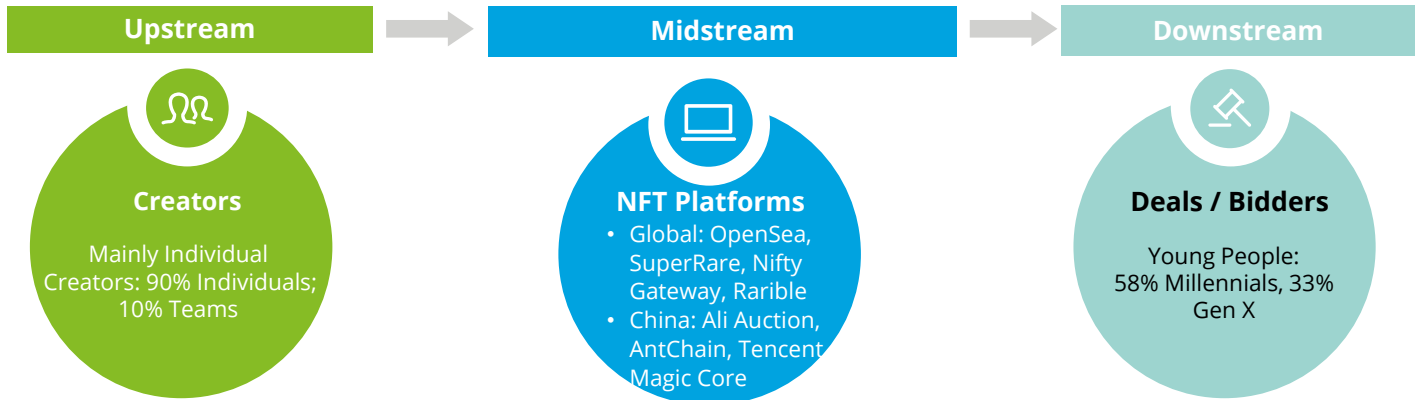


Source: Public information data, Deloitte analysis

NFT business and circulation models

Participants in NFT circulation are either upstream-creators, midstream-platforms, or downstream-bidders.

Figure33: NFT circulation



Source: Public information, Deloitte analysis

NFTs generate value at every link, including gas fees charged by blockchains, sales and trading fees charged by platforms, and copyright payments to content creators. Typically, upstream creators pay gas fees to a blockchain when creating an NFT. They then pay gas fees to the blockchain and commission to a platform when the NFT is published. Creators also collect transaction fees from buyers, and buyers pay gas and platform fees.

If the NFT is traded again, the creator receives a copyright fee and the platform charges a resale service fee. The seller collects the NFT payment and pays resale service, royalty income, and gas fees. The buyer pays for the NFT and pays gas fees too.

Figure34: NFT value distribution

Value Distribution	Value Attribution	NFT Market Value Distribution			
1 Gas: a Gas fee is needed for recording creation and transaction information on the blockchain	Blockchain	Infrastructure layer	Gas fee	Gas fee	Gas fee
		creation layer (creator)	not in the chain: 0 within the chain: Gas fee	without platform: sales revenue-Gas fee with platform: first sales revenue-Gas fee	Royalties
		creation layer (primary transfer platform)		first sales revenue	
2 Sales/Resale Services Fee: NFT transactions through the platform need to pay the platform certain service fees	Creation Platform	creation layer (secondary transfer platform)			resale service fee
		collector (seller)			resale revenue-resale service fee-royalties-Gas fee
3 Sales Revenue, Royalties: creator's income comes from the sales income in the primary market and the circulation royalties income in the secondary market	Creator	collector (buyer)		issue revenue-Gas fee	resale revenue-Gas fee

Examples of Main NFT Market					
	Established Time	Entry Forms of Creators	First Sales Service Fee	Resale Service Fee	Royalties of Creators
OpenSea	2017	Not Set	2.5%	2.5%	10%
SuperRare	2018	Application	15%	3%	10%
Nifty Gateway	2018	Targeted Invitation and Application	-	5%+0.3USD	Self Design
Rarible	2019	Application	2.5% (in the price)	2.5% (out of the price)	Up to 50%

Source: Public information, Deloitte analysis

The three roles in circulation

Upstream NFT developers include individuals and organizations using the UGC or PGC model. Individual creators represent 90% of NFT developers worldwide, but in China, professional teams dominate NFT creation.

Figure35: NFT creation

	PGC	UGC
Creators	Professional teams generate content	users generate content
Model of creation	platform releases NFT with its own artist team or external artists	users can create NFT works and upload, currently support audio, video, pictures, etc.
Cases	Global: Nifty China: Ali Auction, AntChain, Tencent MagicCore, JD lingxi	Global: OpenSea, SuperRare, Rarible, etc.
Profit model-platform	Sales sharing: the platform cooperates with well-known IP, and the sales are divided according to the agreed proportion	service fee: users pay Gas fees to upload their work to the chain through the platform, and the platform can earn Gas fees as a middleman Gas spread: the platform charges users a fee when they sell NFT, about 5%-15%
Profit model-creators	sales sharing, contract fee	sales revenue-chain fee-service fee

Source: Deloitte analysis

Globally, the midstream NFT trading platforms include OpenSea, SuperRare, Nifty Gateway, and Rarible. In China they include Alibaba Auction, Ant Chain, Tencent Huanhe, and NFT China. Internet and technology companies dominate China's NFT market because NFTs cannot be traded freely there. There are major differences in the technology, types of artworks, and oversight on Chinese and global platforms.

Figure36: NFT markets globally and in China

	Blockchai	Type of Artwork	Threshold of Creators	Currency	Restrictions	Restrictions	
China vs. global platforms	Global Market	focus on public chain	wealthy	including high and low thresholds	Ethereum, RARI and other cryptocurrencies	Lax regulation And flexible trading	more relaxed rise and fall
	China's Market	focus on private chain	less	focus on high thresholds	legal currencies, e.g. RMB, digital RMB	some can be donated, not open for resale	restricted rise and fall

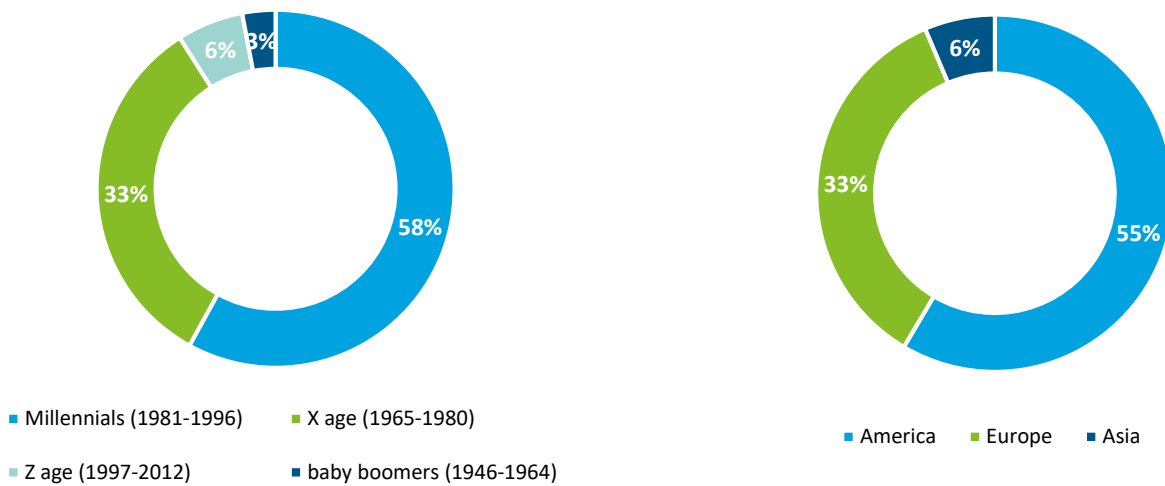
Source: Deloitte analysis

Most downstream buyers and bidders are young. According to the auction data from Everyday: The First 5,000 Days, millennials (1981-1996) and Gen X (1965-1980) bought more than 90% of the NFTs, showing the current NFT market belongs to young people with buying power, at least for now.

Demographically, NFT market is more mature overseas, especially in Europe and the US. Among the biggest NFT buyers, 55% are in the Americas, 27% in Europe, and only 18% in Asia, mainly due to the greater flexibility of overseas markets.

Figure37: Profile of NFT bidders and buyers

NFT dealers/Bidders, Users Portfolio: Take Everyday: The first 5000 Days the Bidding of as an Example



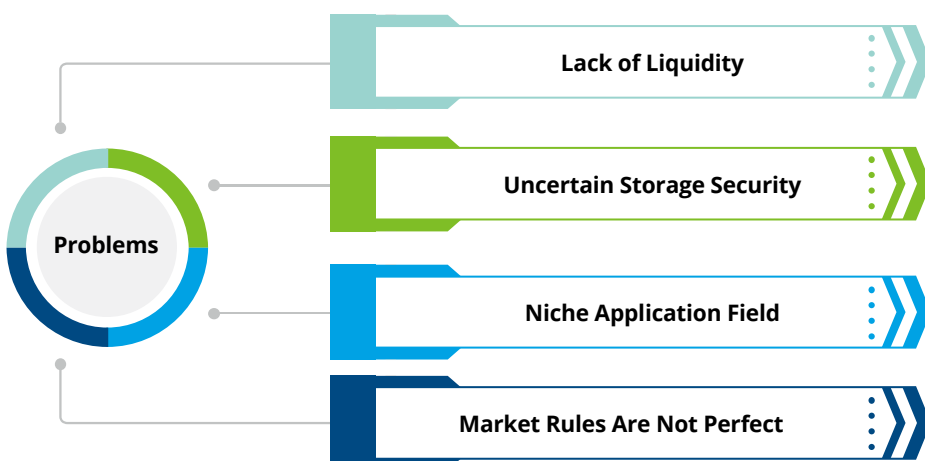
Source: leadleo.com, Deloitte analysis

Current problems

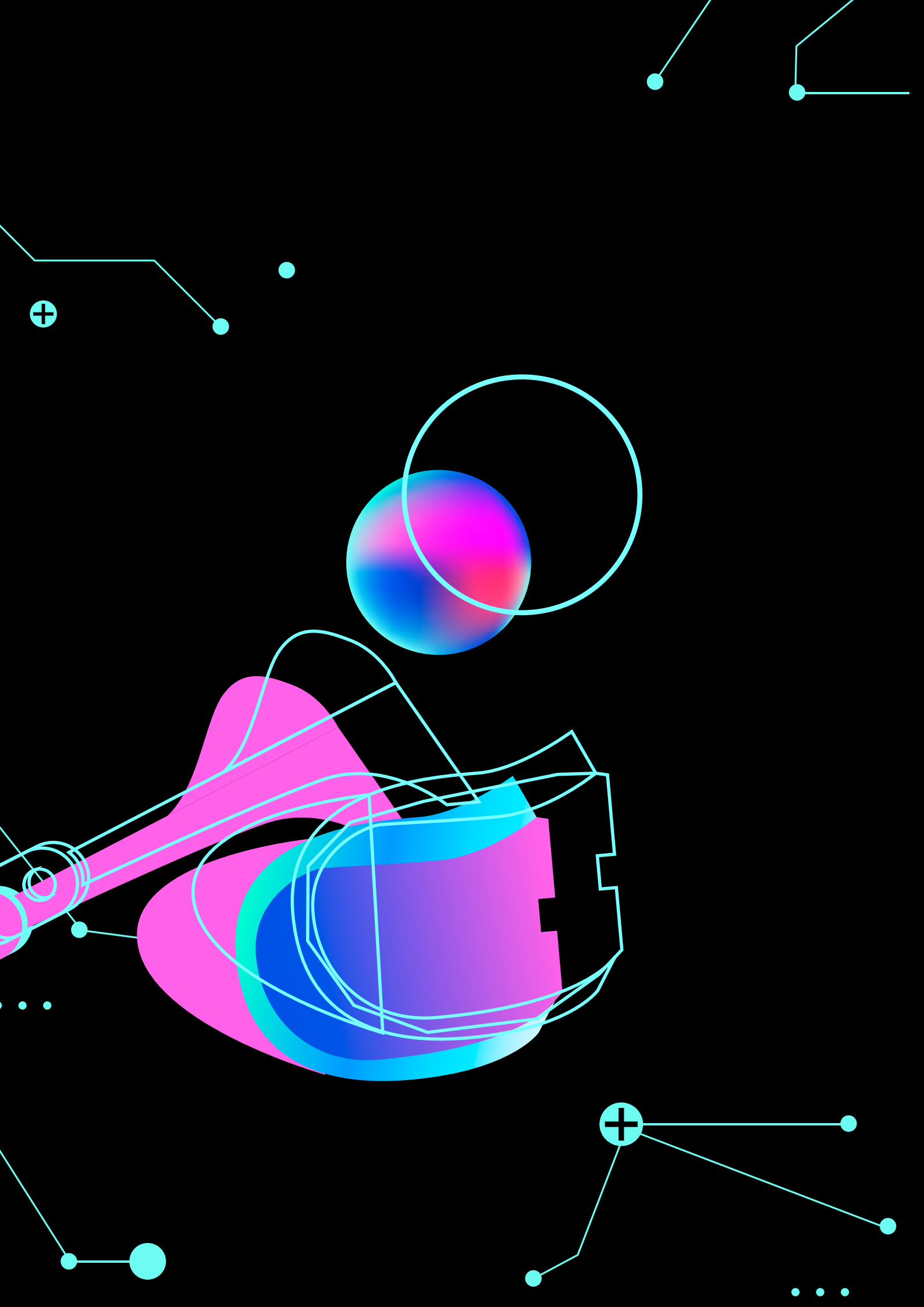
Four major problems currently beset the NFT market, the most prominent being security and market supervision. There is a long way to go before the massive adoption of NFTs and it will require cooperation and joint efforts from multiple counterparts.

The four major problems are a lack of liquidity, with high price thresholds and no fair pricing mechanism; the security and uncertainty of blockchain storage, with occasional NFT losses; NFTs being a niche market limited to digital art, collections, and games, with a long way to go before mass adoption; and as-yet-unsettled market rules, with regulatory development far slower than NFT market growth, and the lack of a gateway for NFT supervision.

Figure38: Problems in the NFT market



Source: Deloitte analysis



4. Metaverse tactics for enterprises

This chapter explores the future stages of the Metaverse, major potential risks, the attitude to NFTs in China, and how companies should respond to Metaverse opportunity.

4.1 Metaverse development

Defining Metaverse development depends on how immersive the experience is, user scale, the smartness of AI technology, and how much humans rely on the virtual world. Our predictions for Metaverse development are based on the key factor of "ownership of governance".

There will be five stages in the Metaverse development:

We are currently in the agrarian age when primary applications spread rapidly. A huge amount of new enterprises and services are emerging, and most of them can find their niche because the Metaverse remains a

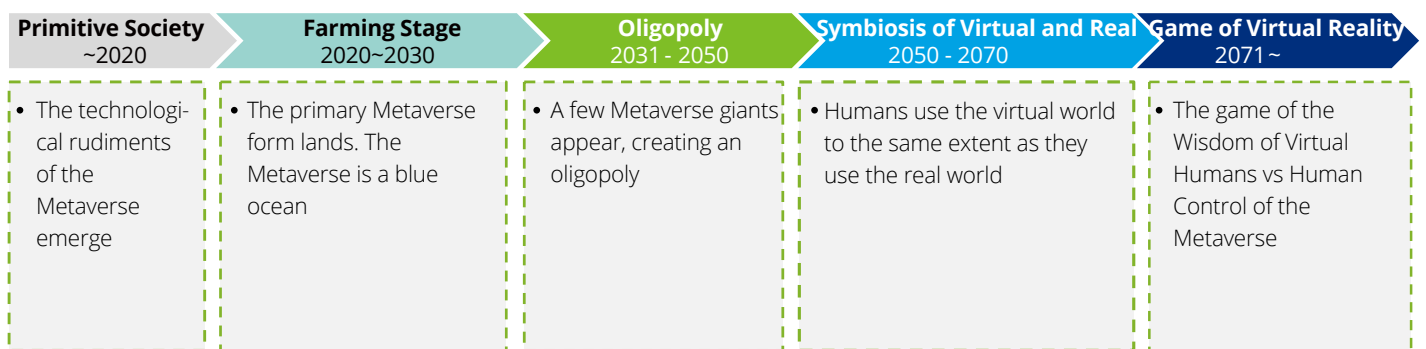
"blue ocean" market. Big companies are accumulating experience across the Metaverse, while startups thrive on segmented portions of the Metaverse, similar to how people fed themselves in the agricultural age.

This stage will only last around 10 years) as the public is already forming a consensus on how much value the Metaverse brings. The next stage will be oligopoly after the biggest companies achieve their strategies and stop accumulating, having gained the largest slice of the market. This stage will last for around 20 years as these giants build high barriers to competition.

The Metaverse will then enter a symbiosis of virtualization and reality. People will shuttle back and forth between the virtual and real worlds. Virtual humans and AI will enter many scenarios, interacting and coexisting with humans. The length of this period depends on technical breakthroughs in AI.

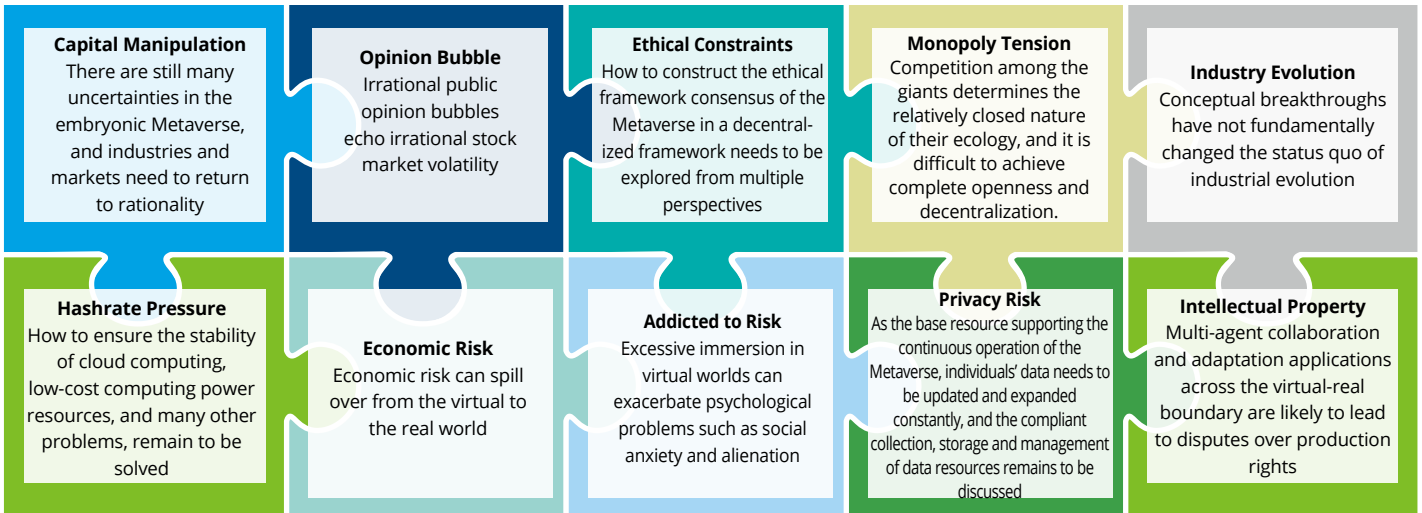
Finally, the virtual and the real will compete with each other. This will happen after around 50 years when virtual humans are intelligent enough and even surpass the average intelligence of human beings, being able to compete with humans for control.

Figure39: Development stages of the Metaverse



Source: Deloitte analysis

Figure40: Potential risks



Source: Deloitte analysis

4.2 Potential risks

The advance of the Metaverse will present potentially significant risks related to addiction, privacy, intellectual property, economics, oligopoly, and governance.

- **Addiction:** With continuous development of the Metaverse, addiction risk is becoming more significant. The Metaverse breaks the physical rules of the real world, redefines production and lifestyles in the digital world, and transforms social productivity. However, brand-new visual stimulus and interactive experiences could make people addicted to the virtual world and unable to extricate themselves from it. It is therefore critical to find a way to balance the relationship between the real world and the Metaverse, letting the latter play a more positive role.
- **Privacy:** The Metaverse will become a massive, extremely complex, open, and dynamically optimized system that is more deeply integrated

than the "old" internet has been in people's daily work and lives. Any malicious use of the data recorded by every interaction of people with the Metaverse will bring huge risks to people's privacy.

- **Intellectual Property:** With the integration of the digital and real worlds, the ownership and distribution of intellectual property in the virtual world and the problem of virtual item embezzlement will challenge intellectual property management.
- **Economics:** Economic risk includes the possibility that the contradiction between huge economic value in the virtual world and the virtual nature of this value leads to speculative behavior, or that the Metaverse is attacked, invaded, disrupted, and destroyed, damaging real-world economic and social development.
- **Oligopoly:** Construction of the Metaverse requires a huge amount of investment to realize mass

user interaction and form unified standards, and needs stable service providers, which creates potential oligopoly risk. Avoiding this risk is crucial to Metaverse development.

- **Governance:** The most desirable relationship between virtual and human humans; whether decentralization of the digital world is realized or it merely becomes the embodiment of a group of developers' personal will; the influence of the digital world on the real world; and the division of governance across the virtual and real worlds are key problems and complex to solve.

4.3 China's attitude to the Metaverse

Generally, China's attitude towards the Metaverse has been to embrace it actively but move forward cautiously. China welcomes Metaverse technology innovation and industrial cultivation, but is strict with digital currency and NFT trading.

Embrace actively



The Ministry of Industrial and Information Technology (MIIT) recently mentioned the Metaverse for the first time and local governments are making plans for the Metaverse.

MIIT: cultivate a group of innovative SMEs in the Metaverse and other emerging industries.

The MIIT has said it will support SMEs with digital transmission, seize the opportunity to push forward new infrastructure and develop the digital economy, and cultivate innovative SMEs specializing in the digital industry and innovative SMEs in emerging industries such as the Metaverse, blockchain, and AI.

Beijing Municipal Administrative Center (Beijing MC) the first mover

At the Beijing MC Industry Development Promotion Conference in Tongzhou District, Beijing issued a series of policies including "Metaverse-related policies" focusing on content design, industrial spaces, application

scenarios, and partnership in the Metaverse.

Shanghai includes Metaverse in 14th Five-Year Plan

According to the 14th Five-Year Plan for Shanghai Electronic Information Manufacturing Industry, Shanghai plans to develop quantum computing, 3rd-generation semiconductors, 6G technology, the Metaverse and other industries, and create image engine and blockchain technology to meet the development needs of the Metaverse. Shanghai is encouraging application of the Metaverse to public services, business, social entertainment, industrial manufacturing, production security, and video games.

Jiangsu to build Metaverse Ecological Industry Demonstration Zone

Binhu District of Wuxi City launched the Metaverse Ecological Industry Development Plan of Taihu Bay Science and Technology Innovation

Leading Zone, aiming to build a paragon of international innovation and a domestic Metaverse ecological industry demonstration zone.

Zhejiang accelerates Metaverse development

Zhejiang's Guidance on The Construction of Future Industry Pilot Zones in Zhejiang Province states that the Metaverse, alongside AI, blockchain, and 3rd-generation semiconductors, is one of the most important strategies for Zhejiang's industry pilot zone due to launch by 2023. Zhejiang will accelerate the development of an open innovation platform in brain-machine cooperation, VR, and blockchain, and boost industrial technology and integrated innovations.

Wuhan writes Metaverse into government work report

The government work report of the 15th People's Congress of Wuhan in Hubei Province talks about accelerating

development of the digital industry and pushing the integration of the Metaverse, big data, cloud computing, blockchain, geospatial information, and quantum technology with the real economy.

Hefei and Hainan bring Metaverse into future strategy

Within the next five years, Hefei plans to put more effort into future industry, aiming to develop a group of pilot companies, leading-edge technologies, and high end products in areas including the Metaverse, superconducting materials, and precision medicine.

In Hainan, meanwhile, the Sanya Municipal People's Government and NetEase have signed a strategic cooperation agreement in which NetEase base its Hainan headquarters in Sanya. From this new base, it will develop the NetEase Metaverse Industrial Base project to promote high-quality development of Hainan's digital culture and creative industries, and create an international digital innovation center that integrates internet technology with digital content production, copyright operations, and products.

Move forward cautiously

China's policies on digital currencies and digital art transactions are the main reflection of its cautious attitude towards the Metaverse

China has strict supervision on digital assets. Back in 2013 and 2017, the People's Bank of China and other government departments issued notices clarifying that Bitcoin does not have the same legal status as fiat currencies and financial institutions

should not use it to price products or services, or directly or indirectly provide Bitcoin-related services. The notices clarify that token issuance is essentially an unapproved, illegal public financing, with suspected illegal sales of tokens and securities, illegal fundraising, fraud, pyramid schemes, and other illicit activities.

In 2021, China adopted stricter digital currency policies, with mining designated as an eliminated industry and clarification that digital currencies such as Bitcoin and Ethereum do not have the same legal rights as fiat currencies. Related financial activities and overseas digital currency exchanges providing services to residents in China have been declared illegal.

In the NFT space, platforms need to finish a very strict approval process before conducting business. This requires them to have licenses for value-added telecommunications and the dissemination of audio-visual programs via information networks, a permit for cyber culture business operations, one recordation for blockchain information services and another for artwork business record. It is difficult for enterprises to acquire all of these.

Furthermore, it is difficult to operate an NFT marketplace. According to the *Implementation Opinions of the General Office of the State Council on Straightening out and Rectifying Various Types of Trading Venues*, standardized contract transactions cannot be conducted by centralized trading methods including call or continuous auctions, electronic matching, anonymous trading. The

Opinions also prohibit acting as a market maker and other trading methods. In addition, as NFTs are considered to have financial attributes, marketplace must obtain approvals from the State Council and its financial authorities.

4.4 Metaverse tactics

The Metaverse presents a huge opportunity but also major risks. Enterprises aiming to embrace the Metaverse should take the following approaches:

- **Active learning.** The Metaverse is essentially a new technology-driven revolution in society with deep influence. To embrace this change, enterprises should understand its full scope before seeking opportunities in the Metaverse.
- **Gain first-mover advantage.** Enterprises hoping to enter the Metaverse and provide services to companies or individuals must move fast, provide targeted solutions, and enter customers' consciousness to amplify results. The capital market, enterprises, and individuals accepted the concept of the Metaverse rapidly. Despite recent drops in market valuations of Metaverse-related companies, it gained acceptance much faster than the internet did when it emerged. This means each window of opportunity will not be open for long and first-mover advantage is key.
- **Treat the Metaverse as an advanced digital transformation.** Businesses that want to empower themselves with Metaverse technologies and models can consider these part of their overall digital transformation and intelligent

upgrading. When the concept of the Metaverse was proposed, all of the relevant technologies already existed and had varying extents of application. All of the same technologies are also required in digital transformation. The immersive experience of the Metaverse suits marketing and consumer interactions, R&D and manufacturing use digital twins and 3D simulation, and AI algorithms are already widely used.

- **Focus on business model innovation based on core competitiveness.** Companies that want to enter the Metaverse

market to develop innovative businesses should explore the Metaverse value chain to find a link in that chain that fits their existing capabilities. For example, the four layers of the NFT market have corresponding core capabilities, NFT infrastructure requires blockchain and NFT expertise, NFT production requires creative resources, NFT trading requires a platform, and NFT derivatives require industry applications. The entry points for a Metaverse business are similar to those in the NFT market, and enterprises should use their own capabilities and characteristics to

choose their positioning.

- **Build an ecosystem.** Metaverse technology is becoming increasingly precise, and demand for application scenarios is expanding. Enterprises must build ecosystems around their core competitive advantages to provide customers with integrated application scenarios and solutions.
- **Avoid risk.** Act according to national policies, protect data and network security to prevent data breaches, and avoid speculation in the Metaverse to prevent economic risks.

Conclusion

The Metaverse is guided and driven by human imagination and contains a vast amount of complex content. Its application also varies from country-to-country. Enterprises should embrace the Metaverse, clarify their positioning and layout in the Metaverse, and continuously strengthen their core capabilities and ecosystem construction to maximize the benefit of this new universe. Most of all, they should look forward to exploring and discussing the Metaverse together.

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