



Research Office
Legislative Council Secretariat



Information Note

Development of Web 3.0 technologies in selected places

IN10/2023

1. Introduction

1.1 Web 3.0 is the latest generation of the World Wide Web that envisages a more decentralized version of the web with increased openness and wider possibilities for its users. Underpinning Web 3.0 is a constellation of advanced technologies and applications including blockchain technology, smart contracts, virtual assets (e.g. cryptocurrencies), non-fungible tokens (“NFTs”) and metaverse technologies.¹ These technologies/applications help provide the technical, financial and other vital infrastructure needed for a decentralized web, which in turn enables direct interactions among users without the need for intermediary platforms. This marks an evolution from its predecessor – Web 2.0 – which is characterized by the dominance of a relatively small group of large technology companies and the need for intermediaries such as online marketplaces and banks to facilitate transactions.²

1.2 In Hong Kong, the Government has sought to brace the development and adoption of Web 3.0. The Financial Secretary has announced in the 2023-2024 Budget to nurture a Web 3.0 ecosystem and establish a task force on the development of virtual assets, a component of Web 3.0. Nevertheless, there remain concerns over Hong Kong lagging behind in Web 3.0 development, in view of the scaled-up efforts undertaken by other places around the world to accelerate the adoption of Web 3.0 and related technologies/applications, noticeably in Asia and the Gulf region. Given the recent turmoil in the cryptocurrency market, there have also been calls for Hong Kong to look beyond financial services and virtual assets, and drive innovation in other Web 3.0 technology domains such as blockchain and metaverse technologies.³

¹ See Deloitte Insights (2020) and University of Cambridge (2022).

² Web 2.0 is centralized. User data and other data are stored in centralized servers controlled, and even owned, by large technology companies/platforms.

³ See 邱達根 (2023), 信報 (2023) and GovHK (2022e).

1.3 At the request of Dr Hon Johnny NG Kit-chong, the Research Office has conducted a study on the different approaches adopted by some Web 3.0 pioneering places to develop the related technologies/applications. The study focuses on the experiences of Japan, Singapore, South Korea and the United Arab Emirates (“the UAE”), in view of their status of being global or regional innovation hubs that are making active forays into Web 3.0 technologies.⁴ Among them, **Japan** has set out a high-level policy steer on Web 3.0 development and established a dedicated office to strengthen Web 3.0 policy coordination across the government. Unlike Japan with a holistic strategy to lead Web 3.0 development, other places studied have concentrated on one or more specific domains of Web 3.0. Indicative of this, **Singapore** and the **UAE** are actively exploring use cases of blockchain technology through partnerships with the industry and/or the launch of incubator hubs; whereas **South Korea** is proactive in rolling out a metaverse strategy to spur innovation across a wide variety of sectors, such as public services, culture and tourism.⁵

1.4 This *Information Note* first discusses the key features of Web 3.0 and its underlying technologies and applications, followed by an overview of the recent development of Web 3.0 in Hong Kong. It then delves into the development of Web 3.0 and related technologies/applications in selected places, first reviewing the holistic strategy approach in Japan, and followed by specific application-oriented development measures for (a) blockchain technology and/or asset tokenization in Singapore and the UAE; and (b) metaverse technologies in Singapore, South Korea and the UAE.⁶

2. Basics of Web 3.0

2.1 The invention of the World Wide Web has been hailed as one of the biggest technological breakthroughs in modern human history. That said, the web has always been a work in progress. By mid-2010s, the idea of “Web 3.0”

⁴ Singapore, South Korea and Japan were ranked among the top 20 in the Global Innovation Index 2022 published by the World Intellectual Property Organization. The UAE came in 31st globally and 3rd regionally in the index.

⁵ Some places might also differ in the roles of the respective governments in driving the development of Web 3.0. For example, the Mainland has embarked on a government-led approach while the United States has adopted a market-driven stance. Please see **Appendix 1** for highlights of these two approaches.

⁶ This study will not go into details of the regulation of virtual assets to avoid unnecessary duplication of information already covered in the comprehensive researches recently conducted by the Hong Kong Monetary Authority (“HKMA”) on this issue. For details, see Hong Kong Monetary Authority (2022, 2023).

has been coined to describe parts of the Internet/Cyberspace with the following defining features which set Web 3.0 apart from its predecessors⁷:

- (a) **decentralized**: running on decentralized networks is regarded as a core tenet of Web 3.0. Data generated by users in the Web 3.0 era is hosted on a network of computers in multiple locations using technologies such as blockchain, rather than on centralized databases held by large technology companies, thereby giving users greater control over their data, privacy and digital identity⁸;
- (b) **open and interoperable**: Web 3.0 applications are generally built with open-source software produced by a community of developers, allowing different systems and platforms to work together seamlessly on a decentralized network⁹; and
- (c) **permissionless and trustless**: anyone can participate without having to seek permission from a governing body such as a service provider, making peer-to-peer interaction and transaction possible in the absence of trusted, third-party intermediaries like banks and brokerages.¹⁰

2.2 There is yet to be a single, universally recognized definition for Web 3.0, notwithstanding the realization of a decentralized Web 3.0 through the development and convergence of a number of advanced technologies. **Figure 1** below highlights a number of disruptive technologies and applications that serve as promising tools for laying the foundation for Web 3.0 development and are being developed in the selected places covered by this Note (see **Appendix 3** for more details):¹¹

⁷ For an overview of the three key stages of World Wide Web development since mid-1990s, see **Appendix 2**.

⁸ See World Economic Forum (2022), Ejeke (2023) and Grant (2023) for details.

⁹ See *ibid*.

¹⁰ An example of trustless transaction is sending cryptocurrency (e.g. Bitcoin) directly to someone rather than through a bank or digital wallet stored on a centralized server. According to some analysts, having the whole transaction process managed by the blockchain algorithm and encryption makes it more difficult to forge or alter records. See Forbes (2022).

¹¹ Given the fast-evolving nature of Web 3.0 and the absence of universally agreed definition of Web 3.0, Figure 1 and Appendix 3 cannot claim to be exhaustive on technologies and applications that are relevant to Web 3.0.

Figure 1 – Selected technologies and applications

Technology/ application	Salient features
<u>Distributed ledger technology (“DLT”)</u>	
Overview	<ul style="list-style-type: none"> Transaction data on DLT systems is “distributed” across a vast network, resulting in unalterable and transparent records as well as protection against hacking/tampering due to the distributed nature of records. Blockchain is a type of DLT.
<i>Selected blockchain applications:</i>	
Asset tokenization	<ul style="list-style-type: none"> Converts digital or real world assets into digital tokens that can be traded, often without central authorities or intermediation (e.g. brokers and clearing houses) Fungible tokens, such as cryptocurrencies (e.g. Bitcoin and stablecoins), are exchangeable with tokens of the same type; NFTs, meanwhile, are uniquely identifiable and can be used to prove authenticity and ownership of digital assets/intellectual properties (“IPs”)
Decentralized finance (“DeFi”)	<ul style="list-style-type: none"> Enables financial activities (e.g. borrowing, lending, securities trading, and insurance policies, etc.) to take place outside traditional financial institutions and infrastructure like banks, insurers, brokerages and securities exchanges Makes use of smart contracts, which are blockchain-based computer programmes that automatically execute the terms of a contract when predetermined conditions are met
Decentralized autonomous organizations (“DAOs”)	<ul style="list-style-type: none"> A new form of corporate governance: community-led entities characterized by (a) the lack of hierarchical structure; and (b) allowing anyone with ownership of the relevant digital tokens to vote on decisions of the DAOs (e.g. funds allocation, employee hiring, and projects to pursue) When a decision is approved by members, it is executed automatically by smart contracts
<u>Metaverse technologies</u>	
Overview	<ul style="list-style-type: none"> Metaverse is a fully immersive virtual world, enabled by technologies like extended reality which encompasses virtual, augmented and mixed realities (“VR”, “AR” and “MR”)
<i>Some elements/applications in the metaverse environment:</i>	
Avatars	<ul style="list-style-type: none"> Users can create their own avatars to represent themselves in the metaverse
Digital twin	<ul style="list-style-type: none"> A virtual replica of real world locations and objects Users can interact with one another (often using their avatars) and participate in virtual events and activities in real-time

Sources: Ragnedda and Destefanis (2020), Voshmgir (2020), Blockchain Simplified (2020), Cointelegraph (2023b) and McKinsey & Company (2023).

3. Development of Web 3.0 technologies in Hong Kong

3.1 Like many places globally, Hong Kong is at an early stage of formulating policies to support the development of Web 3.0. In the 2023-2024 Budget, the Government has stressed the importance for Hong Kong to seize the “golden opportunity” of Web 3.0. It has allocated HK\$50 million to accelerate the development of the Web 3.0 ecosystem through initiatives such as hosting key international seminars to encourage cross-sectoral business collaboration and organizing workshops for young people.¹² Recognizing virtual assets as an essential component of the Web 3.0 ecosystem, the Budget also announced the formation of a task force led by the Financial Secretary to bring together members from relevant policy bureaux, regulators and the industry to provide recommendations on virtual asset development (see paragraphs 3.4-3.7 below for more details on the development of virtual assets in Hong Kong so far).

3.2 Hong Kong saw more discernible development in Web 3.0 in the early 2020s. For instance, the Government completed four pilot blockchain projects in 2020 to explore the applicability and benefits of blockchain technology for different e-Government services. These projects involved facilitating trademark transfers, optimizing procedures for preparing environmental impact assessment reports, improving pharmaceutical product traceability, and keeping track of company filing records. It further launched a Shared Blockchain Platform in June 2022 and would follow up on developing common service and reference programme modules to assist bureaux and departments in developing blockchain applications.¹³

3.3 Cyberport, the digital technology flagship and a key financial technology (“fintech”) innovation hub in Hong Kong, also established the Web3 Hub in January 2023, with the goal of supporting local innovators and attracting international Web 3.0 companies to settle in Hong Kong.¹⁴ With a nascent cluster of Web 3.0 start-ups, the Cyberport was home to some 80 blockchain or virtual asset companies as at late November 2022.^{15, 16}

¹² See The Budget (2023).

¹³ See Office of the Government Chief Information Officer (2022).

¹⁴ The Cyberport is managed by the Hong Kong Cyberport Management Company, which is wholly owned by the Government. Web 3.0 start-ups in the Cyberport fall into three major categories: fintech, smart living and digital entertainment/e-sports. See Cyberport (2023).

¹⁵ See GovHK (2022c).

¹⁶ To engage the Web 3.0 community, NFTs were issued for the Hong Kong Fintech Week 2022 to serve as proof of attendance for attendees while giving holders exclusive access to upcoming industry activities. Attendees could also create their own AR avatars to experience the metaverse at the event. See GovHK (2022a).

3.4 Given Hong Kong’s position as a premier international financial centre, it should not be surprising that financial services-related Web 3.0 applications have registered particularly vibrant progress. In October 2022, the Government issued a policy statement to set out its vision and approach towards promoting the “sustainable and responsible” development of the virtual asset industry.¹⁷ In particular, the Government seeks to strike a balance between supporting financial innovation and mitigating risks/safeguarding investors, following the recent turmoil in cryptocurrency markets and a global push towards better governance of the industry.

3.5 As to the regulation of the virtual assets, the passage of the Anti-Money Laundering and Counter-Terrorist Financing Ordinance in December 2022 enabled the introduction of a new licensing regime for virtual asset exchanges to be supervised by the Securities and Futures Commission (“SFC”). The new regime, which came into force in June 2023, has replaced the previous opt-in regime for virtual asset exchanges, where licences were not mandatory. It requires that relevant operators be subject to regulatory requirements similar to those of traditional financial institutions, including compliance with anti-money laundering and counter-terrorist financing (“AML/CTF”) and other investor protection standards (e.g. safe custody of client assets and avoiding conflicts of interest). Licensees are also required to regularly submit audited accounts to SFC, which has the authority to access business premises for inspections when necessary.¹⁸

3.6 In January 2023, the Hong Kong Monetary Authority (“HKMA”) published its consultation conclusions on the regulation of stablecoins¹⁹, and is developing the regulatory framework for further public consultation this year. Separately, SFC has finalized rules on how retail investors could be granted a suitable level of access to virtual assets under the new licensing regime, as well as steps to be taken to ensure investor protection.²⁰ SFC also approved the

¹⁷ See GovHK (2022a).

¹⁸ See GovHK (2022b).

¹⁹ HKMA has proposed a regulatory regime for payment-related stablecoins (i.e. stablecoins with the potential to become a widely acceptable means of payments). It has recommended, among other things, that stablecoins be fully backed and redeemable at par, and that licensees be subject to rules regarding ownership, governance, AML/CTF, disclosure, etc. See Hong Kong Monetary Authority (2023).

²⁰ Earlier on, SFC conducted a consultation study on the issue in early 2023. It concluded in May 2023 that retail investors could start trading “eligible large-cap virtual assets” (i.e. those included in a minimum of two acceptable indices issued by at least two different independent providers) on licensed virtual asset exchanges. It also announced the implementation of robust measures to enhance protection for retail investors, such as ensuring suitability in client onboarding, token admission, and other disclosure obligations for relevant exchange operators. See Securities and Futures Commission (2023).

authorization of virtual asset futures exchange traded funds for public offering in October 2022.²¹ Considering that virtual assets have distinctive qualities that set them apart from traditional assets, the Government is also open to conduct future reviews on property rights for tokenized assets and the legality of smart contracts in order to lay the legal foundation for their development.²²

3.7 Regulation aside, the Government has rolled out several pilot projects to drive digital and virtual asset innovation in the financial sector. One example was the inaugural offering of HK\$800 million worth of tokenized Government green bonds in February 2023.²³ This initiative was designed to test out the financial and legal infrastructure needed for the use of DLT throughout the bond lifecycle (i.e. from issuance to settlement and maturity redemption) and serve as a model for future issuances.

Issues of concerns

3.8 Notwithstanding the Government's effort in recent years, there remains concerns over Hong Kong lagging behind in Web 3.0 development as its peers in the region and beyond have intensified efforts to hasten the adoption of Web 3.0 technologies. There have been calls for the Government to:

- (a) formulate a **blueprint** to facilitate the holistic development of Web 3.0, with an emphasis on nurturing talents and start-ups.²⁴ There are also proposals for the Government to make strategic investments in Web 3.0-based technologies through the newly established Hong Kong Investment Corporation ("HKIC")²⁵;
- (b) actively explore various **Web 3.0 technologies** (such as blockchain-based applications including DeFi and smart contracts), considering that Web 3.0 has far-reaching potential applications beyond virtual assets²⁶;

²¹ See Securities and Futures Commission (2022).

²² See GovHK (2022a).

²³ See GovHK (2023).

²⁴ See 葛珮帆 (2023).

²⁵ The 2022 Policy Address announced the establishment of HKIC to optimize the use of financial reserves for strategically promoting the development of target industries and the economy. See also GovHK (2022d).

²⁶ See 邱達根 (2023) and 信報 (2023).

- (c) provide more **legal clarity** in light of new trends brought by Web 3.0 technologies, including the emergence of DAOs and IP right issues/concerns arising with the use of NFTs²⁷; and
- (d) catch up with **metaverse development** by referencing the experiences of other places and exploring its application in public services, tourism and other industries.²⁸

4. Development of Web 3.0 technologies in selected places

4.1 Globally, policymakers have increasingly recognized the potential of Web 3.0 technologies and taken steps to foster their development. It is observed that governments in the places studied have adopted different approaches to Web 3.0 development, with Japan being an example of government focusing on formulating a holistic Web 3.0 policy strategy (see paragraphs 4.2-4.3 below), while many other places including Singapore, South Korea and the UAE concentrate on developing one or more specific domains of Web 3.0 such as DLT/blockchain (paragraphs 4.4-4.8) and metaverse technologies (paragraphs 4.9-4.15). The salient features of their respective strategies are discussed in the paragraphs below.

Formulating a holistic Web 3.0 policy

4.2 In **Japan**, there are growing views that the development of Web 3.0 and relevant technologies/applications could serve as the next frontier for the country to reassert itself as a leading technology nation on the global stage.^{29, 30} In particular, the advanced features of Web 3.0 will be a key factor in increasing productivity³¹, which in turn helps sustain economic growth in the face of a rapidly ageing population and dwindling workforce in Japan. Indeed, Japan's

²⁷ Some analysts have noted legal uncertainty on issues such as how to determine one's eligibility to issue NFTs when he/she owns part of the original work, and whether or not to grant copyright to artificial intelligence, which has been developed and trained by humans to produce creative works. See China Daily (2022) and Now財經 (2022).

²⁸ See 思考香港 (2022) and GovHK (2022e).

²⁹ See Liberal Democratic Party (2022).

³⁰ For instance, Japan had been a front runner in the global virtual asset market and was among the first to regulate cryptocurrencies with enhanced investor protection and regulation clarity. The latter included introducing a registration system for crypto asset exchange service providers in 2017 and requiring them to keep at least 95% of customers' crypto assets in cold wallets (i.e. offline environments) to prevent hacking and fraudulent activities. See Financial Services Agency Japan (2022).

³¹ See Črešnar and Nedelko (2017).

ruling party, the Liberal Democratic Party, has formed a special project team³² under its Headquarters for the Promotion of a Digital Society to research on the development of the Web 3.0 technologies as a growth strategy for Japan. In April 2022, the project team published the White Paper on Japan’s NFT Strategy for the Web 3.0 Era, outlining suggestions to revamp policy and legal frameworks to accommodate the evolving Web 3.0 economy. The key recommendations include³³:

- (a) **high-level policy steer**: the White Paper proposes appointing a minister in charge of Web 3.0 and establishing a cross-ministry organization in the government to facilitate policy coordination and implementation of a national strategy on Web 3.0 development;
- (b) **NFT education for industry**: while Japan has a wealth of IP content in games and animation, some content holders remain hesitant to enter the NFT market because they are unclear about their rights as NFT holders. The White Paper recommends creating a common template of the licence terms and setting up consultation desks and information sessions to address enquiries and concerns about NFT ownership and IP rights;
- (c) **legal status of DAOs**: recognizing DAOs as a new form of governance in the Web 3.0 ecosystem, the White Paper urges the government to clarify the legal status of DAOs, as well as rights and obligations for its participants under the Japanese law. It further proposes allowing the legal incorporation of DAOs in Japan, citing the example of the United States (“US”) where some states like Wyoming have permitted DAOs to incorporate as a distinct type of limited liability companies since 2021³⁴; and

³² Established in January 2022, the project team initially focused on NFTs but was reorganized in October 2022 to become the Web3 Project Team under the Digital Society Promotion Council (a government body charged with promoting the formation of a digital society).

³³ See Liberal Democratic Party (2022).

³⁴ Wyoming was the first US state to pass legislation granting DAOs legal personality and conferring a wide range of rights, including limited liability for members. The law also imposes additional requirements on DAOs. For example, a DAO must have a registered agent in Wyoming and its registered name must include words like “DAO LLC” to denote its status. See State of Wyoming Legislature (2021).

- (d) **talent attraction:** amid a global competition for Web 3.0 talent, the White Paper encourages the issuance of special crypto visas to attract top talent with knowledge and skills in Web 3.0 technologies to settle in Japan. It also suggests tax reforms that would entice Web 3.0 businesses and investors, including lowering the tax rate on gains from crypto asset transactions.³⁵

4.3 Moreover, Japan is among the first places to establish a **dedicated Web 3.0 Policy Office** with the mandate of improving the business climate for Web 3.0 development. The office, which was set up in July 2022 under the Ministry of Economy, Trade and Industry, aims to be a “cross-departmental internal organization” that brings together relevant government departments involved in Web 3.0 development, including those in charge of industrial finance, taxation, media content, sports and fashion.³⁶ As a start, the office is gathering information from stakeholders including business operators, investors and legal professionals regarding the challenges facing the business environment for Web 3.0. In addition to establishment of a dedicated policy office, Web 3.0-related legislation is expected to be introduced to the Diet (Japan’s parliament) over the course of 2023, focusing on, among other things, tax reforms for crypto assets and the legal status of DAOs.³⁷ As to the latter, the government has reportedly set up its own DAO to study its real-life operations and roles in the Web 3.0 ecosystem, so as to inform policymakers on the benefits and challenges of granting legal status to DAOs.³⁸

³⁵ Under Japan’s income tax law, profits from crypto asset transactions can be taxed at rates up to 55%. The White Paper recommends reducing the relevant tax rate to 20%. Whereas in Hong Kong, capital gains from crypto asset trading are generally tax-free for investors holding these assets for long-term investment. Yet if a business is considered to be carried on, such as by trading, exchanging or mining of crypto assets, its locally sourced profits from relevant activities are subject to a 16.5% profits tax rate.

³⁶ See Ministry of Economy, Trade and Industry (2022).

³⁷ See Morrison Foerster (2023).

³⁸ See CoinGeek (2022).

Exploring applications of blockchain technology and/or asset tokenization

Singapore – financial services-related applications

4.4 As a regional and international financial centre, **Singapore** seeks to promote an “innovative and responsible” **digital asset ecosystem**³⁹ centred upon innovation for the financial services sector rather than speculative activities.⁴⁰ In particular, Singapore has put much emphasis on leveraging the transformative potential of DLT and asset tokenization by pledging support for innovation in pertinent use cases:

DLT

- (a) on exploring the potential of using DLT on **cross-border payment and settlement**, a commercial joint venture (“JV”) between the Singaporean sovereign wealth fund, Temasek, and two commercial banks has used a wholesale multi-currency clearing and settlement platform powered by DLT to reduce settlement times for Singapore Dollar and US Dollar transactions from days to just minutes⁴¹;

Asset tokenization

- (b) another JV between Temasek and the Singapore Exchange explored the use of tokenized assets in the **capital market** with a view to expediting the clearing and settlement of securities transactions. A blockchain-based platform for bond issuance was created as a result, enabling the digitalization of manual processes and the full elimination of paper trails, with settlement times for new bond issuance decreasing by 60% to two days,⁴² and

³⁹ Singapore defines a digital asset as “anything of value whose ownership is represented in a digital or computerized form”. Based on this definition, financial assets (e.g. cash and bonds) and real assets (e.g. property) can potentially be tokenized into digital assets. See Monetary Authority of Singapore (2022d).

⁴⁰ Singapore has been tightening rules around crypto assets, including limiting retail access and clamping on marketing high-risk products to the public. In October 2022, the Monetary Authority of Singapore issued two consultation papers, proposing to (a) restrict retail investors from using credit facilities and leverage to purchase cryptocurrencies; and (b) require them to complete a risk awareness assessment before they can participate in trading. It also plans to regulate the issuance of single currency-pegged stablecoins exceeding S\$5 million (HK\$29 million) worth in circulation.

⁴¹ See Monetary Authority of Singapore (2022d).

⁴² See Singapore Exchange Group (2022).

- (c) the Monetary Authority of Singapore (“MAS”)’s Project Guardian, launched in May 2022, is spearheading the use case assessment of **tokenized financial and real economy assets** as well. Project Guardian is a collaborative initiative between MAS, traditional financial institutions and/or fintech companies to test the feasibility of applications in four major areas, viz. (a) using public blockchains to build open, interoperable networks for trading digital assets across platforms and liquidity pools; (b) using independent trust anchors for verifying credentials of participants⁴³; (c) promoting asset tokenization; and (d) establishing regulatory safeguards within DeFi protocols to counteract market manipulation.⁴⁴

4.5 For Project Guardian more specifically, its first industry pilot project, which studies the potential DeFi applications in wholesale funding markets, completed its first live trades in November 2022. The pilot saw a live cross-currency transaction involving tokenized Japanese Yen and Singapore Dollar deposits as well as trading of tokenized government bonds. This demonstrated Singapore’s capacity of instant and direct clearing and settlement among participants, while achieving lower execution costs.⁴⁵ Leveraging this experience, MAS is introducing two new industry pilots to expand the use of tokenized assets in sectors including trade finance and wealth management.⁴⁶

The UAE – government services and other applications

4.6 The UAE has taken active steps to explore the application of the technology on a broader front. The related activities include (a) implementation of blockchain technology in applicable government services; (b) supporting the creation of a blockchain industry through providing an enabling ecosystem that empowers start-ups and businesses; and (c) establishing international leadership in blockchain. The UAE’s adoption of blockchain is guided by the Emirates

⁴³ Trust anchors are regulated financial institutions for screening and issuing verifiable credentials to entities that wish to participate in DeFi protocols. This ensures that participants trade only with verified counterparties, issuers and protocol developers. See Monetary Authority of Singapore (2022b, 2022c).

⁴⁴ DeFi protocols are codes, procedures, and rules that govern how digital assets are used on a blockchain network. See Monetary Authority of Singapore (2022b, 2022c).

⁴⁵ See Monetary Authority of Singapore (2022a).

⁴⁶ One of the pilots explores the issuance of tokens linked to trade finance assets, while the other one enables native digital issuance of wealth management products.

Blockchain Strategy launched at the national level in 2018⁴⁷, while the Dubai emirate is also leading the way with its Blockchain Strategy released in 2016.⁴⁸

4.7 Since the launch of national and emirate-level blockchain strategies, some 200 project initiatives involving over 40 government entities and 120 companies have sprouted up in the UAE.⁴⁹ For instance, the UAE's Ministry of Health and Prevention has partnered with a local healthtech company to introduce a blockchain-based platform since 2019 to improve organ matching and verify donated organs, with the goal of curbing illicit organ trading. This platform is estimated to save the government over US\$20 million (HK\$157 million) in dialysis costs per year.⁵⁰ Another initiative is the launch of a blockchain-powered system by Dubai Roads and Transport Authority to track vehicles' lifecycle (e.g. sale and accident history) in order to promote transparency and prevent disputes in vehicle transactions.⁵¹ To speed up e-commerce clearance, Dubai Customs has also built a platform supported by blockchain technology to automate customs declaration and duty exemption requests upon return of goods. DHL and other major e-commerce players were reportedly users of this platform.⁵²

4.8 Nurturing and attracting Web 3.0-related start-ups is another key strategy of the UAE. To help identify promising use cases for blockchain technology, the Dubai government organized a **global blockchain challenge** and invited 20 blockchain start-ups each year between 2017 and 2019 to showcase their innovative solutions. Winners would receive cash prizes, access to venture capital and the chance to work with potential government partners.⁵³ **Incubator hubs** are also playing a crucial role in blockchain development in the UAE. A notable example is the establishment of the Crypto Centre by the Dubai Multi Commodities Centre, one of the UAE's largest free zones offering tax and

⁴⁷ The Emirates Blockchain Strategy includes four pillars, focusing on residence happiness, government efficiency, advanced legislation, and global entrepreneurship. It also sets an ambitious target of transforming 50% of government transactions into the blockchain platform by 2021. See Government of UAE (2023a).

⁴⁸ Dubai is the most populous of the seven emirates in the UAE. Its government has embarked upon a mission to become a global hub for Web 3.0 and metaverse development, and has developed its Blockchain Strategy based on three pillars: government efficiency, industry creation and international leadership.

⁴⁹ See World Economic Forum (2020).

⁵⁰ See *ibid.*

⁵¹ See Government of UAE (2023a).

⁵² See World Customs Organization (2020).

⁵³ The 2019 challenge alone saw over 700 applications from 79 countries. See Digital Dubai (2021).

other benefits for incoming businesses.⁵⁴ Inaugurated in May 2021, the Crypto Centre aims to become a hub for crypto and blockchain technologies. It offers co-working space and a variety of incubator and accelerator programmes, including access to a US\$150 million (HK\$1.2 billion) accelerator fund.⁵⁵ Through a partnership with the Switzerland-based CV Labs⁵⁶, it also provides members with advisory services, networking events, and blockchain and entrepreneurship training. As at January 2023, the Crypto Centre was home to more than 500 members, making it the largest concentration of crypto and blockchain companies in the Middle East region.⁵⁷ Other UAE free zones are catching up, with the Abu Dhabi Global Market⁵⁸ recently announcing a US\$2 billion (HK\$15.7 billion) funding initiative to nurture blockchain and Web 3.0 start-ups through various support programmes and access to investment partners.⁵⁹

Facilitating the development of metaverse technologies

4.9 In addition to encouraging blockchain development, several selected places are ramping up investment to pioneer the development of metaverse, a market estimated to value up to US\$5 trillion (HK\$39 trillion) globally by 2030.⁶⁰ Both the UAE and South Korea have joined the rank of early movers to articulate comprehensive metaverse strategies and leverage relevant technologies to enable the delivery of public services in the metaverse. Meanwhile, Singapore has yet to officially unveil a government strategy to guide the development of metaverse, but the city-state is proactively trialling the use of metaverse technologies in the tourism sector.

The UAE

4.10 Launched in July 2022, Dubai's metaverse strategy aims to turn the emirate into one of the world's top 10 metaverse economies. It envisages that the metaverse sector would add US\$4 billion (HK\$31 billion) to Dubai's economic growth by 2030, besides supporting some 40 000 jobs to become

⁵⁴ There are more than 40 free zones across the UAE, each focused on specific sectors/industries and providing foreign investors with a range of benefits from personal and corporate tax exemptions to setting up companies with 100% foreign ownership.

⁵⁵ See Dubai Multi Commodities Centre (2022).

⁵⁶ CV Labs is the entity behind the Switzerland government's Crypto Valley project, which has given rise to blockchain unicorns such as Ethereum and Cardano. See Dubai Multi Commodities Centre (2021).

⁵⁷ See Dubai Multi Commodities Centre (2023).

⁵⁸ It is a free zone and an international financial centre located in the UAE.

⁵⁹ More details are expected to be announced in due course. See Abu Dhabi Global Market (2023).

⁶⁰ See McKinsey & Company (2023).

virtual and improving the productivity of professionals including surgeons and engineers through the use of metaverse technologies.⁶¹ In particular, its strategy focuses on⁶²:

- (a) **fostering innovation** through research and development collaborations, and utilizing accelerators and incubators to attract metaverse companies and projects to Dubai;
- (b) **cultivating talents** by investing in metaverse education aimed at developers, content creators and users; and
- (c) **developing Web 3.0 technologies** and their applications to create new government work models in vital sectors such as tourism, education, retail, legal, healthcare, etc.

4.11 Furthermore, Dubai’s Virtual Assets Regulatory Authority (“VARA”)⁶³ became the world’s first regulator to enter the metaverse in May 2022, when it purchased land in the virtual world of The Sandbox to set up a metaverse headquarters. The move, as described by the regulator, represents a step towards making itself “accessible to its industry in their environment”.⁶⁴ According to VARA, the metaverse headquarters would serve as a channel for engaging potential licensees to start applications and providing other stakeholders with access to its regulatory resources.⁶⁵

4.12 While Dubai has led metaverse development in the UAE, other UAE government agencies that have also established their presence in the metaverse include: (a) the Ministry of Economy, which has announced plans to open a metaverse office to complement its physical offices, offering 24-hour customer service and virtual venues for holding events and signing agreements⁶⁶; and (b) the Emirates Health Services, which is starting to deploy three-dimensional (“3D”) VR technology to improve the delivery of virtual consultation and remote healthcare solutions.⁶⁷

⁶¹ See Government of Dubai Media Office (2022b).

⁶² See Government of UAE (2023b).

⁶³ VARA, established by virtue of the Dubai Law No. 4 of 2022, is the entity in charge of regulating, supervising and overseeing virtual assets and relevant service providers across the emirate of Dubai (excluding the Dubai International Financial Centre).

⁶⁴ See Government of Dubai Media Office (2022a).

⁶⁵ See *ibid.*

⁶⁶ See Dubai Future Foundation (2022).

⁶⁷ Patients can use their personal devices with a camera and microphone to access such services, without the need for VR headsets. See Emirates Health Services (2022).

South Korea

4.13 It is believed that innovation in the metaverse space can complement South Korea's booming cultural and entertainment industry. The Ministry of Science and Information & Communications Technology announced a government strategy on metaverse in early 2022, as part of the government's Digital New Deal 2.0 initiative to speed up post-pandemic economic recovery through digital transformation. The strategy, which has a budget of KRW223.7 billion (HK\$1.3 billion), contains the following key measures⁶⁸:

- (a) **activating the metaverse ecosystem** through investments in metaverse projects related to education, manufacturing and health, among others;
- (b) **establishing a metaverse academy** to train young developers and creators, as well as hosting developer competitions and hackathons to discover metaverse talents;
- (c) **nurturing metaverse companies** by providing small industry players and start-ups with access to testing and demonstration facilities, and supporting the commercialization of AR/VR and other immersive technologies; and
- (d) **creating a safe environment for metaverse users**, especially by forming a government-wide metaverse committee to examine legal issues such as data privacy and IP protection, and to determine regulation procedures for unlawful activities in the metaverse.

4.14 On the city-level, the Seoul government has achieved some progress in its "Metaverse Seoul" project. The KRW3.9 billion (HK\$23 million) project, which was officially launched in January 2023, would be carried out in stages to create a digital twin of the South Korean capital. The current stage focuses on improving the delivery of public services, including complaint filing, tax counselling, youth mentoring and supporting struggling businesses, through a public metaverse platform.⁶⁹ Later stages of the project will broaden the scope of available public services and integrate AR/VR to manage the city's infrastructure, with completion scheduled for 2026.⁷⁰ This project has reportedly elicited mixed reactions, with the TIME Magazine naming it one of

⁶⁸ See Ministry of Science and Information & Communications Technology (2022a, 2022b).

⁶⁹ In addition, users can stroll around the virtual city with their own avatars to explore cultural attractions in the comfort of their homes. See Government of Seoul (2023).

⁷⁰ See *ibid* and Forkast (2023).

the best inventions of 2022, and others raising concerns about its cost and accessibility for senior citizens.⁷¹

Singapore

4.15 The Singapore Tourism Board has been assisting **industry players** in using metaverse technologies to enhance tourism offerings, especially in the face of pandemic disruptions. These initiatives include: (a) making available some 100 3D models of Singapore’s iconic attractions to tourism businesses for free so that they can develop their own AR, VR or other extended reality projects to create immersive content for visitors;⁷² and (b) engaging in proof-of-concept projects, such as building an AR app for an aquarium with which visitors can interact with marine creatures digitally; as well as partnering with a hotel group on a campaign for participants to explore Singapore’s streets in the metaverse and win prizes (e.g. hotel and dining vouchers) for use in physical venues.⁷³ Furthermore, Singapore is integrating metaverse technologies into several **national tourism projects and events**. For instance, its key tourist attraction – Gardens by the Bay – offers immersive metaverse experiences including a digital replica of the Gardens and a concert performed by an avatar of a Singapore artiste in the metaverse.⁷⁴ The 2022 Singapore Grand Prix, which attracted some 250 000 spectators, utilized 3D AR race simulators to let the audience experience what it would be like to be in a Formula One driver’s seat.⁷⁵

5. Concluding remarks

5.1 Web 3.0, often dubbed the decentralized web, represents a shift away from the primarily centralized and intermediated models, thereby offering users greater autonomy and control over their digital lives. Technologies at the heart of Web 3.0 include, first and foremost, DLT/blockchain technology, which serves as the building block for a myriad of Web 3.0 technologies and applications ranging from virtual assets (e.g. cryptocurrencies) to NFTs, DeFi and smart contracts. In Hong Kong, the Government has announced various initiatives to support the development of a Web 3.0 ecosystem, hitherto focusing on the virtual asset market and other financial services-related applications. There are concerns over the progress of developing other Web 3.0 technology domains and hence Hong Kong’s competitiveness vis-à-vis its Asian and Gulf counterparts, as

⁷¹ See The Korea Times (2023) and TIME (2022).

⁷² See Singapore Tourism Board (2022a).

⁷³ See *ibid* and Singapore Tourism Board (2022b).

⁷⁴ See Gardens by the Bay (2022).

⁷⁵ See Singapore Tourism Board (2023).

the latter are harnessing their own strengths to develop Web 3.0 and explore its potential on a wider variety of application scenarios.

5.2 In a bid to reinforce its position as a global innovation powerhouse, **Japan** is formulating a holistic policy to support Web 3.0 development on multiple fronts. This include adapting its policy and legal framework to cater for Web 3.0 technologies such as NFTs and the rise of DAOs as a new corporate structure. While relevant legislation is still pending, Japan has kickstarted reforms by setting up a dedicated Web 3.0 office to facilitate policy coordination across government departments.

5.3 Other places, meanwhile, concentrate on developing one or more specific domains of Web 3.0 based on their competitive edge and policy goals. While **Singapore** is exploring DLT/blockchain technology applications in the financial sector, the **UAE** focuses on blockchain initiatives for enhancing government efficiency, industry creation and international leadership in the Web 3.0 space. **South Korea** and the **Dubai emirate in the UAE** are also among the first wave of governments to formulate a strategy for developing immersive metaverse technologies.

5.4 Most of the aforementioned policy initiatives unveiled by the places studied are still in their planning or nascent implementation stages, and it may take time to ascertain their outcome and effectiveness. Nevertheless, Hong Kong can draw on the experience of these early movers as policy guides when it gears up for the development of Web 3.0 technologies/applications.

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14 June 2023
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Web 3.0 development on the Mainland and in the United States

A1.1 The central and local governments have proactively shaped the development of Web 3.0 technologies on **the Mainland**. While cryptocurrency trading has officially been banned due to concerns over market volatility and illegal financial activities, the central government has continued its support for the development of other Web 3.0 technology domains. The State Council, in its 14th Five-Year Plan released in 2021, highlighted blockchain as one of the major areas of development for the country's digital economy.⁽¹⁾ Some local governments have also rolled out plans to accelerate metaverse development. Notably, the Shanghai municipal government issued a policy paper in 2022 outlining its strategy to cultivate a metaverse industry worth RMB350 billion (HK\$386 billion) by 2025. It seeks to foster 10 leading metaverse companies and develop applications in fields such as education and smart manufacturing, through the setting up of metaverse industrial parks and a dedicated industry fund to support the sector's development.⁽²⁾

A1.2 In comparison, the **United States** ("US") has allowed the market to take the lead as the principal driver of Web 3.0 development. That said, the US President Joe Biden signed an Executive Order in March 2022 to support the responsible development of Web 3.0 technologies like digital assets and cryptocurrencies. The Order, which the White House referred to as the "first whole-of-government strategy" on digital assets, has stressed the need to strike a balance between strengthening consumer protection against financial risks, while fostering innovation and the US leadership in the digital asset space.⁽³⁾ To achieve the latter, the government has pledged to support fundamental research on next-generation cryptography and responsible digital asset use, apart from providing technology firms with regulatory guidance, best-practices sharing and technical assistance through initiatives like Tech Sprints.⁽⁴⁾ As at 2022, the US was home to nearly half of the world's 100 most valuable fintech companies, many of which were involved in digital asset services.⁽⁵⁾

(1) See 中華人民共和國政府 (2021).

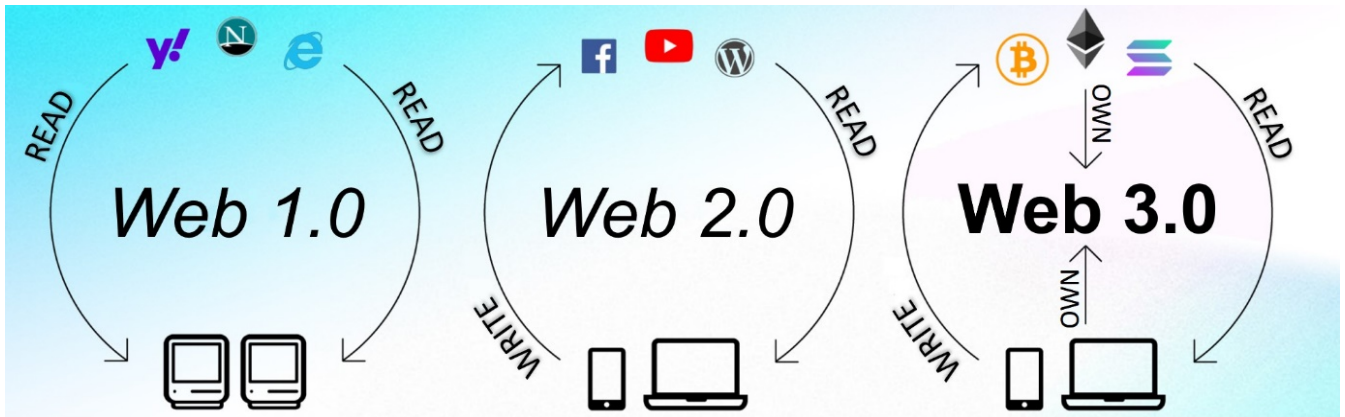
(2) See Shanghai Municipal People's Government (2022).

(3) See White House (2022a).

(4) It is a hackathon for developing innovation solutions to financial regulation (e.g. AML/CTF) challenges. See White House (2022b).

(5) See *ibid.*

Evolution of the World Wide Web



Web 1.0: read-only web

- In the mid-1990s, the proliferation of web browsers marked the **beginning** of the first-generation Internet.
- At that time, the Internet mainly consisted of static webpages for viewing information with little user interaction.

Web 2.0: read-write web

- Developed over last two decades or so, Web 2.0 describes the **current version** of the Internet where users can interact with one another and become active content creators rather than just viewers.
- This pivot towards a more interactive and social web has brought with it the advent of centralized platforms controlled by social media and digital behemoths⁽¹⁾, raising public concerns about data privacy and ownership.

Web 3.0: read-write-own web

- Gavin Wood, co-founder of blockchain-based platform Ethereum, first **coined the term Web 3.0 in 2014** to describe his vision for a decentralized and user-centric web.
- Web 3.0 began to gain momentum in **2021**, fuelled by the maturity of blockchain technology, venture capitalist investment and rising calls to curb the influence of big technology companies.⁽²⁾

Sources: Andreessen Horowitz (2022), Ejeke (2023) and Grant (2023).

⁽¹⁾ Some prominent examples are Google, Meta, Twitter and YouTube.

⁽²⁾ See World Economic Forum (2022).

Selected Web 3.0 technologies and applications

Blockchain and distributed ledger technology

A3.1 Blockchain is a type of distributed ledger technology (“DLT”) for recording transactions. In a traditional ledger, transactions between parties are stored in a centralized server such as the database of a bank. With DLT, transaction data are distributed and stored across a vast network of computers, making them more secure and difficult to hack or tamper with. By creating an unalterable and transparent record of transactions⁽¹⁾, blockchain and DLT have many applications, ranging from financial transactions to supply chain management and storage of medical data. They also form the backbone of cryptocurrencies, NFTs and other Web 3.0 technologies.⁽²⁾

Asset tokenization

A3.2 Asset tokenization is a use case of blockchain technology that is gaining traction. In short, it is the process of converting digital or real-world assets into digital tokens that can be traded. Proponents argue that asset tokenization has transformative potential in the financial market and real economy.⁽³⁾ One argument is that it does away with intermediaries (e.g. brokers and clearing houses), while allowing fractional ownership of some assets to be divided into smaller parts and sold to a broader range of investors. This makes it easier for people to invest in assets that were previously out of reach, such as real estate, securities and commodities. For example, turning real estate assets into digital tokens allow small investors to own a slice of a property and earn a proportional share of the rental income. One common way to classify digital tokens is whether they are fungible or not (**Figure A1**).

(1) If an entry has a mistake, a new entry must be made to fix it, and both entries will show up in the ledger because of this.

(2) See Ragnedda and Destefanis (2020) and Voshmgir (2020).

(3) See Monetary Authority of Singapore (2022d).

Figure A1 – Comparison of fungible tokens and NFTs

	Fungible tokens	NFTs
Uniqueness	<ul style="list-style-type: none"> • Every token is identical 	<ul style="list-style-type: none"> • Every token is unique
Interchangeability	<ul style="list-style-type: none"> • Can be exchanged for other tokens of the same type 	<ul style="list-style-type: none"> • Cannot be exchanged for other tokens of the same type
Divisibility	<ul style="list-style-type: none"> • Can be divided into smaller units 	<ul style="list-style-type: none"> • Cannot be divided into smaller units
Examples	<ul style="list-style-type: none"> • Cryptocurrencies (e.g. Bitcoin and stablecoin) 	<ul style="list-style-type: none"> • Rare collectibles and certificates

Source: Blockchain Simplified (2020).

A3.3 A fungible token is a type of virtual asset⁽⁴⁾ which is “fungible” in the sense that each token has the same value and can be exchanged for other tokens of the same type. **Cryptocurrencies** (e.g. Bitcoin and Ether) are prominent examples of fungible virtual assets.⁽⁵⁾ They operate independently of a central authority and use blockchain technology and encryption to secure transactions. Meanwhile, **stablecoin** – a cryptocurrency whose value is pegged to an underlying asset such as the US Dollar – aims to give the benefits of cryptocurrencies while offering investors a haven from market volatility. Yet the collapse of high-profile cryptocurrency players in 2022 has undermined investor confidence and sent shockwaves across the cryptocurrency market.⁽⁶⁾

A3.4 NFTs are not fungible in the sense that each token is unique and cannot be swapped for other tokens of the same type. Nevertheless, they can be traded and exchanged for money and cryptocurrencies. Since each NFT is uniquely identifiable on the blockchain, it offers a new way for content creators to prove authenticity and ownership of digital/IP assets like artwork, music, videos and other rare collectibles, and sell them as one-of-a-kind items. While NFTs have become popular in the art and gaming industries, they can also be used to represent individuals’ identities and certificates, such as school transcripts, software licences, event tickets, and many more.⁽⁷⁾

⁽⁴⁾ Virtual assets generally refer to digital representations of value that can be traded or transferred online, especially for payment and investment purposes. See Financial Action Task Force (2021).

⁽⁵⁾ As at November 2022, Bitcoin and Ether together accounted for nearly 60% of crypto market capitalization, while there were nearly 10 000 active cryptocurrencies globally. See Hong Kong Exchanges and Clearing Market (2023).

⁽⁶⁾ Notable examples were the demise of leading cryptocurrency exchange FTX and the crash of TerraUSD, one of the largest stablecoins by market capitalization.

⁽⁷⁾ See Voshmgir (2020).

Decentralized finance (“DeFi”)

A3.5 DeFi is a technology that enables financial activities such as borrowing, lending, securities trading and insurance policies to take place beyond the bounds of traditional institutions like banks, insurers, brokerages and stock exchanges. DeFi makes use of **smart contracts**, which are blockchain-based computer programmes that automatically execute the terms of a contract when predetermined conditions are met.⁽⁸⁾ A smart contract allows for automatic execution of transactions and transfer of assets without the use of intermediaries, thereby saving time, reducing transaction costs and lowering the risk of errors by third parties. Collateralized lending is one of the fastest growing DeFi applications⁽⁹⁾, followed by decentralized exchanges and applications offering derivatives, asset management, and insurance.⁽¹⁰⁾ DeFi advocates claim that it can potentially disrupt the financial sector by making services more accessible to anyone with an Internet connection. Yet critics are wary that the lack of clarity around DeFi regulation, coupled with inadequate consumer protection, may encourage fraudulent activity.⁽¹¹⁾

Decentralized autonomous organizations (“DAOs”)

A3.6 DAOs represent a new form of corporate governance in the Web 3.0 era. They are community-led entities that lack of the kind of hierarchical structure prevalent in traditional companies (**Figure A2**). Anyone can join a DAO by buying digital tokens, which give them the right to vote on decisions like how to allocate funds, who to hire, and what project to pursue. When a decision is approved by members, it is executed automatically by smart contracts. Since all decisions and transactions are recorded on the blockchain, they cannot be easily altered or manipulated. Owing to its highly automated and decentralized nature, DAOs are perceived by some as an avenue for developing organizations that are less susceptible to bureaucracy and corruption.⁽¹²⁾ DAOs have reportedly been used to support various causes in the Web 3.0 ecosystem, such as fundraising for DeFi projects, buying NFTs and investing in start-ups.⁽¹³⁾

⁽⁸⁾ For example, smart contracts can be created to automatically pay out insurance claims right after a flight cancellation. They can also be used to automate financial transactions such as (a) automatic transfer of funds to the supplier upon delivery of the goods to the customer; and (b) automatic payment to the home seller and transfer of property ownership to the homebuyer upon completion of a home inspection.

⁽⁹⁾ Holders of crypto assets can lend them to others and earn interest on the loan.

⁽¹⁰⁾ Collateralized lending accounted for 53% of the total value of cryptocurrency assets locked in DeFi applications as at June 2021, while decentralized exchanges accounted for 33%. See Organisation for Economic Co-operation and Development (2022).

⁽¹¹⁾ See MIT Sloan School of Management (2022).

⁽¹²⁾ See Cointelegraph (2023a).

⁽¹³⁾ See TechTarget (2023) and Cointelegraph (2023b).

Yet establishing a DAO is not without challenges. An issue worthy of note is that many jurisdictions have yet to recognize DAOs as legal entities, which may create uncertainty around liability and lead to tax and other legal issues.⁽¹⁴⁾

Figure A2 – Key features of DAOs versus traditional companies

	DAOs	Traditional companies
Structure	<ul style="list-style-type: none"> Usually flat 	<ul style="list-style-type: none"> Usually hierarchical, top-down
Governance	<ul style="list-style-type: none"> Community-led 	<ul style="list-style-type: none"> Governed by a board of directors and executives
Voting	<ul style="list-style-type: none"> Voting by members required for making any changes to the protocol 	<ul style="list-style-type: none"> Depending on the company’s structure, and a sole party can implement changes
Transparency	<ul style="list-style-type: none"> Activities are more transparent to the public 	<ul style="list-style-type: none"> Mostly private with limited public involvement
Handling of services	<ul style="list-style-type: none"> Automated and handled in a decentralized manner 	<ul style="list-style-type: none"> Requiring human handling or centrally controlled automation

Sources: Cointelegraph (2023b) and Medium (2021).

Metaverse technologies

A3.7 Metaverse technologies are considered by some as core features of Web 3.0.⁽¹⁵⁾ The metaverse is often described as a fully immersive virtual world, enabled by technologies like extended reality which encompasses virtual, augmented and mixed realities (“VR”, “AR” and “MR”).⁽¹⁶⁾ By visiting the “digital twin” – a virtual replica of real-world locations and objects – users can interact with one another and participate in virtual events and activities in real-time. Some envisage that in later stages of development, some Web 3.0 technologies such as cryptocurrencies and NFTs would be more widely used to facilitate transactions in the metaverse.⁽¹⁷⁾ Although the metaverse is still in its infancy and beset by challenges (e.g. motion sickness from prolonged use of VR headsets), its global market value is expected to grow more than 15 times to US\$5 trillion (HK\$39 trillion) by 2030⁽¹⁸⁾, owing to its broad applications across sectors such as retail, entertainment, tourism, culture and public services.

⁽¹⁴⁾ See TechTarget (2023) and Cointelegraph (2023b).

⁽¹⁵⁾ See Blockchain Council (undated).

⁽¹⁶⁾ VR refers to a fully-immersive **digital** environment, whereas AR gives a view of the **physical world** with an overlay of digital elements. MR takes AR a step further by enabling users to **interact** with virtual objects and information. See Interactive Design Foundation (2023).

⁽¹⁷⁾ See European Parliamentary Research Service (2022).

⁽¹⁸⁾ See McKinsey & Company (2023).

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