# BRIDGING BLOCKCHAIN AND IP: A SINGAPORE PERSPECTIVE

IPOS
INTELLECTUAL PROPERTY
OFFICE OF SINGAPORE

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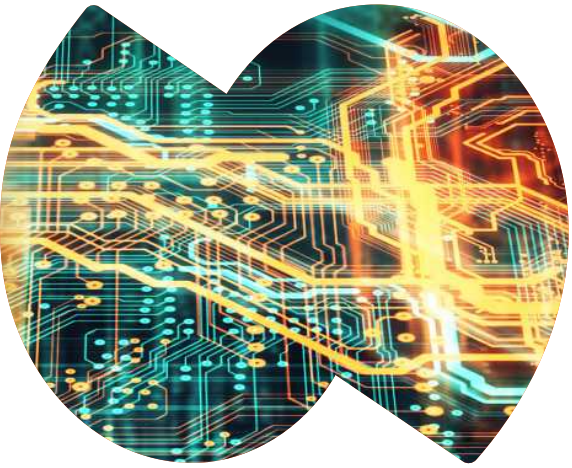


# Foreword

Frontier technologies have the power to shape commerce, society, and our daily lives in tremendous ways. Innovative economies must carefully examine these cutting-edge technologies, to harness their true potential for the advancement of society.

Blockchain, a form of distributed ledger technology, is one of these frontier technologies. The rapid growth of blockchain technology is evident from developments in Singapore and worldwide, particularly from the increase in relevant patent filings. We believe that blockchain technology will continue to play an important role for economic growth, in Singapore and globally.

This study brings together the perspectives of stakeholders from both the blockchain and IP communities, to shine light on opportunities for closer cooperation between them. While challenges exist, stakeholders are positive about the potential benefits that can be harnessed as we bridge both communities. The recommendations from this study serve to strengthen the nexus between the blockchain and IP ecosystems to realise the promise of blockchain technology.

This study is conducted in parallel with the Swiss Federal Institute of Intellectual Property (IPI), which has also published an independent country report. I would like to thank IPI for this excellent collaboration. I would also like to express my appreciation to all participants of the surveys, roundtable sessions, and engagements for sharing your insights and recommendations. These invaluable inputs contribute towards the findings and recommendations of this study, and will help us in our onward journey to unlock the value of blockchain technology.

**Mrs. Rena Lee**
Chief Executive
Intellectual Property Office of Singapore
*Singapore, November 2023*

# Executive Summary

Blockchain technology offers a trusted and immutable way of keeping records and transactions through a distributed network. Having been in the spotlight of frontier technology over the past decade, blockchain technology has garnered much investment interest and media attention. Many sectors have explored the relevance of blockchain technology to their industries, including the Intellectual Property (IP) sector.

At the global level, the World Intellectual Property Organization (WIPO), a specialised agency of the United Nations (UN), has examined the use of blockchain technology for the IP ecosystem. Similarly in the private sector, the International Trademark Association (INTA) has also deliberated the impact of blockchain sector on trademarks and brands. In Singapore, the Monetary Authority of Singapore (MAS) has launched a pilot, Project Guardian, to test the feasibility of applications in asset tokenisation and decentralised finance with partners from the financial industry (MAS, 2022). Against the backdrop of global interest in distributed ledger technology and its implications, the Intellectual Property Office of Singapore (IPOS) has embarked on a study to explore the implications of blockchain technology and its interactions with the IP ecosystem.

This study is conducted in parallel with the Swiss Federal Institute of Intellectual Property (IPI), which has also penned an independent country report. This Singapore report is an aggregation of our findings and reflections through desk research, engagements, surveys, and roundtable sessions. The analysis draws out key challenges and potential use cases of blockchain technology in IP, and outlines a set of recommendations for the IP community.

While sentiments on the potential of blockchain technology were generally positive, a key challenge identified in this study is the absence of a clear raison d'etre for the application of blockchain in the IP ecosystem. In other words, a breakthrough in practical functionality of blockchain for the IP industry is yet to be seen. Our study has identified a few areas where the application of blockchain might be promising for the IP sector, including a registry function for non-registrable IP (trade secret, copyright, etc.) and supporting the commercialisation of IP.

This report highlights two key steps to strengthen the nexus between the blockchain and IP sectors that may catalyse growth and enhance efficiency for our businesses. First, strengthening connectivity and awareness among IP and blockchain stakeholders. Second, developing interoperable blockchain infrastructure and standards.

We hope that the findings and reflections of this study will serve as a starting point for stronger collaborations between the IP and blockchain sectors. We would like to express our sincere gratitude to all partners and stakeholders who have participated in this study.

# Introduction

## Blockchain and its Current Footprint Globally

Frontier technologies typically have significant impact on the business environment, our societies and way of life. Used appropriately, they offer new methods of production or service outcomes, which can lead to productivity gains. Blockchain, a subset of Distributed Ledger Technology (DLT)[1], is an example of a frontier technology that has generated huge interest for its wide applications and impact to the global economy.

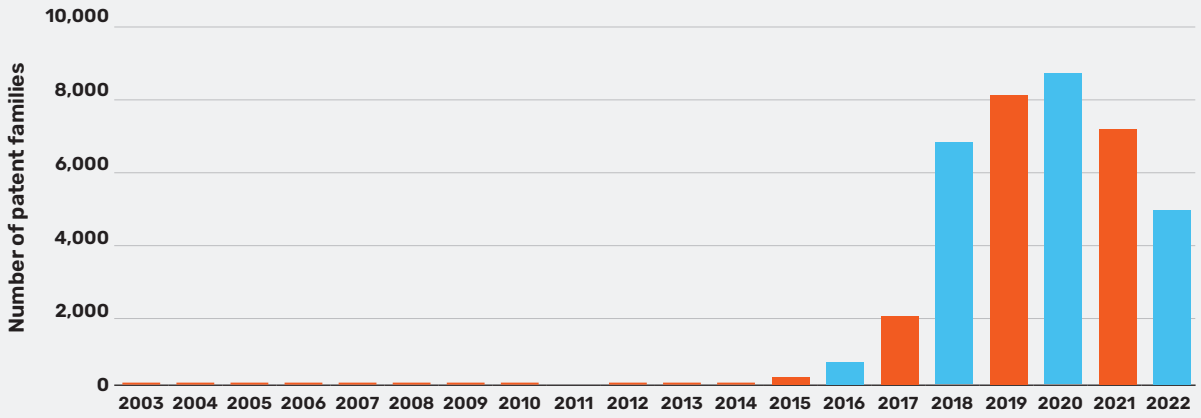
According to estimates by PricewaterhouseCoopers (PwC), blockchain technology has the potential to boost global Gross Domestic Product (GDP) by US$1.76 trillion, or 1.4% of global GDP, by 2030 (PwC, 2020). Similarly, McKinsey estimated that up to 10% of global GDP could be associated with blockchain-based transactions by 2027 (McKinsey, 2022). In Singapore, 45% of the respondents in a PwC survey expressed confidence that blockchain technology growth would accelerate over the next three to five years (OpenNodes et al, 2020).

The burgeoning interest in blockchain technology is also evident from patenting activities. In the last decade, over 37,400 blockchain patent families were filed globally[2]. The growth in blockchain patent applications has been rapid, increasing from close to 700 patent families in 2016 to almost 8,500 patent families in 2020 – a compounded annual growth rate of 86.8% (see **Figure 1**).

While the financial services industry appears to be the main leader in blockchain patent applications, blockchain technology is sector agnostic. Its applications may be found across diverse sectors, including food, consumer retail, trade, and security. A wide spectrum of industries,

**Figure 1**

**Global blockchain patent families by application year**




1 DLT is a wider range of technologies for which blockchain is a part of. While blockchain technology is the main emphasis of this study, we will use both terms interchangeably, for circumstances where the broader DLT is relevant.

2 Refer to Annex II for technical notes. A simple patent family is a collection of patent documents that are considered to cover a single invention. The technical content covered by the applications in one simple patent family is identical. Patent applications that are members of one simple patent family will have the same priorities. The application with the earliest application date within the simple patent family was referenced for analysis. Data for 2021 to 2022 is incomplete due to a lag in the publication of patents. The dip in this period reflects the lag rather than a declining trend in applications.

beyond financial services, have been recognised as the next emerging adopters of blockchain technology (see **Figure 2**). These include manufacturing, energy, healthcare, retail, and government services.

There is a wealth of information and analyses pertaining to global developments in blockchain technology, including that of the Singapore blockchain ecosystem. The broad applications and potential of blockchain technology have also captured the interest of the IP community. For instance, WIPO has published a whitepaper on *Blockchain technologies and IP ecosystems* to explore potential applications and opportunities presented by blockchain technology for the IP community (WIPO, 2022). Similarly, the European Union Intellectual Property Office (EUIPO) has also piloted an *IP Register in Blockchain* for trademarks and industrial designs (EUIPO, 2021). This report attempts to distil the key developments in blockchain and IP, and provide a stocktake of the current state of play.

The analysis focuses on the intersection of blockchain technology and IP, specifically in the context of potential opportunities for Singapore. It considers how Singapore may work with IP offices and partners to explore this intersection (see **Figure 3**), as we work towards the objectives of the Singapore IP Strategy (SIPS 2030). That is, for Singapore to serve as a global hub for Intangible Assets (IA) and IP activities and transactions.

**Figure 2**

**Industry sentiment on leaders in blockchain (PwC, 2018)**

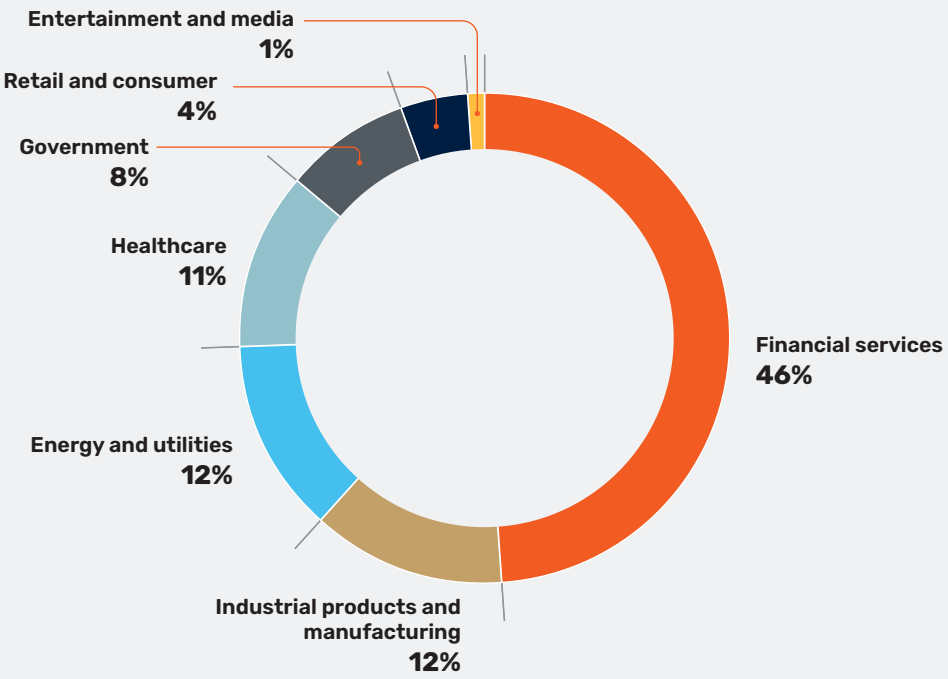
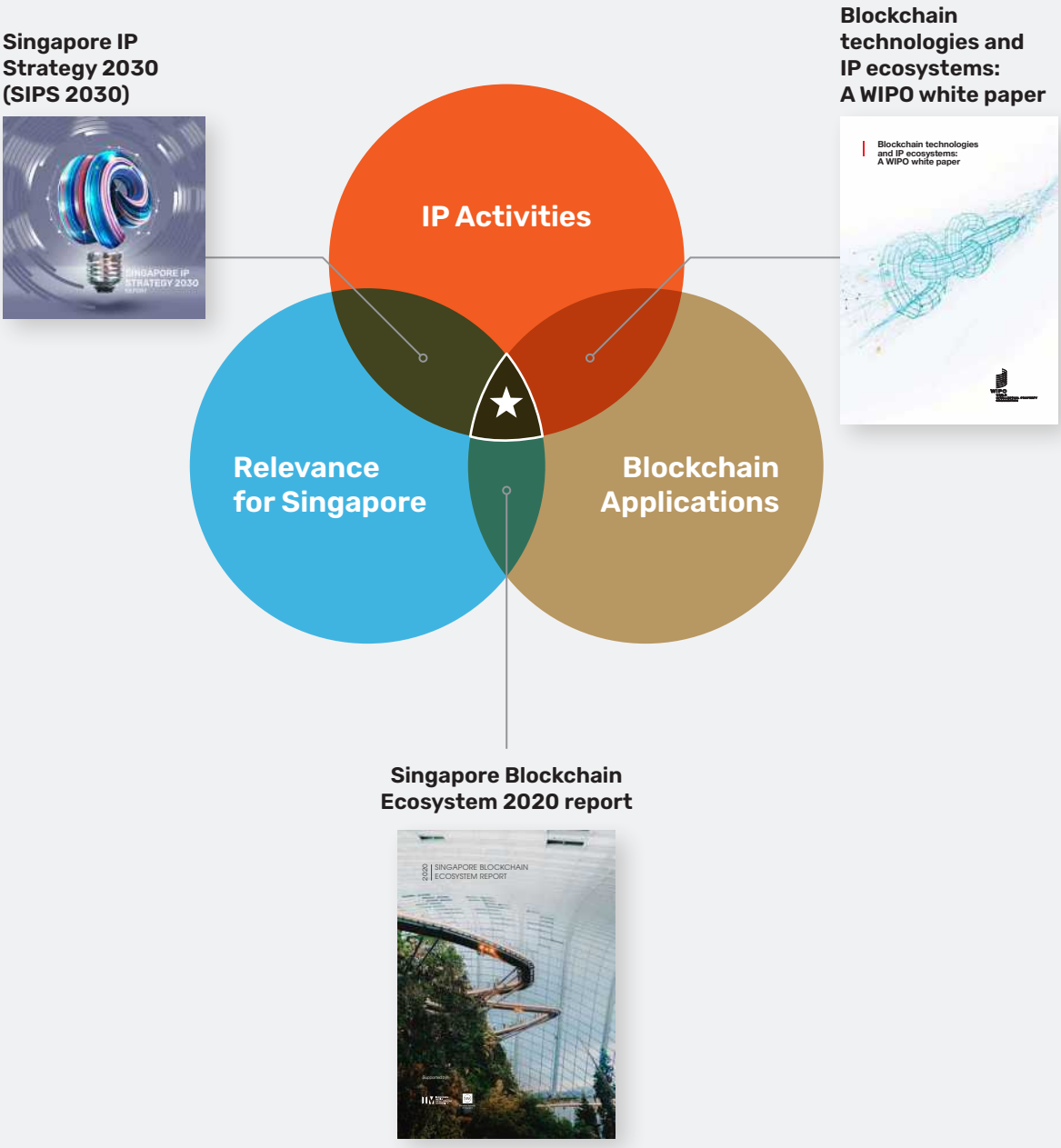


**Figure 3**

**Intersection between the IP community, blockchain ecosystem, and their relevance for Singapore**

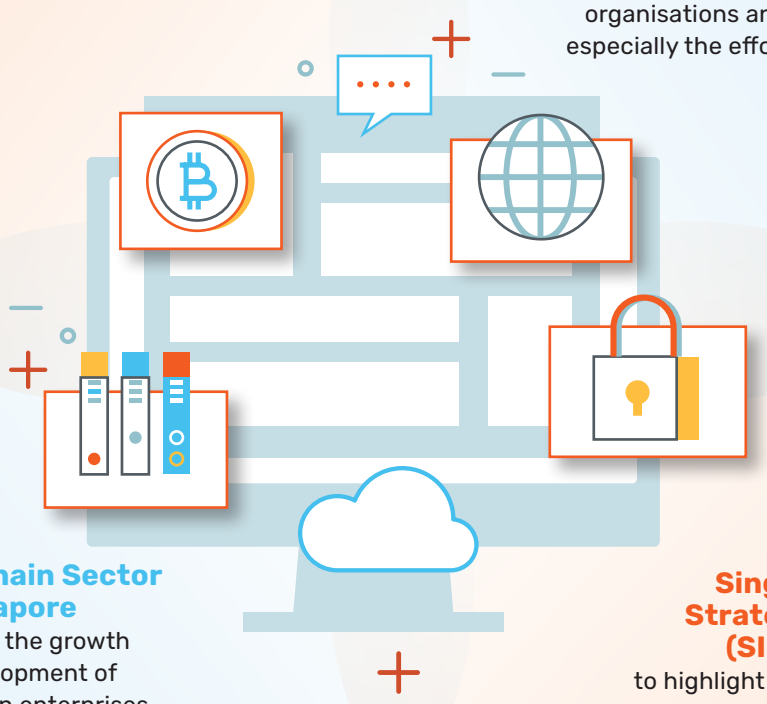


# Understanding the Current IP and Blockchain Ecosystem

This section provides a summary and background of the IP and blockchain ecosystems, and their interplay within the Singapore landscape. The following themes will be addressed:

**Blockchain 101**
to define blockchain and the key concepts surrounding blockchain technology.

**Global Developments in Blockchain and IP sectors**
to highlight the initiatives undertaken by international organisations and agencies, especially the efforts of WIPO.



**Blockchain Sector in Singapore**
to outline the growth and development of blockchain enterprises in Singapore, and the patent landscape.

**Singapore IP Strategy 2030 (SIPS 2030)**
to highlight Singapore's IP roadmap for the next decade, and the impact of frontier technologies such as blockchain on SIPS 2030.

## Blockchain 101

Blockchain technology is an electronic system that serves as a distributed ledger of information to record transactions between parties (Plansky, J. et al., 2016). This ledger can also be seen as a database that is stored cryptographically. A subset of DLT, blockchain enables the secure storage of information across many computers in a peer-to-peer network that is continuously expanding (WEF, 2018). The interlinkage of information ensures that records cannot be altered singularly at any point without changing the entire network. This immutability creates trust in blockchain technology because users can simultaneously access the information with no single point of failure. Further, third parties are not required to verify the records because this process is secured by cryptography. Blockchain hence reduces the need for intermediaries while fostering trust, transparency, and efficiency across organisations (PwC, 2020).

The discourse on blockchain technology is often linked to cryptocurrency. With the meltdown of the crypto ecosystem in recent years bringing upon an era of "crypto winters", overall adoption of blockchain technology has also slowed (Segal, 2023). For example, the Australian Securities Exchange cancelled plans for a blockchain-based system for clearing trades, despite a hefty cost of US$168 million (Kharif, 2023).

Closer to home, Singapore has been steadfast in supporting the blockchain ecosystem. The Monetary Authority of Singapore (MAS), has opted for an adaptive, continuously evolving, and consultative approach on matters relating to the crypto ecosystem (MAS, 2022), approaching new technology development holistically from not just the risks that they pose but also the uses they bring about (Menon, 2022). MAS has outlined its vision for the crypto market as one that enables high value assets to be fractionalised, unlocking new economic value, enhancing financial inclusion, and enabling more seamless and efficient financial services (MAS, 2022). This suggests that the emergence of blockchain technology, coupled with its applications beyond financial services, is not one to be ignored even with its associated risks.

In addition to the broad definition of blockchain, the following terms and concepts will be used throughout the report.

1. **Public and private blockchain.** A **public blockchain** network is completely decentralised, meaning there is no central authority or organisation that controls the network (Kwan, 2023); anyone can access and join the network. Notable examples include Bitcoin and Ethereum. In a **private blockchain**, only a cluster of organisations has access and authority over the network (Iredale, 2021), and there is some form of central authority or organisation controlling the network (Kwan, 2023). Many enterprise blockchains are private blockchains.

2. **Smart contract.** Smart contracts describe computer codes that automatically execute all or parts of an agreement and are stored on a blockchain-based platform (Levi and Lipton, 2018). They work by following simple "if/when…then…" statements that are coded into a blockchain (IBM, n.d.). Smart contracts are typically used to automate the execution of an agreement so that all participants can be immediately certain of the outcome, without the involvement of intermediaries and minimising time loss. Insurance claims have been one of the first use cases of smart contracts.

3. **Digital Asset.** A digital asset is anything of value whose ownership is represented in a digital or computerised form (MAS, 2022). It may manifest as a financial asset such as a bond, a real asset including a work of art, or something intangible like computing resources.

4. **Non-fungible tokens.** More commonly known as NFTs, these are typically unique digital assets on a blockchain which link or point to any type of digital assets, such as images, films or music (IPOS, 2023).

5. **Tokenisation.** Tokenisation involves the conversion of ownership rights over any assets (tangible or intangible) into a digital token. Assets that can be tokenised and traded include works of art, real estate, livestock, and loyalty points. Tokenisation makes it easier to fractionalise (break into smaller parts) an asset, and thereby increasing liquidity. On the blockchain, tokenisation facilitates secure and seamless asset trading without the need for intermediaries.

6. **Layers of blockchain.** Blockchain is commonly categorised by layers. **Layer 0** usually refers to the network architecture of blockchains, which is the bastion of reliable communication between two participants in a blockchain (Gudgeon et al.,

2020). **Layer 1** maintains the blockchain network's fundamental operations such as programming languages and consensus mechanisms (Yadav & Shevkar, 2021). Ethereum, Binance Smart Chain, and Bitcoin are famous examples of Layer 1 infrastructure. **Layer 2** is deployed upon Layer 1 to enhance blockchain's productivity. Lightning Network is an example of a Layer 2 blockchain built on the Bitcoin layer. **Layer 3** is the layer where participants interact with the user interfaces. Such decentralised applications include wallet providers like Coinbase and payment mechanisms like Tornado Cash (Blockchain Council, 2022).

## Global Developments on Blockchain and IP Sectors

In recent years, international bodies and agencies have undertaken considerable efforts to understand the blockchain sector. Examples include the World Economic Forum (WEF) paper on *Global Standards Mapping Initiative: An overview of blockchain technical standards* (WEF, 2020). The Joint Inspection Unit of the United Nations System (UNJIU) has published a report on *Blockchain applications in the United Nations system: towards a state of readiness* (Dumitriu, 2020). Specific to trade, the United Nations Conference on Trade and Development (UNCTAD) has also released a *Global Report on Blockchain and its Implications on Trade Facilitation Performance* (UNCTAD, 2023).

For the IP sector, the International Trademark Association (INTA) has published two white papers – one on trademarks in the metaverse and the other on NFTs. Championed by INTA's Emerging Issues Committee with contributions from more than 13 INTA committees, both papers are among the first to examine these new technologies from an IP perspective focusing on trademarks. The papers covered issues including the harmonisation of classification of trademarks in the metaverse, NFTs and blockchain (INTA, 2023), with blockchain being an enabling technology for metaverse and NFTs. These papers shed light on the interaction between IP and blockchain from both the legal and technical lens.

In 2022, a WIPO paper explored the potential applications and opportunities[3] presented by blockchain technology to IP ecosystems (WIPO, 2022) (see **Table 1**). This paper also identified the challenges of determining the feasibility and cost-effectiveness of utilising such technologies for the benefit of all IP stakeholders. In particular, WIPO

3 Use cases are classified by WIPO according to horizontal and vertical use cases. The former is applicable in all phases of IP value chains, whereas the latter is applicable in specific phases of the IP value chains.

suggests that the primary considerations of using blockchain in IP ecosystems are technical standards, regulatory framework, blockchain-network governance, and capacity building.

Aside from its publications, the application of blockchain technology is also being deliberated at WIPO's Committee of WIPO Standards[4] (CWS). In 2018, CWS established a new Blockchain Task Force to undertake the following tasks (WIPO, 2021):

1. Explore the possibility of using blockchain technology in the processes of providing IP rights protection and processing information about IP objects and their uses;

2. Collect information about IP office developments in their use of and experience with blockchain, assess current Industry Standards on blockchain and consider merit and applicability to IP offices;

3. Develop a model to standardise approaches of using blockchain technology in the IP field, including guiding principles, common practices, and use of terminology as a framework supporting collaboration, joint projects, and proofs of concept; and

4. Prepare a proposal for a new WIPO standard supporting the potential application of blockchain technology within the IP ecosystem.

The above efforts by the global community are testament to the growing interest about the potential impact of blockchain technology for the global IP ecosystem. The subsequent sections will provide an update on the work that is done in Singapore in relation to blockchain and IP.

**Table 1**

**Horizontal and vertical use cases of blockchain technology in the IP ecosystem (WIPO, 2022)**

### Horizontal use cases

1. **Decentralised identifiers (DIDs):** creation of DIDs for IP ecosystem actors enables faster interactions along different phases of the IP value chain.
2. **Time-stamping:** a digital time-stamp is proof that the digital content existed at that point of time.
3. **Alternative Dispute Resolution (ADR) services:** blockchain in ADR could be used in increasing security with regard to evidence relating to dispute.
4. **Transactions via smart contracts:** actors could undersign transactions via smart contracts and receive tokens (coins) representing a certain value or the right to use a service/asset as agreed via that smart contract.
5. **Version management:** as IP assets continuously transform, blockchain could help to maximise legal certainty regarding IP rights in such assets.
6. **Proof of existence:** blockchain could also improve legal certainty around intellectual assets by providing immutable proof of existence of these assets.

* Note: Horizontal uses such as proof of existence can find multiple vertical applications, e.g., trade secret protection, prior user rights, recognition of prior public use or prior art, and others.

### Vertical use cases

1. **IP register:** blockchain could create securely interconnected IP registers of registered IP rights.
2. **Evidence of generation**: blockchain could enable a time-stamped record and trustable proof of generation.
3. **Track and trace source of origin:** blockchain could enable the fight against counterfeiting.
4. **IP rights enforcement:** blockchain allows parties on a blockchain platform to have access to relevant product-related information.
5. **Priority document exchange:** blockchain could enable greater control, security over information, traceability, and automation for IP offices.
6. **Certification mark:** creation of a distributed register of certification marks in which the details (including ownership and certification authorities) are stored.
7. **Evidence of trademark use:** blockchain could provide evidence of actual and frequency of use of a trademark in trade.
8. **Prosecution of plant variety protection:** blockchain could create an immutable record of "events" in the life of a protected variety globally.
9. **IP rights (IPR) transfer:** blockchain could make it easier to create and manage the evidence of agreement between assignee and assignor.
10. **IP licenses:** blockchain could bring a secure, reliable, and scalable distribution transaction process to licensing IPR.

4 The CWS provides a collaborative international forum to adopt new or revised WIPO standards, policies, recommendations, and statements of principle relating to intellectual property data, global information system related matters, information services on the global system, data dissemination, and documentation.

## Blockchain Sector in Singapore

The growth of the blockchain sector in Singapore is in tandem with the growing interest in blockchain technology around the world. The *Singapore Blockchain Ecosystem 2020 report*[5] highlighted that businesses were optimistic about blockchain growth. A PwC survey found that one in five respondents was confident that blockchain would come into mainstream solutions in the coming three to five years (OpenNodes et al., 2020).

Against this growth opportunity, the respondents also indicated that Singapore is well-positioned to become a global leader in blockchain technology. In 2020, there were 234 blockchain entities represented across 26 categories (e.g., sectors and industries) in Singapore[6]. The city state continues to grow this community through its initiatives and support schemes. One such initiative is the $12 million Singapore Blockchain Innovation Programme (SBIP). Founded in December 2020[7], SBIP's mission is to engage local companies, grow Singapore's blockchain community, and research on next-generation blockchain. The SBIP further aims to align blockchain technology research with the needs of the industry, facilitating the development, commercialisation, and adoption of wider real-world applications. In addition, SBIP looks into blockchain scalability (to enable the adoption of blockchain in environments with high transaction rates), supporting blockchain interoperability, and growing the tech talent pool (IMDA, 2020).

**CASE STUDY 1:**

### Singapore Blockchain Innovation Challenge

The Singapore Blockchain Innovation Challenge (SBIC) is a part of the SBIP. Its latest edition ran from 4 August 2023 to 15 September 2023 and saw the participation of 11 teams, comprising start-ups, enterprises, students, and professionals. The teams were tasked to propose innovative and creative blockchain solutions or tools to address existing or identified real-world issues or use cases. The corporate-track winner of this year's competition was Utilify, which aims to bridge businesses with NFT communities, as such communities are attractive, but unexplored markets for traditional companies. The enthusiast-track winner was Wen Lambo, which brings Bifrost interoperability and vToken use cases to the Ethereum ecosystem.

**CASE STUDY 2:**

### IP8Value

IP8Value is an in-house, proprietary solution, developed by one of the teams at SBIP. It focuses on intellectual asset management for technology innovation and commercialisation. The project envisions a global platform for IP marketing, technology search, and investment. The aim of IP8Value is to support IP tokenisation and NFT-based patent pool management for users to contribute IPs and generate revenue together. The team is conducting pilot tests with various universities and research institutes in Singapore, and the project is currently being incubated at SBIP and the National University of Singapore (NUS) Database System.

5 Co-developed by OpenNodes, Temasek, IBM, PwC, EY, and SGTech, and supported by Singapore's Infocomm Media Development Authority (IMDA) and Monetary Authority of Singapore (MAS).

6 Co-developed by IMDA and OpenNodes, and powered by Tribe.

7 Founded by Enterprise Singapore (ESG), Infocomm Media Development Authority (IMDA), the National Research Foundation Singapore (NRF), and supported by the Monetary Authority of Singapore (MAS).

The growth of blockchain-related patent applications in Singapore also attests to the robust development of the blockchain ecosystem here. Since its emergence in 2015, Singapore saw close to 660 blockchain patent families applied and published here[8]. Mirroring the global trend (see **Figure 1**), the volume of blockchain-related patent applications also climbed in Singapore, from about 20 applications in 2016, to over 250 applications in 2019 (see **Figure 4**). From 2016 to 2020, blockchain patent applications increased at a compound annual growth rate of 45.1%.

As a hub for global patenting activity in blockchain innovation, Singapore sees patent filings from MNCs in East Asia, Americas, and Europe. The parent companies of top filers include Ant Group Co., Ltd; nChain Holdings Ltd; Visa, Inc; Mastercard, Inc; and JPMorgan Chase & Co. Beyond a destination for blockchain filings, these filers continue to contribute to innovation activities in Singapore relating to blockchain technology, with close to 180 blockchain patent families whose owners resided here[9]. These patent families saw a multi-fold increase from a single family in 2015 to 69 in 2020 (see **Figure 5**).

**Figure 4**

**Number of patent families filed in Singapore**

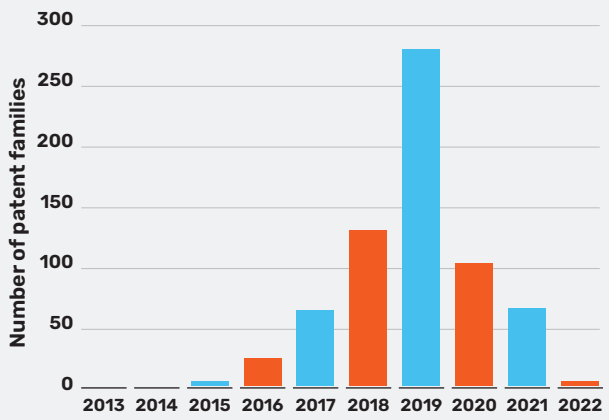
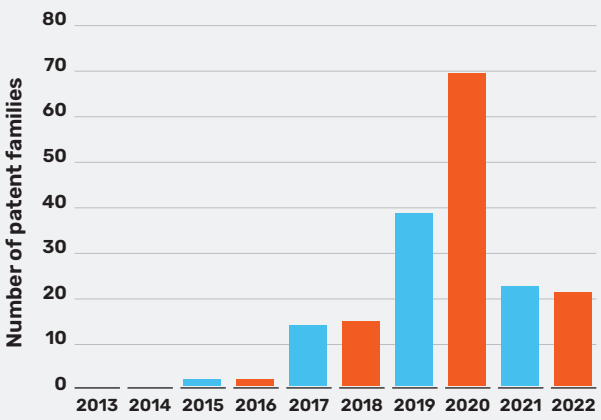



**Figure 5**

**Number of patent families owned by Singapore resident assignees**




8, 9 Refer to Annex II for technical notes. A simple patent family is a collection of patent documents that are considered to cover a single invention. The technical content covered by the applications in one patent family is the same or similar. The applications in a patent family are related to each other through priority claims. The application with the earliest application date within the simple patent family was referenced for analysis. In instances where a patent has more than one current assignee, each assignee is allocated a single count. Data for 2021 to 2022 is incomplete due to a lag in the publication of patents. The dip in this period reflects the lag rather than a declining trend in applications.

**CASE STUDY 3:**

## Mighty Jaxx Group

The Mighty Jaxx Group is a collection of brands and companies that bridges future culture via an integrated platform that curates and produces unique in-person experiences, and develops digital and phygital collectibles for every fandom and audience.

With a mission to supercharge future culture globally, Mighty Jaxx works collaboratively with some of the world's most iconic brands like Netflix, Disney, Formula 1, Hasbro, and Toei Animation, to create unique experiences and deliver happiness for a diverse and global fanbase of collectors in over 90 countries – through their live in-person events, digital and phygital collectibles, innovative technologies, merchandise, and more.


Apart from using blockchain technology to develop a platform to issue and validate unique, tamper-proof certificates for its products, Mighty Jaxx has also utilised blockchain ticketing for their Stranger Things Encounter (STE) event in Singapore. The STE is an immersive event that takes visitors on a journey through iconic locations from the popular hit TV series, Stranger Things. Mighty Jaxx's proprietary XPass platform adds an immersive experiential layer to the entire event. The XPass is a Digital Ticket (an NFT), that ties in various related products (digital or physical) to the visitors' journey through an interactive retail experience. By tracking the visitors' engagement within the experience, XPass grants access to exclusive drops and rewards to the holder, thus holding value before, during, and beyond the event itself. Each XPass is also itself a unique Digital Collectible, taking the form of an avatar that evolves with the individual visitor's journey. This avatar design can then be directly applied to selected merchandise, to create unique personalised products for the visitor. For the STE, visitors can collect digital assets named FRGMNTS scattered through The Encounter, unlocking various iconic Stranger Things elements within their XPass which culminates in a unique digital collectible for each visitor. For example, visitors can use their XPass to personalise merchandise such as t-shirts and tote bags, creating memorabilia to commemorate their very own Encounter, making this more than just an admission ticket.

## Singapore IP Strategy 2030 (SIPS 2030)

The Singapore IP Strategy 2030, or SIPS 2030, is a national blueprint aimed at building a vibrant and competitive IP ecosystem that supports enterprises and the wider innovation community. SIPS 2030 reflects Singapore's vision to develop into a global hub for IA/IP activities and transactions, as encapsulated in the 2013 IP Hub Master Plan, which was updated in 2017.

Launched in 2021, SIPS 2030 seeks to support enterprises and the wider innovation community through enhancing the use and management of IA/IP. It guides Singapore's development as a global-Asia node of technology, innovation, and enterprise, so it can better support innovation and enterprises in Singapore. SIPS 2030 consists of three key interlinked thrusts (see **Figure 6**):

1. Strengthen Singapore's position as a global hub for IA/IP (Hub)
2. Attract and grow innovative enterprises using IA/IP (Business)
3. Develop good jobs and valuable skills in IA/IP (Jobs)

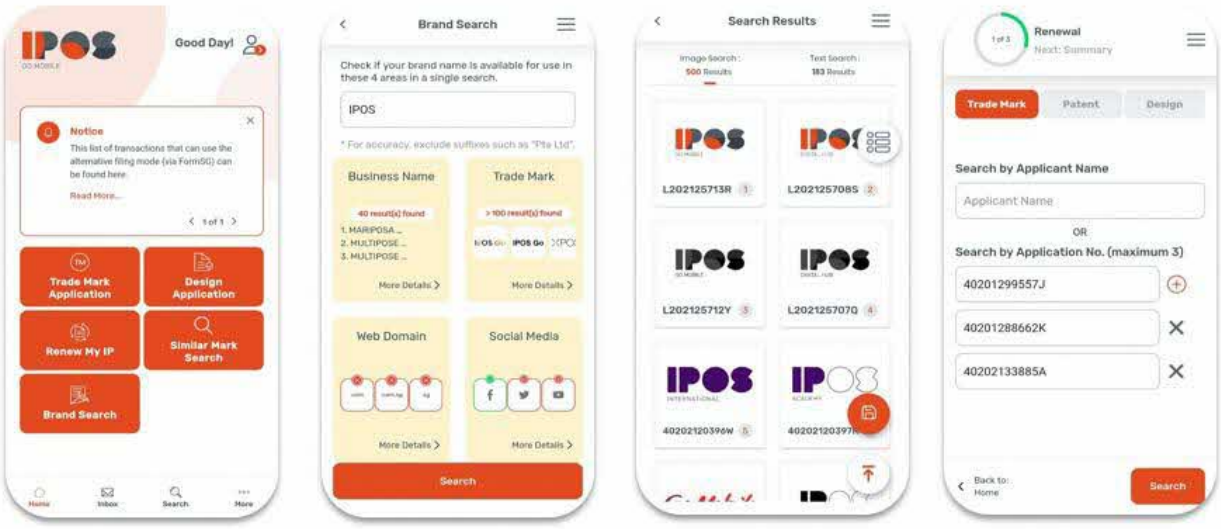
**Figure 6**

**Overview of the Singapore IP Strategy 2030**

A key thrust of SIPS 2030 is to understand the challenges and embrace the opportunities presented by frontier technologies. This is important for building a world-class IA/IP regime, and supporting innovation and enterprises in Singapore. IPOS has already started to leverage Artificial Intelligence (AI) to enhance the user experience in our IP filing process. The IPOS Digital Hub (IDH) eServices platform launched in June 2022, and the IPOS Go mobile application both use AI to facilitate IP registration, renewals and searches. For example, IPOS Go taps on AI-powered image search to allow users to look for trademarks in the IPOS database with ease by uploading a photo into the search engine (**see Figure 7**).

**Figure 7**

**Selected screenshots from the IPOS Go App**




IPOS will continue to explore the use of new frontier technologies to improve its suite of services and offer a greater value-add to innovators and creators. Beyond infrastructure capabilities, IPOS has also considered practical issues arising from the development of frontier technologies for the IP sector, including through the following publications:

1. **Research to understand the perceptions of key stakeholders concerning the interface between Artificial Intelligence (AI), data, and IP** (SMU, 2022). This research project was conducted by the Centre of AI and Data Governance at the Singapore Management University (SMU) and was jointly supported by IPOS and the Infocomm Media Development Authority of Singapore (IMDA). The study explored how IP and data can support and enable AI innovations.

2. **Information note on IP and NFTs** (IPOS, 2023). This NFT-focused note provides more information about the subject matter, particularly the relationship between NFTs and IP, and what one should note when creating or owning an NFT.

3. **Circular on the classification practices on NFTs and metaverse-related goods and services** (IPOS, 2023). This is part of our commitment to provide clarity and certainty to trademark applicants in times of rapid technological change in a manner that is forward looking and aspirational.

# Motivation of Study

The growth in blockchain adoption, evidenced by the influx of early adopters and enterprises alike, coupled with the increase in patenting activities and economic impact, suggests growing maturity and development in this frontier technology. Within the ambit of SIPS 2030, this study is a continuation of IPOS' efforts to examine the state of play of frontier technologies.

The aim of this study is to understand the challenges and identify opportunities in the intersection between blockchain and IP, with an emphasis on the following four areas:

1. **Enhancing conventional IP office functions**
2. **Facilitating IA/IP commercialisation for innovators**
3. **Reimagining the functions of IP registries**
4. **Enabling the blockchain IP sector**

This study has taken a pragmatic perspective to examine the viable applications of blockchain technology for IP offices and the IP sector, in support of key SIPS 2030 objectives. While blockchain is no silver bullet in addressing the challenges or needs of the IP community, it is hoped that the findings and recommendations will serve as a starting point to spur further collaborations between the IP and the blockchain communities in Singapore. In addition, this study aspires to offer a Singapore perspective for the international community, to deepen conversations and collaborations with and between cross-border partners, including IP offices.

# Methodology of Study

Apart from desk research, this report derives its insights from engagements with stakeholders, including blockchain solution providers, associations, and government agencies through surveys and roundtable sessions.

One of the key sources to understand the views of stakeholders based in Singapore was an online survey on blockchain. This survey was jointly developed by IPOS and the Swiss Federal Institute of Intellectual Property (IPI), with some customisation and adaptation of survey elements to better reflect the respective local contexts. Each office then independently conducted the online survey (hereafter referred to as "blockchain survey") as part of the study. The joint efforts by Switzerland and Singapore, both ranked among the top five most innovative economies in the WIPO Global Innovation Index 2023, will enable both economies to compare notes and support one another on their respective IP and blockchain journeys.

The blockchain survey in Singapore was conducted with two groups –

1. Respondents of IPOS Customer Perception Survey (2H 2022). The survey was implemented as an optional component as part of the IPOS Customer Perception Survey (2H 2022), which draws from users of Singapore IP filing platform. 14 respondents completed the blockchain survey.
2. Participants of the *Blockchain and the future of IP Ecosystem* roundtable sessions. IPOS invited attendees to complete the online blockchain survey. There were 14 completed responses from this group.

In total, the blockchain survey received 28 fully completed responses.

In addition to the blockchain survey, IPOS also held two roundtable sessions themed *Blockchain and future of IP Ecosystem* to gather feedback from the stakeholders. Over 30 participants from more than 25 organisations participated in the roundtable sessions. Participants came from (i) IP legal/professional firms; (ii) blockchain solution providers; and (iii) government agencies and associations. Discussions were held in an open style manner with a facilitator.

We would like to express our deepest appreciation to Mr Benjamin Cheong (Deputy Head, Technology, Media and Telecomms, Rajah & Tann) for facilitating the roundtable sessions. We would also like to thank all participants of the roundtables, who have contributed their invaluable insights and suggestions.

# Key Observations and Findings

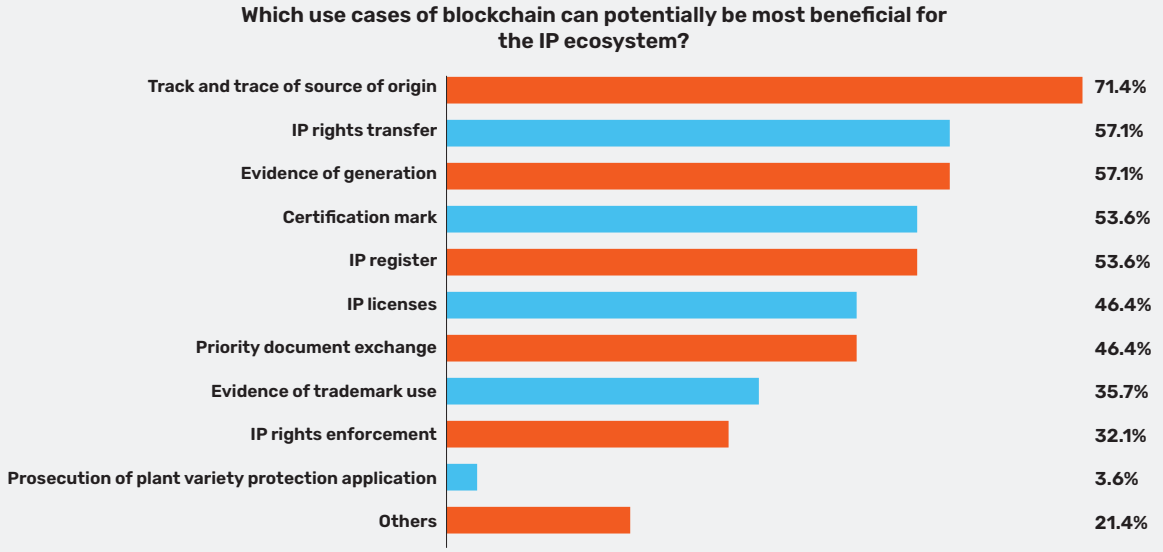
## Survey Findings

The survey results offer broad perspectives of the relevance of blockchain for the IP sector. Four key areas of findings are highlighted in this report, namely, (i) most beneficial use cases; (ii) uncertainties and challenges; (iii) changes required to capture blockchain developments; and (iv) the role of IP offices. The quantitative findings from the online survey are corroborated with discussions from our roundtable sessions. While the limited sample size (n = 28) may not reflect the full spectrum of views, it is helpful in generating a broad understanding of the untapped potential of blockchain in IP.

**KEY FINDING 1:**
**Track and trace, IP rights transfer, and evidence of generation are the top three uses of blockchain for the IP sector**

**Figure 8**

**Survey findings for most beneficial use cases of blockchain for the IP ecosystem (N=28. Multiple answers could be selected)**




Three in four respondents indicated provenance (i.e., track and trace of source of origin; 71.4%) as the most beneficial IP use case. Notably, only 32.1% of respondents indicated IP rights enforcement as a potential use case. This suggests a preference for application of blockchain on provenance rather than enforcement. This datapoint corroborates with anecdotal feedback from our roundtable participants who highlighted the usefulness of provenance for the verification and tracing of copyright ownership.

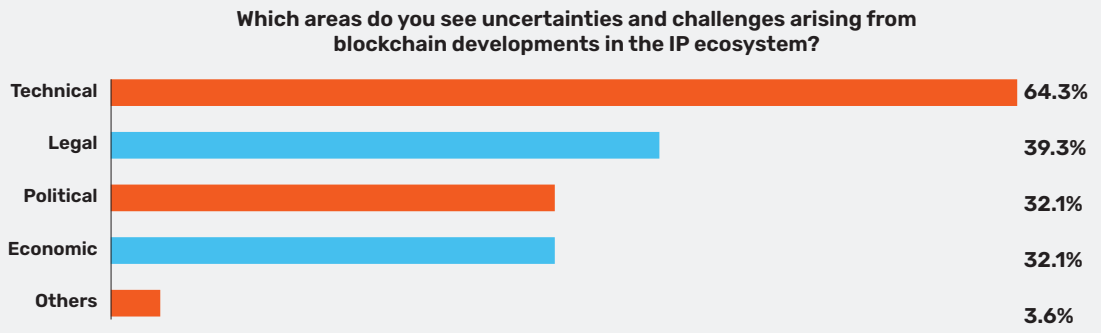
The commercialisation of rights (through transfers (57.1%) and licenses (46.4%)) also emerged among the top reasons for blockchain use among the IP community. Coupled with evidence generation (57.1%) and certification mark (53.6%), this reflects an inclination from survey respondents for practical use cases which support IP-related commercial activities.

**KEY FINDING 2:**

**Technical issues were seen as the key uncertainty or challenge arising from blockchain developments**

**Figure 9**

**Survey findings for uncertainties and challenges arising from blockchain developments. (N=28. Multiple answers could be selected)**

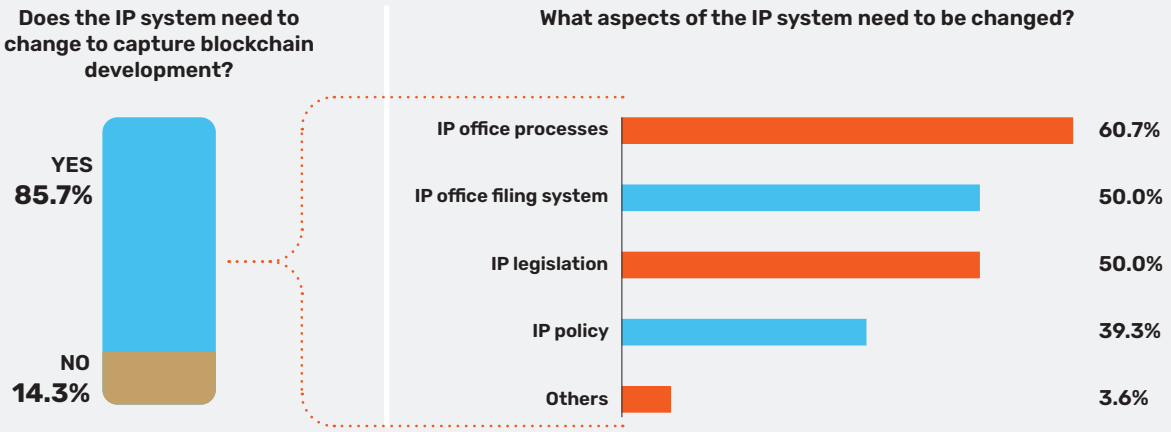



Over two-thirds of respondents identified technical issues as the main uncertainty and challenge arising from blockchain developments in the IP ecosystem. This highlights a need for deeper understanding of the technology to enable a breakthrough at the nexus of blockchain and IP developments. Around a third of respondents indicated legal, political, or economic challenges for blockchain and IP respectively.

**KEY FINDING 3:**
**Changes required for the IP system to capture blockchain developments**

**Figure 10**

**Survey findings for changes to the IP system to capture blockchain developments. (N=28. Multiple answers could be selected)**

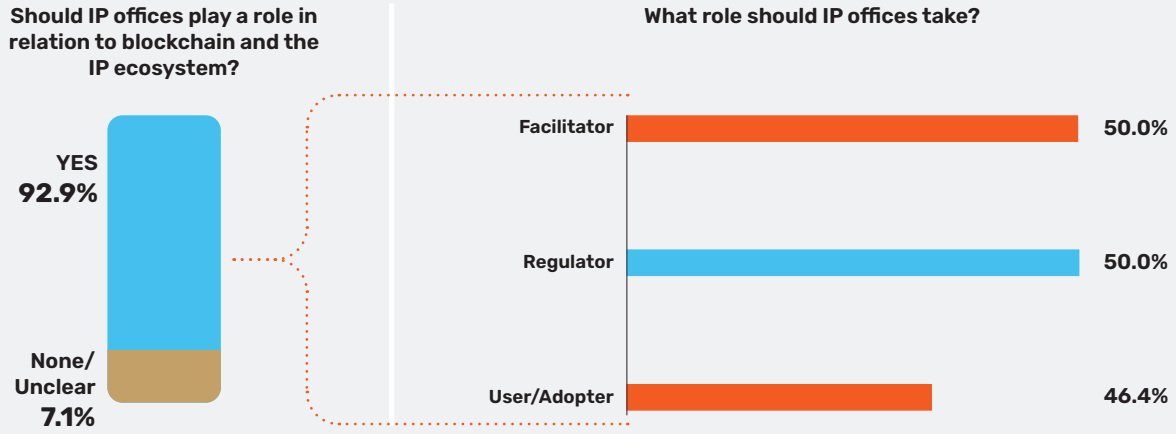



Majority (85.7%) of respondents indicated that the IP system would need to change to capture blockchain developments in the IP sector. Close to two-thirds of respondents identified IP office processes as an aspect requiring adjustments for any blockchain deployment in the IP sector while half of respondents felt the need for IP filing system or IP legislation to be changed for the same.

**KEY FINDING 4:**
**Participation of IP offices in blockchain developments is desired**

**Figure 11**

**Survey findings on the role of IP offices in the development of the blockchain and IP ecosystem. (N=28. Multiple answers could be selected)**




Majority (92.3%) of respondents indicated that IP offices had a role to play in relation to blockchain and the IP sector. However, opinions of the role of IP offices were split between being a facilitator, regulator, and adopter. This is an area which will benefit from deeper conversations in future engagements, in particular on whether, as well as the degree to which, IP regulators should devote resources towards the adoption and facilitation of blockchain technology in the IP sector.

## Roundtable Findings

The two roundtable sessions on "*Blockchain and future of IP Ecosystem*" supplement the survey findings. These two in-person discussions were successful in drawing out anecdotal accounts and insights from both IP and blockchain practitioners. The qualitative results are organised into two sections, namely, (i) challenges; and (ii) potential use cases.

### Challenges

**Challenge 1: Need for a clear raison d'etre for blockchain application in the IP sector**

Participants of the roundtables emphasised that a clear raison d'etre for the use of blockchain technology in the IP context would need to be identified before embarking on new projects. This is particularly important for IP offices, whose systems and initiatives have an ecosystem-level impact.

It is important for Singapore to maintain its forward-looking and objective approach in developing a top-class IP regime that supports innovation. For blockchain technology, this means identifying a fit-for-purpose use case for the IP sector before embarking on any pilots to testbed the technology. Such a use case should critically examine a strong impetus for blockchain solution (e.g., the need for a decentralised ledger system or a need for provenance). In addition, roundtable participants called on IP offices to consider other existing and mature technologies, rather than expecting DLT to be an elixir for the IP sector. The roundtables also highlighted that it was paramount for IP offices to take on the role of collaborators rather than owners of the blockchain system.

One of the key benefits accrued by using blockchain is an increase in trust between enterprises. However, many participants highlighted that Singapore already possessed a trusted and sophisticated digital infrastructure. Consequently, the main value proposition of trust in using blockchain technology might not be immediately apparent.

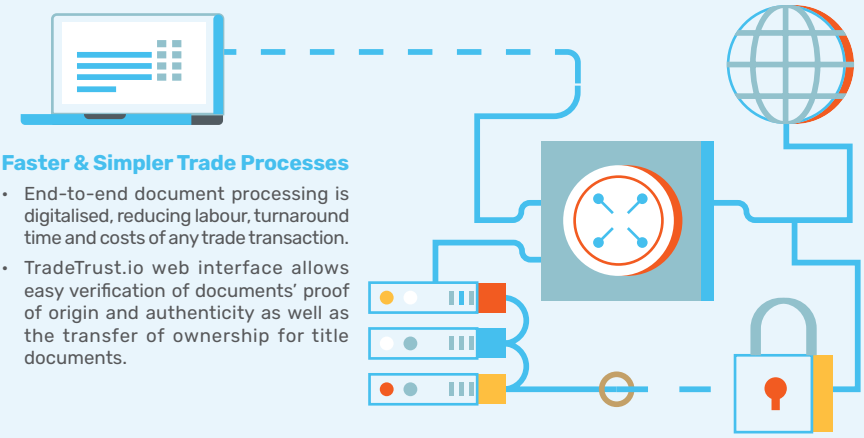
That said, the participants offered several use cases where the application of blockchain in the IP sector might benefit the economy, in parallel to efficiencies already achieved in other sectors. Before outlining these use cases in the next section, the two box stories examine the blockchain use cases in non-IP sectors which were cited at the roundtables. Both case studies were spearheaded by the Singapore Government to experiment blockchain deployment for industry usage. These use cases have matured beyond pilot projects and continue to value-add to their communities today.

CASE STUDY 4:

## TradeTrust

Despite global shifts towards digitalisation, the trade ecosystem is still heavily dependent on physical paper documents and signatures to provide proof of originality and ownership. Even though efforts have been made to digitalise, there are still gaps in legal and technical interoperability between platforms. TradeTrust was designed to alleviate the problems of paper-based international trade through digitalisation. There are two broad categories of trade documents which are supported by TradeTrust – (i) Verifiable Documents (e.g., certificate of origin and packing lists) and Transferable Documents (e.g., Electronic Transferable Records (ETRs) such as electronic Bill of Lading (eBL)).

TradeTrust leverages verifiable credentials technical methods to enable stakeholders to verify the authenticity and provenance of documents, and blockchain technology to effect title transfer in accordance with statutory law. The outcome is a seamless transfer of trade documents across digital platforms resulting in time saving. Previously, manual paper-based modalities would take 5 – 10 days for processing. With TradeTrust, the processing time is reduced to less than 24 hours.



**Faster & Simpler Trade Processes**

- End-to-end document processing is digitalised, reducing labour, turnaround time and costs of any trade transaction.
- TradeTrust.io web interface allows easy verification of documents' proof of origin and authenticity as well as the transfer of ownership for title documents.

**Seamless Trade Eco-System**

- TradeTrust's open-source code allows easy access for trade platforms to integrate with their existing systems, allowing scalability of operations for the end user.

**Greater Security & Synchronisation**

- Legal harmonisation and a robust accrediation structure ensure documents exchanged through TradeTrust are legally recognised in different compliant jurisdictions.

CASE STUDY 5:

## OpenCerts

OpenCerts is a blockchain platform offering an easy, reliable way for schools to issue and validate tamper-resistant digital academic certificates to students. It is built on the Ethereum blockchain. Since OpenCerts is built on a blockchain platform, its certificates are easily verifiable and has the possibility to be revoked post-issuance (should the need arise). Students can receive their academic certificates and transcripts digitally, which can also be viewed, shared, and verified internationally. With OpenCerts, the authenticity of each digital certificate can be trusted, thus reducing costs, time, and effort to verify.

OpenCerts was first conceptualised in collaboration with Ngee Ann Polytechnic (NP) in November 2017. It was developed by Government Technology Agency (GovTech), Ministry of Education (MOE), NP, and SkillsFuture Singapore (SSG), and is now adopted by educational institutes.

The two case studies on TradeTrust and OpenCerts demonstrate how blockchain can be effectively deployed. In both use cases, "trust" is a common theme. For TradeTrust, it is the authenticity and provenance of trade documents. For OpenCerts, it is the verifiability of academic certificates and transcripts. The need for trust is even more pronounced for cross-border usages.

These examples highlight the importance of determining instances where blockchain can offer solutions to real-life challenges faced, or enhance the offerings, by the IP sector, even as we adopt a forward-looking approach in considering the use of new technologies. Both cases further suggest that the value of DLT deployment will be higher when the buy-in from markets is greater. This will be elaborated in the next segment before presenting the use cases for blockchain in the IP industry with the most potential and relevance as identified at the two roundtable sessions.

### Challenge 2: Lack of interoperability across blockchain infrastructure and standards

For any blockchain solution to be useful, it is important to address a certain market need. The solution cannot be localised to stakeholders in the Singapore market alone. It must be extensive to include external markets where businesses are keen to operate in. For example, the execution of smart contracts would require interoperability between blockchains. This may be challenging as different markets or even stakeholders within the same market, may have different preferences on the use of blockchain technology.

Blockchain interoperability refers to the ability of different blockchain systems to communicate and operate seamlessly with each other. Interoperability is critical for the adoption of blockchain solutions at scale because it allows for more efficient and user-friendly applications. The roundtable participants recognised that while there were efforts to enhance interoperability of blockchain, it was insufficient.

Currently, there are many blockchain systems (e.g., Bitcoin, Ethereum, and Binance Smart Chain) available at the layer 1 infrastructure level and the number is constantly growing. These systems could use different underlying cryptographic mechanisms. For example, different blockchains may have different approaches to data storage and privacy mechanisms. Hence, there is a need for greater interoperability across the different blockchain infrastructure and standards.

To date, there is no clear emergent chain which users may adopt. Each option comes with its own set of advantages and limitations. The lack of a single unified chain or an efficient means of interoperability across mainstream chains makes adoption difficult for widespread usage. This is especially important for cross-border adoption across jurisdictions where each office might consider its own blockchain standard.

Pilot projects in IP offices around the world have already witnessed the use of different layer 1 technologies. For instance, IP Australia uses Quorum for the incorporation of legal status data (Burn, 2018) while the European Union Intellectual Property Office uses the European Blockchain Services Infrastructure for its European Logistics Services Authentication initiative to ensure product authenticity through information sharing (EUIPO, 2023).

Beyond blockchain infrastructure, roundtable participants highlighted the need for IP offices and stakeholders to determine a set of common standards. This includes areas such as data standards (what form of information can go on chain), smart contract standards (what are the parameters to trigger the contract), and identity standards (what form and depth of personal information and identifiers on chain).

The next section highlights several use cases identified at the roundtables as being the most relevant for the IP sector.

## Potential Use Cases

**USE CASE 1: Registry for non-registrable IPs**

The administration of IP rights in Singapore can be divided into registrable IP (e.g., patent, trademark, industrial designs, geographical indications) and non-registrable ones (e.g., copyright, trade secrets). The roundtable discussions suggest that a blockchain-driven system may work for non-registrable IP such as copyright.

In particular, blockchain technology for copyright registration offers several advantages. The inherent immutability of blockchain presents opportunities for the record of copyright existence and ownership. Blockchain may serve as a decentralised and tamper-proof timestamping mechanism providing proof of when the copyright is created. However, the roundtable participants recognised that copyright protection was automatically conferred the moment a work was created in Singapore[10]. There is no need for registration of copyright in Singapore for the rights to subsist.

The consideration for a copyright registry is not new to IPOS. In the run-up to the Copyright Amendment Act 2021, responses from the public consultation were sought and captured in the Singapore Copyright Review Report (MinLaw, 2019). More than half of the respondents then[11] indicated favourably for a copyright registry, but there was confusion over the protection and proof of ownership that the registry could offer. For clarity, a registry will not confer more protection for a copyright regime which already accords automatic protection. On ownership, a registry system can only provide evidence of such but, even so, it may not be a conclusive source of truth. The roundtable discussions highlighted this gap as an area that blockchain solutions may address.

Participants suggested that blockchain might be able to overcome the limitation of a copyright registry. For example, ownership identifiers (e.g., name and address of right holders, date of publication, and title of work) may be included in a blockchain-based register. Such a register could also result in cost and time savings for rights owners. Beyond registration, blockchain may also facilitate the downstream commercialisation of the rights, access control, and provide greater clarity on ownership transfers (Pech, 2020). This is seen in the efforts of overseas private industries, such as the joint initiatives by the American Society for Composers, Authors and Publishers (ASCAP), Society of Authors, Composers and Publishers of Music (SACEM; France), and the Performing Right Society (PRS; UK).

Apart from copyright, the roundtables discussed the usefulness of blockchain-based solutions for other types of non-registrable IP (e.g., trade secrets, confidential information and know-hows). This is increasingly relevant in the context of Singapore where businesses have heightened awareness of the importance of non-registrable IP. For example, SMEs and innovators in Singapore have indicated a high reliance on IA such as trade secrets and confidential information, as reported in the Trade Secrets Enterprise Guide (IPOS, 2021).

Participants also emphasised the importance of business agility and speed to market, especially for fields experiencing swift technology transformation. Further, a blockchain-based register could potentially accord some form of accountability and disclosure to interested stakeholders (e.g., investors and board members) on the enterprises' IA portfolios. However, it remains to be seen how blockchain solutions can address the issues of information veracity (i.e., how to validate the trade secrets portfolio that is placed on the blockchain) and scalability (e.g., how to connect with the registers in other countries, and registers of private entities).

10 Subjected to certain criteria in the Copyright Act.

11 Largely creators and a few users.

**USE CASE 2: Open-source repository**

Open-source software is becoming increasingly prevalent, and often serves as the enabler in software innovation (e.g., Github, a repository for open-source codes). However, a central repository where the public can easily access all other forms of open-source materials, is not readily available.

One of the recommendations at the two roundtables is for the development of such an open-source central repository. This will allow the public to access license-free materials or licensed resources that are royalty-free (e.g., photos, videos, and source code) through a centralised platform. Though open-source, some materials (e.g. creative commons, GNU General Public License) can still have IP protection to accord some control of the materials to the creators (e.g., that it could only be use for public good).

With the use of blockchain technology, there can also be greater certainty over when the materials, whether license-free or royalty-free, are used. This could be made possible through the traceability of blockchain. Traceability allows creators to know when their works from the repository are used and who the users are. Users, on the other hand, can also glean clarity about the creators behind the open-source materials they are accessing.

**USE CASE 3: Opportunity for downstream commercialisation**

One of the major benefits of blockchain technology is the accompanying feature of smart contracts to facilitate commercialisation activities. A smart contract serves as an escrow, releasing funds/payments when certain conditions are met (e.g., transfer of digital assets). This offers a platform for the commercialisation of IA/IP, especially for creators in the gig economy, where access to professional services or sophisticated legal contracts may be limited. Smart contracts can facilitate financial transactions between parties, while tracking origin of source at the same time. The roundtable participants recognised the value of smart contracts in supporting commercialisation activities involving IA/IP. This ensures that creators are duly paid and recognised for their innovation. Below are two ways in which blockchain technology may be applied to IP commercialisation:

1. **Licensing and royalty tracking and payments.** Blockchain technology may help facilitate licensing arrangement and tracking of licensing and royalty payments (e.g., in the use of music, photos, and source codes). It may also facilitate traceability of the parties using the licensed rights and the origin of such rights.

2. **Marketplaces for intangible assets.** Apart from licensing, blockchain technology may help in the sale and transfer of ownership for IA. This is most commonly seen in the sales of NFTs (e.g., through platforms such as OpenSea). However, respondents have also pointed out that such open platforms did not necessarily lend assurances to the ownership, provenance, and underlying rights behind the assets. For example, creators did not have the requisite underlying rights in the case of Metabirkins listing on OpenSea. Hence, there is an opportunity for more robust marketplaces beyond NFTs, with improved features such as digital identities, better traceability and assurance of the ownership and creatorship.

Overall, the roundtable participants recognised the limitations of blockchain technology in IA/IP commercialisation presently. The nature of smart contracts today involves premediated and relatively straightforward transactions which can be easily interpreted by algorithms (e.g., point to point asset transfer). In this vein, executing complex commercial contracts is precluded. As such, there remains much room for development before smart contracts may be relied on for commercialisation in complex cases that goes beyond the execution of a simple algorithm, including in the IP sector. Until blockchain technology develops to become more sophisticated, contracts where human-to-human interactions are required will still occur off the chain.

**USE CASE 4: Supporting IP dispute resolution**

As enterprises become more sophisticated in developing their IA/IP portfolios and global presence, IP disputes may arise. These disputes can be complex, involving multiple parties, jurisdictions, and pieces of evidence. The roundtables observed that blockchain technology might play a role in the gathering and verification of evidence to help support the IP dispute resolution process. In particular, participants pointed out that trust in the Singapore government could put us in good stead to be an IP dispute resolution hub for Asia.

In cases of IP dispute resolution, blockchain's properties of transparency and immutability can provide an objective source of information related to an intellectual property asset. For instance, when IP-related transactions, such as licensing agreements and ownership transfers, are recorded on a blockchain, they cannot be altered or deleted. This creates an objective and tamper-proof trail of evidence, which may be useful in resolving disputes. Another relevant use case is in recording evidence of use for trademarks in the commercial context in relation to the goods and services registered. This is important as non-use may form a legal argument in trademark disputes.

Again, the roundtables acknowledged that blockchain technology alone would not be sufficient to ensure the veracity of information put on chain. Importantly, the adoption of blockchain technology in legal processes will also require the willingness of stakeholders to embrace new technology. It will require a change in mindset as well as collaborative efforts among legal experts, blockchain developers, and industry stakeholders. Legal uncertainties are also reflected in our survey findings as a potential challenge to blockchain development for the IP sector (see **Figure 9**).

# Recommendations

This study draws out the nexus between blockchain and IP, highlighting promising use cases of blockchain for the IP ecosystem, as well as its accompanying challenges. This section proposes recommendations on the way forward.

**Recommendation 1:**
**Strengthening connectivity and awareness among IP and blockchain stakeholders**

The level of crosstalk and interaction between IP and blockchain practitioners is still nascent in Singapore. A better mutual understanding of the intricacies and development in IP and blockchain will benefit the innovation community in Singapore. It will help to facilitate closer collaboration and promote co-solutioning. At the global level, WIPO has held several conversation sessions on IP and frontier technologies, with blockchain being one of such technologies considered to have cross-cutting applications such as the metaverse and IP office administration.

At the industry level, INTA has also examined related areas through its Emerging Issues Committees. Similarly, IPOS has held various discussions on frontier technologies such as blockchain, including at its annual flagship event – IP Week @ SG. Efforts to continue enhancing awareness and connectivity between the IP and blockchain sectors will be pertinent and useful. Singapore should continue to work with like-minded IP offices, industry partners and stakeholders to foster further conversations for cross-border blockchain applications/transactions.

As cautioned in this study, careful comparison and consideration of other mature technologies should also be done. The development of an internationally interoperable blockchain infrastructure cannot rely entirely on the efforts of IP offices alone. The discovery process will benefit from drawing exchanges with stakeholders from both the blockchain and IP sectors, so that all parties can understand the intricacies and latest developments in blockchain and IP. As a top innovation and IP hub, Singapore is well poised to contribute to these conversations.

**CASE STUDY 6:**

## Blockchain Association Singapore

The Blockchain Association Singapore (BAS) was founded in 2018 to empower its members and the community to leverage blockchain and scalable technologies for business growth and transformation. BAS helps to deepen understanding of the blockchain ecosystem through the courses and webinars it conducts regularly. Since its inception, BAS has trained over 700 participants. BAS is also the main organiser of Singapore Blockchain Week. The 2022 edition saw 10,000 participants from 20 countries.

**Recommendation 2:**

## Developing interoperable blockchain infrastructure and standards for the IP sector

The earlier discussion has highlighted the lack of a commonly agreed foundational layer 1 blockchain (e.g., Bitcoin, Ethereum, Binance Smart Chain) infrastructure globally. Alignment on the foundational layer 1, both locally and globally, will be critical and beneficial for the IP ecosystem. For example, it will support IP offices looking to leapfrog the digitalised filing platform process or those which are seeking to decentralise their digital filing system. The establishment of a foundational layer 1 infrastructure will have the effect of facilitating and encouraging the development of more experimental blockchain projects or pilots. It will also allow other improvement works (e.g., on cost and speed) to be carried out through the development of subsequent layer 2 infrastructure.

Beyond the need for foundational layer 1 blockchain infrastructure is the need for blockchain standards for the IP ecosystem. An example is the types of information to be put on the blockchain or to be stored off-chain. These may include identifier information (e.g., applicant name, inventor name, addresses), IP specific information (e.g., priority dates), documentation format and requirements, just to name a few.

However, there are currently no global standards to adhere to, which may result in inconsistencies across different IP offices. That said, WIPO is currently exploring a global identifier pilot that examines common identity for use in the IP systems. This is a positive first step as we explore interoperable infrastructure and standards.

Another area for consideration is the feasibility of standardising smart contracts for the IP sector. In particular, how IP commercialisation clauses (e.g., licensing, ownership transfer) can be assimilated into smart contract algorithms and how payment mechanisms and teams can effect commercial activities. This will require close collaboration between blockchain developers and IP commercialisation experts. This also necessitates the formulation of a set of blockchain standards for the IP sector globally.

Especially for a small open economy like Singapore, the importance of developing interoperable blockchain infrastructure and standards for the IP sector cannot be understated. This highlights the need for Singapore to remain plugged in to global discussions on IP and blockchain.

# Conclusion

**This study provides a snapshot of the current blockchain and IP ecosystem in Singapore.**

Blockchain technology continues to be an exciting frontier technology with opportunities to support and transform the IP ecosystem, especially in the use and commercialisation of IP. The key tenet of blockchain is building trust. It is equally important to consider the context in which blockchain will create the most value for the IP sector. This is especially so given the strong brand and trusted IP regime that Singapore already offers.

Instead of developing blockchain solutions for IP in silos, this study points towards the need for greater collaboration and further discussions with stakeholders globally to help develop cross-border blockchain applications for the IP ecosystem.

We have identified two key challenges. First, the need for a clear raison d'etre for blockchain application in the IP sector. Second, the lack of interoperability across blockchain infrastructure and standards.

Four potential use cases were identified in this study, namely (i) registry for non-registrable IPs; (ii) open-source repository; (iii) opportunity for downstream commercialisation; and (iv) supporting IP dispute resolution. It further proposes two key recommendations. One, to strengthen connectivity and awareness among stakeholders in the IP and blockchain communities. Two, for the two communities, both local and international, to work together to develop interoperable blockchain infrastructure and standards.

Overall, the findings have affirmed that stakeholders would like to see IP offices play a role in the development and strengthening of the blockchain and IP sectors. IPOS will continue to examine the use of DLT, in particular blockchain, as part of its objective in SIPS 2030 for Singapore to serve as a global hub for IA/IP activities and transactions.

We hope that the findings will serve as a springboard to ignite further discussion and collaboration between the IP and blockchain communities in Singapore. The study also seeks to encourage and contribute to meaningful discussions on both the public and private fronts. Beyond Singapore, IPOS remains committed to examining the use of DLT in the IP sector with our international partners, including IP offices, in tandem with similar discussions by the global community.

We would like to thank all stakeholders for their insights and valuable contributions to this study, which have been instrumental to the findings and recommendations of this report.

We would also like to express our special gratitude to the Swiss Federal Institute of Intellectual Property (IPI) for this joint study.

## 2 Challenges

- Need for a clear raison d'etre for blockchain application in the IP sector
- Lack of interoperability across blockchain infrastructure and standards

## 4 Potential Use Cases

- Registry for non-registrable IPs
- Open-source repository
- Opportunity for downstream commercialisation
- Supporting IP dispute resolution

## 2 Recommendations

- Strengthen connectivity and awareness among stakeholders in the IP and blockchain communities
- Local and international, to work together to develop interoperable blockchain infrastructure and standards

# References


Blockchain Council (2022). A Beginner's Guide to Understanding the Layers of Blockchain Technology - Blockchain Council. Retrieved from: **https://www.blockchain-council.org/blockchain/layers-of-blockchain-technology/.**

David Segal (2023). Crypto Meltdown, What Crypto Meltdown? The New York Times. Retrieved from: **https://www.nytimes.com/2023/01/17/business/crypto-market-meltdown-nft-blockchain.html.**

European Union Intellectual Property Office (EUIPO) (2021). EUIPO connects to TMview and DesignView through blockchain. Retrieved from: **https://euipo.europa.eu/ohimportal/en/-/news/euipo-connects-to-tmview-and-designview-through-blockchain.**

European Union Intellectual Property Office (EUIPO) (2023). EUIPO unveils 'EBSI-ELSA': a ground-breaking step in global supply chain product authentication. Retrieved from: **https://www.euipo.europa.eu/en/news/euipo-unveils-ebsi-elsa-a-ground-breaking-step-in-global-supply-chain-product-authentication.**

Fintech News Singapore (2022). Ravi Menon Lays Out Singapore's Crypto Hub Ambitions at SFF 2022. Retrieved from: **https://fintechnews.sg/66280/crypto/ravi-menon-lays-out-singapores-crypto-hub-ambitions-at-sff-2022/.**

Gudgeon, L., Moreno-Sanchez, P., Roos, S., McCorry, P., & Gervais, A. (2020). Sok: Layer-two blockchain protocols. *In Financial Cryptography and Data Security: 24th International Conference, FC 2020, Kota Kinabalu, Malaysia, February 10–14, 2020 Revised Selected Papers 24* (pp. 201-226). Springer International Publishing.

Gwyneth Iredale (2021). Public Vs Private Blockchain: Key Differences. Retrieved from: **https://101blockchains.com/public-vs-private-blockchain/.**

IBM. What are smart contracts on blockchain. Retrieved from: **https://www.ibm.com/topics/smart-contracts.**

Infocomm Media Development Authority (IMDA) (2023). Singapore invests $12 million in first national effort to expand blockchain technology research. Retrieved from: **https://www.imda.gov.sg/resources/press-releases-factsheets-and-speeches/press-releases/2020/singapore-invests-$12-million-in-first-national-effort-to-expand-blockchain-technology-research.**

Infocomm Media Development Authority (IMDA) (2023). Tradetrust. Retrieved from: **https://www.imda.gov.sg/how-we-can-help/international-trade-and-logistics/tradetrust.**

Intellectual Property Office of Singapore (IPOS) (2023). Classification practices on Non-Fungible tokens (NFTs) and Metaverse-related goods/services (Circular No. 2/2023). Retrieved from: **https://www.ipos.gov.sg/docs/default-source/resources-library/trade-marks/circulars/2023/tm-circular-no-2-of-2023.pdf.**

Intellectual Property Office of Singapore (IPOS) (2023). IP and Non-Fungible Tokens. Retrieved from: **https://www.ipos.gov.sg/docs/default-source/resources-library/copyright/ip-and-nft-14june2023.pdf.**

Intellectual Property Office of Singapore (IPOS) (2023). Copyright Resources. Retrieved from: **https://www.ipos.gov.sg/about-ip/copyright/copyright-resources.**

Intellectual Property Office of Singapore (IPOS) (2021). Singapore IP Strategy 2030 (SIPS 2030). Retrieved from: **https://www.ipos.gov.sg/docs/default-source/default-document-library/singapore-ip-strategy-report-2030-18May2021.pdf.**

Intellectual Property Office of Singapore (IPOS) (2021). Study on the Protection and Management of Trade Secrets in Singapore. Retrieved from: **https://www.ipos.gov.sg/docs/default-source/resources-library/trade-secrets/trade-secrets-public-report-2sept2021.pdf.**

International Trademark Association (INTA) (14 April 2023). International Trademark Association Releases White Papers on Trademarks in the Metaverse and Non-Fungible Tokens. Retrieved from: **https://www.inta.org/news-and-press/press-releases/the-international-trademark-association-releases-white-papers-on-trademarks-in-the-metaverse-and-non-fungible-tokens/**.

John Plansky, Tim O'Donnell, Kimberly Richards (2016). A Strategist's Guide to Blockchain, strategy+business. Retrieved from: **https://www.strategy-business.com/article/A-Strategists-Guide-to-Blockchain.**

Julian Kwan. Public vs Private Blockchain. InvestaX. Retrieved from: **https://investax.io/knowledge-center/blog/public-vs-private-blockchain.**

McKinsey (2022). What is blockchain? Retrieved from: **https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-blockchain.**

Michael Burn (2018). IP Australia's Blockchain Initiatives. CWS/6. Retrieved from: **https://www.wipo.int/edocs/mdocs/classifications/en/cws_6/cws_6_item_5b_ip_australia.pdf.**

Ministry of Law, Singapore (2019). Singapore Copyright Review Report. Retrieved from: **https://www.mlaw.gov.sg/files/news/public-consultations/2021/copyrightbill/Annex_A-Copyright_Report2019.pdf.**

Monetary Authority of Singapore (2022). MAS Partners the Industry to Pilot Use Cases in Digital Assets. Retrieved from: **https://www.mas.gov.sg/news/media-releases/2022/mas-partners-the-industry-to-pilot-use-cases-in-digital-assets.**

Monetary Authority of Singapore (2022). "MAS' Approach to the Crypto Ecosystem" – Summary of Keynote Interview by Mr Ravi Menon, Managing Director, Monetary Authority of Singapore, at the Financial Times' Crypto & Digital Assets Summit on 27 April 2022. Retrieved from: **https://www.mas.gov.sg/news/speeches/2022/mas-approach-to-the-crypto-ecosystem.**

Monetary Authority of Singapore (2022). "Yes to Digital Asset Innovation, No to Cryptocurrency Speculation" – Opening Address by Mr Ravi Menon, Managing Director, Monetary Authority of Singapore, at Green Shoots Seminar on 29 August 2022. Retrieved from: **https://www.mas.gov.sg/news/speeches/2022/yes-to-digital-asset-innovation-no-to-cryptocurrency-speculation.**

Olga Kharif (2023). How a Series of Crypto Meltdowns Is Reshaping the Industry, The Washington Post. Retrieved from: **https://www.washingtonpost.com/business/how-a-series-of-crypto-meltdowns-is-reshaping-the-industry/2023/01/20/c8f0a1b8-98a5-11ed-a173-61e055ec24ef_story.html.**

OpenCerts. Frequently Asked Questions. Retrieved from: **https://www.opencerts.io/faq.**

OpenNodes, Temasek, IBM, PwC Singapore, EY, SGTech, IMDA, MAS (2020). 2020 Singapore Blockchain Ecosystem Report. Retrieved from: **https://opennodes.com/Singapore-Ecosystem-Report-2020.pdf.**

Petru Dumitriu (2020). Blockchain applications in the United Nations system: towards a state of readiness. Retrieved from: **https://www.unjiu.org/news/blockchain-applications-united-nations-system-towards-state-readiness-jiurep20207.**

PricewaterhouseCoopers (2020). Time for trust: How blockchain will transform business and the economy. Retrieved from: **https://www.pwc.com/timefortrust.**

PricewaterhouseCoopers (PwC) (2018). Blockchain is here. What's your next move? PwC's Global Blockchain Survey 2018. PwC. Retrieved from: **https://www.pwc.com/jg/en/publications/blockchain-is-here-next-move.html.**

PricewaterhouseCoopers (PwC) (2020). Blockchain technologies could boost the global economy US$1.76 trillion by 2030 through raising levels of tracking, tracing and trust. PwC. **https://www.pwc.com/gx/en/news-room/press-releases/2020/blockchain-boost-global-economy-track-trace-trust.html.**

Ravi Menon (2022). Making Sense of Crypto. International Monetary Fund (IMF). Retrieved from: **https://www.imf.org/en/Publications/fandd/issues/2022/09/Making-sense-of-crypto-Ravi-Menon.**

Ravi Menon (2022). "Yes to Digital Asset Innovation, No to Cryptocurrency Speculation" - Opening Address at Green Shoots Seminar, Monetary Authority of Singapore (MAS). Retrieved from: **https://www.mas.gov.sg/news/speeches/2022/yes-to-digital-asset-innovation-no-to-cryptocurrency-speculation.**

Singapore Government Developer Portal (last updated on 24 August 2022). OpenCerts – An Easy Way to Check and Verify Your Certificates. Retrieved from: **https://www.developer.tech.gov.sg/products/categories/blockchain/opencerts/overview.html.**

Singapore Management University (SMU) (2021). Conversations At The Intellectual Property And Artificial Intelligence Interface: Understanding The Needs Of Singapore's Innovation Community. Retrieved from: **https://caidg.smu.edu.sg/news/2022/jul/25/conversations-intellectual-property-and-artificial-intelligence-interface.**

Smart Nation Singapore. Graduate with a Digital Academic Certificate. Retrieved from: **https://www.smartnation.gov.sg/initiatives/digital-government-services/opencerts.**

Stuart D. Levi and Alex B. Lipton (2018). An Introduction to Smart Contracts and Their Potential and Inherent Limitations. Retrieved from: **https://corpgov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/.**

United Nations Conference on Trade and Development (UNCTAD) (2023). Global Report on Blockchain and its Implications on Trade Facilitation Performance. Retrieved from: **https://unctad.org/publication/global-report-blockchain-and-its-implications-trade-facilitation-performance.**

World Economic Forum (WEF) (2018). Blockchain Beyond the Hype. Retrieved from: **https://www3.weforum.org/docs/48423_Whether_Blockchain_WP.pdf.**

World Economic Forum (WEF) (2018). Building Block(chain)s for a Better Planet. Retrieved from: **https://www3.weforum.org/docs/WEF_Building-Blockchains.pdf.**

World Economic Forum (WEF) (2020). Global Standards Mapping Initiaitve: An overview of blockchain technical standards. Retrieved from: **https://www.weforum.org/whitepapers/global-standards-mapping-initiative-an-overview-of-blockchain-technical-standards/.**

World Intellectual Property Organization (WIPO) (2021). Report for the Eighth Session of the Committee on WIPO Standards (CWS). Retrieved from: **https://www.wipo.int/edocs/mdocs/cws/en/cws_8/cws_8_24.pdf.**

World Intellectual Property Organization (WIPO) (2022). WIPO Releases White Paper on Blockchain and IP ecosystems. Retrieved from: **https://www.wipo.int/standards/en/news/2022/news_0001.html.**

World Intellectual Property Organization (WIPO) (2023). Global Innovation Index 2023: Innovation in the face of uncertainty. Retrieved from: **https://www.wipo.int/global_innovation_index/en/2023/.**

Yadav, J., & Shevkar, R. (2021). Performance-based analysis of blockchain scalability metric. *Tehnički glasnik*, 15(1), 133-142.

# Annex I – Survey

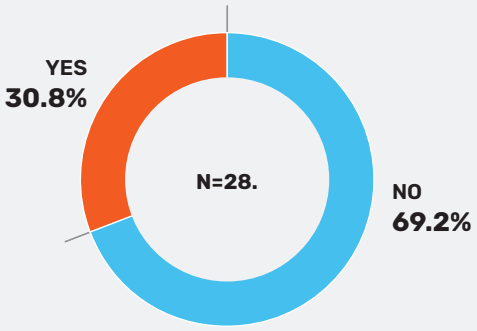
This annex provides additional information (e.g., respondent profile, and list of survey questions) for the blockchain survey. It also covers the rest of the questions which were not featured in the main report.

## Respondent profile

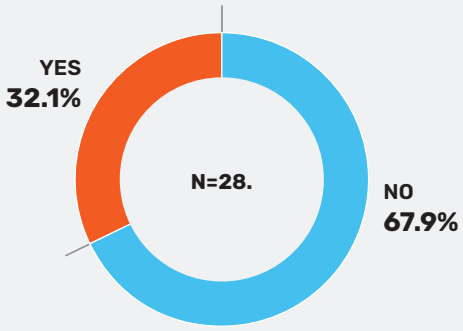
As part of the blockchain survey, we asked respondents about Singapore's blockchain ecosystem, their individual roles, and how their organisations were connected to either the IP or blockchain industry.

### Mapping of ecosystem actors

**Are you aware of any users and/or developers of blockchain solutions for the IP ecosystem?**

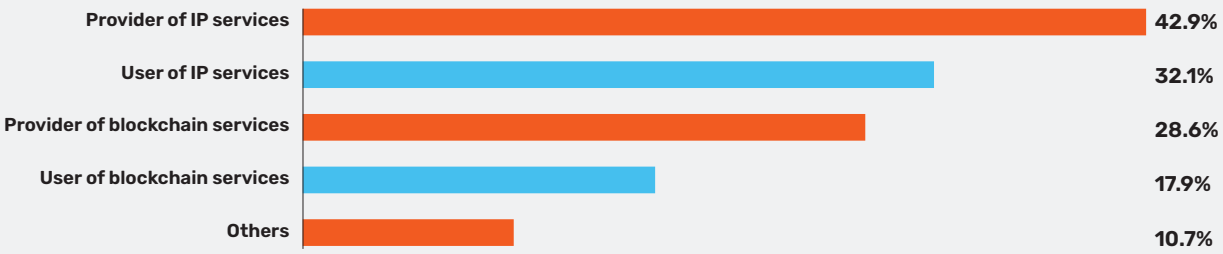



**Have you been involved in the development of or running of blockchain solutions?**




### Respondents' role as users or providers

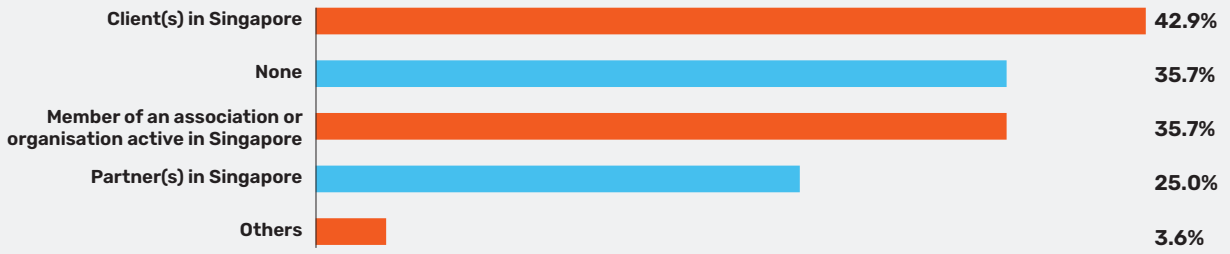
**What is your role in the IP and blockchain ecosystem?**




**N=28. Multiple answers could be selected.**

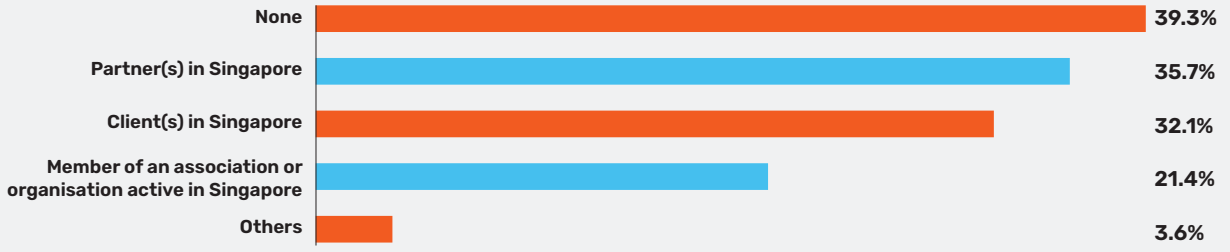
## Respondents' current and planned connections with the Singapore IP or blockchain ecosystem

**Does your organisation have any connection with IP or blockchain ecosystem in Singapore?**




**N=28. Multiple answers could be selected.**

**Does your organisation have any plans to change or expand its relations to the IP or blockchain ecosystem in Singapore?**



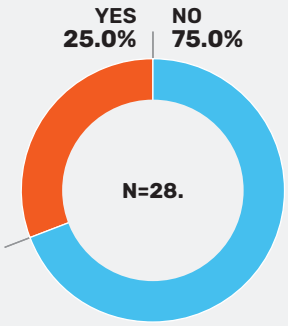

**N=28. Multiple answers could be selected.**

## Other questions in the blockchain survey

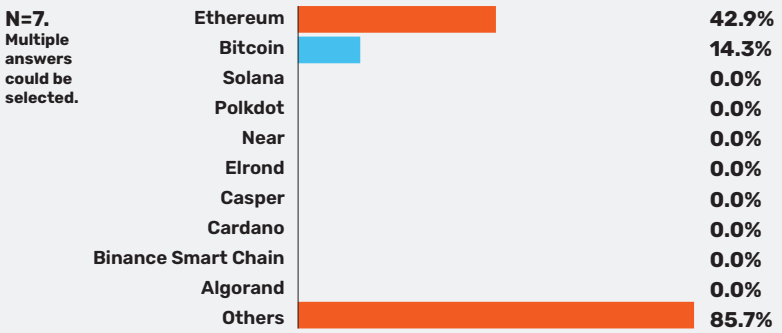
### Blockchain standards

As part of the blockchain survey, we asked respondents that are currently using blockchain protocols to share their views on blockchain standards. Due to the small sample size (n=7), we recommend caution in the interpretation of the findings.

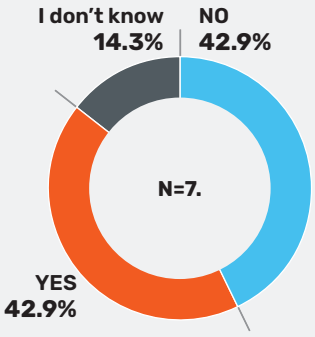
**Are you currently using any blockchain protocol(s)?**



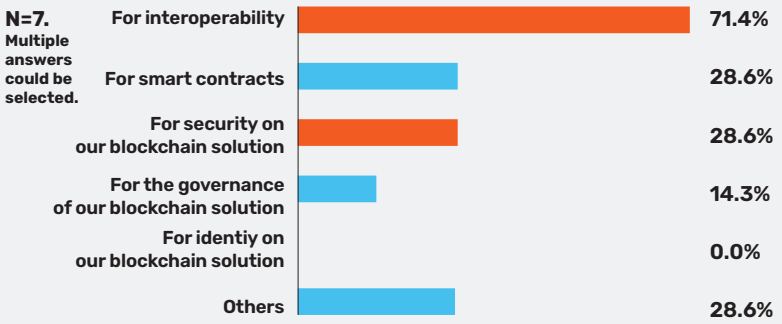

**Which blockchain protocol(s) are you currently working with (Layer-1)?**



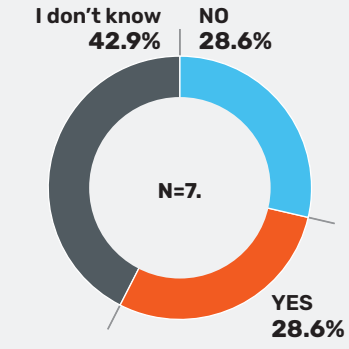

**Do you use standards from international organisations** (eg., ISO-307, ITU, ETSI, others)**?**




**What are the reason/s of adopting the standards for your blockchain solution?**




**Have you considered adopting a different standard in the future?**



# Full Questionnaire for Blockchain Survey

## SURVEY ON BLOCKCHAIN AND FUTURE OF IP ECOSYSTEM

### MAPPING OF ACTORS

**Q1.** **Are you aware of any users and/or developers of blockchain solutions for the IP ecosystem?** **(Please select only one)**

1. Yes
2. No

If yes, please share with us the names of these stakeholders. **[open text answer]**

### APPLICATIONS OF BLOCKCHAIN IN IP ECOSYSTEMS

**Q2.** **Have you been involved in the development of or running of blockchain solutions?** **(Please select only one)**

1. Yes
2. No

If yes, please elaborate. **[open text answer]**

**Q3.** **Which use cases of blockchain can potentially be the most beneficial for the IP ecosystem?** **(Select all that apply)**

1. IP register
2. Evidence of generation
3. Track and trace of source of origin
4. IP rights enforcement
5. Priority document exchange
6. Certification mark
7. Evidence of trademark use
8. Prosecution of plant variety protection application
9. IP rights transfer
10. IP licenses
11. Others, please specify. **[open text answer]**

**Q4.** **Kindly explain how you think the selected use cases will benefit the IP ecosystems e.g., most value-add, or address key challenges, etc.** **[open text answer]**

**Q5.** **Which use cases of blockchain are the most deployable for the IP ecosystem in the near future?** **(Select all that apply)**

1. IP register
2. Evidence of generation
3. Track and trace of source of origin
4. IP rights enforcement
5. Priority document exchange
6. Certification mark
7. Evidence of trademark use
8. Prosecution of plant variety protection application
9. IP rights transfer
10. IP licenses
11. Others, please specify. **[open text answer]**

**Q6.** **What role should IP offices take (e.g., regulator, facilitator, user/adopter) in relation to blockchain and the IP ecosystem? Why?** **[open text answer]**

### UNCERTAINTIES AND CHALLENGES

**Q7.** **Which areas do you see uncertainties and challenges arising from blockchain developments in the IP ecosystem?** **(Select all that apply)**

1. Technical
2. Legal
3. Economic
4. Political
5. Others, please specify. **[open text answer]**

**Q8.** **What aspects of the IP system need to be changed to capture blockchain developments in the IP ecosystem?** **(Select all that apply)**

1. IP legislation
2. IP office filing system
3. IP office processes
4. IP policy
5. Nothing
6. Others, please specify. **[open text answer]**

## BLOCKCHAIN STANDARDS

**Q9. Which blockchain protocol(s) are you currently working with (Layer-1)?**
**(Select all that apply)**

1. Algorand
2. Binance Smart Chain
3. Bitcoin
4. Cardano
5. Casper
6. Elrond
7. Ethereum
8. Near
9. Polkadot
10. Solana
11. Others, please specify. **[open text answer]**

**Q10. On the selected blockchain protocol(s), which (Token-)Standard do you use (e.g., ERC-721, etc.)?** **[open text answer]**

**Q11. Do you use standards from international organisations (e.g., ISO-307, ITU, ETSI, others)?**
**(Please select only one)**

1. Yes
2. No
3. I don't know

If yes, please elaborate. **[open text answer]**

**Q12. What are the reason/s of adopting the standards for your blockchain solution?**
**(Select all that apply)**

1. For interoperability
2. For the governance of our blockchain solution
3. For security on our blockchain solution
4. For identity on our blockchain solution
5. For smart contracts
6. Others, please specify. **[open text answer]**

**Q13. Have you considered adopting a different standard in the future?**
**(Please select only one)**

1. Yes
2. No
3. I don't know

If yes, please elaborate. **[open text answer]**

**Q14. Which blockchain standard(s) do you think will be relevant in the future?** **[open text answer]**

## PARTICIPANT INFORMATION

**Q15. What is your role in the IP and blockchain ecosystem?** **(Select all that apply)**

1. Provider of blockchain services
2. Provider of IP services
3. User of blockchain services
4. User of IP services
5. Others, please specify **[open text answer]**

**Q16. Please elaborate on the IP/blockchain services that you provide/use.**
**[open text answer]**

**Q17. Does your organisation have any connection with IP or blockchain ecosystem in Singapore?**
**(Select all that apply)**

1. Partner(s) in Singapore
2. Client(s) in Singapore
3. Member of an association or organisation active in Singapore
4. None of the above
5. Others, please specify. **[open text answer]**

**Q18. Does your organisation have any plans to change or expand its relations to the IP or blockchain ecosystem in Singapore?**
**(Select all that apply)**

1. Partner(s) in Singapore
2. Client(s) in Singapore
3. Member of an association or organisation active in Singapore
4. None of the above
5. Others, please specify. **[open text answer]**

**End of survey**

# Annex II – Blockchain Patent Statistics

This annex provides additional information on the blockchain patent statistics presented in this report.

## Methodology

We used data from Patsnap.[12] Data was extracted August 2023. The search was limited to simple patent families[13] with an earliest application date on or after 2003 and up to and including 2022. We defined blockchain patents as those in select technology fields (by International Patent Classification (IPC) codes) and with specific keywords found in the title, abstract or claims.

| Search strategy | Patsnap search query[14] |
|---|---|
| Patents with IPC codes of H04L9/00, H04W4/70, G06Q20/38, G06Q10, G06Q30, G06Q40, G06Q50, H04L29/06, H04L67/104, or H04L63/00. | IPC: (H04L9/00 OR H04W4/70 OR G06Q20/38 OR G06Q10 OR G06Q30 OR G06Q40 OR G06Q50 OR H04L29/06 OR H04L67/104 OR H04L63/00) |
| Patents with keywords found in the title, abstract or claims. | TAC: (block#chain OR blockchain* OR "block chain" OR (Public $PRE3 Ledger) OR (Distribut* $PRE3 Ledger) OR (Decentral* $PRE3 Ledger) OR (Merkle $PRE3 tree*) OR (non#fungible $PRE2 token*)) |

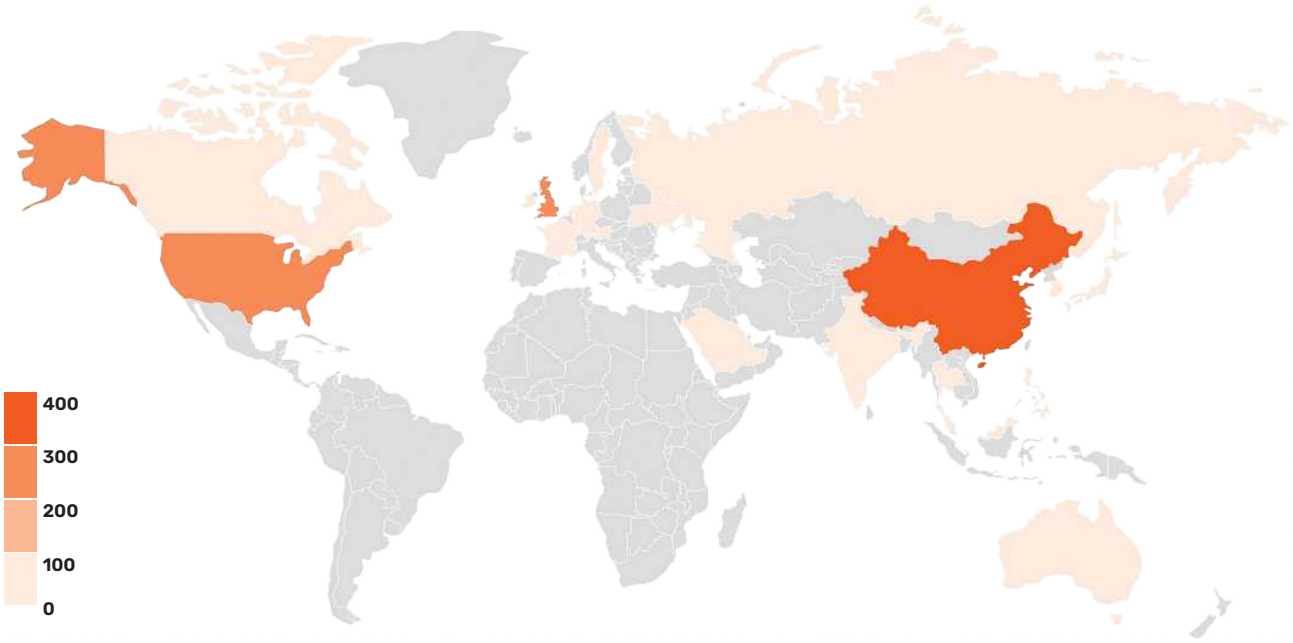
12 Patsnap Analytics database (www.patsnap.com).

13 A simple patent family is a collection of patent documents that are considered to cover a single invention. The technical content covered by the applications in one simple patent family is identical. Patent applications that are members of one simple patent family will have the same priorities. The application with the earliest application date within the simple patent family was referenced for analysis.

14 Note: In the search query, '*' acted as a wildcard that could be used to replace a string of characters at any place within a word, '#' acted as a wildcard that could be used to replace zero or an individual character at any place within a word, and '$PREn' could be used to identify search words that were within n words of each other, in the order specified.

## Additional information

### Singapore as a destination – countries of parent companies of current assignees




The largest assignees, at the parent company level, of blockchain patents filed in Singapore were Ant Group, nChain, Visa, Mastercard and JPMorgan Chase.

| Parent company of current assignee[15] | Parent company country | Number of blockchain patent families[16] |
|---|---|---|
| Ant Group Co., Ltd | China | 310 |
| nChain Holdings Ltd. | United Kingdom | 50 |
| Visa, Inc. | United States | 20 |
| Mastercard, Inc. | United States | 20 |
| JPMorgan Chase & Co. | United States | 20 |

15 If the Patsnap standardised current assignee is a subsidiary company, the parent company is shown. Corporate tree information based on data from Patsnap Discovery.

16 Values were rounded to the nearest tenth. In instances where a patent has more than one current assignee, each assignee is allocated a single count.

# TOP 10
## Current Assignees of Blockchain Patents Using Singapore as Destination

| Patsnap standardised current assignee[17] | Parent company[18] | Parent company country | Number of blockchain patent families[19] |
|---|---|---|---|
| Advanced New Tech Co Ltd | Ant Group Co., Ltd | China | 250 |
| nChain HLDG Ltd | nChain Holdings Ltd. | United Kingdom | 50 |
| Alipay (Hangzhou) Information Tech Co Ltd | Ant Group Co., Ltd | China | 30 |
| Visa Int Service Assoc | Visa, Inc. | United States | 20 |
| Alipay Labs Singapore Pte Ltd | Ant Group Co., Ltd | China | 20 |
| Mastercard Int Inc | Mastercard, Inc. | United States | 20 |
| JPMorgan Chase Bank NA | JPMorgan Chase & Co. | United States | 10 |
| Tzero IP LLC | Overstock.com, Inc. | United States | 10 |
| Tencent Tech (Shenzhen) Co Ltd | Tencent Holdings Ltd. | China | 10 |
| nChain Licensing AG | nChain Licensing AG | Switzerland | 10 |

# TOP 10
## Current Assignees of Blockchain Patents that Resided in Singapore

| Patsnap standardised current assignee[20] | Parent company[21] | Parent company country | Number of blockchain patent families[22] |
|---|---|---|---|
| Alipay Labs Singapore Pte Ltd | Ant Group Co., Ltd | China | 50 |
| 杜晓楠 (Du Xiaonan) | Individual | – | 20 |
| Mastercard Asia Pacific | Mastercard, Inc. | United States | 10 |
| Lenovo (Singapore) Pte Ltd | Lenovo Group Ltd. | China | 10 |
| OneConnect Financial Tech Singapore Co Pte Ltd | OneConnect Financial Technology Co. Ltd. | China | <5 |
| OneConnect Smart Tech Co Ltd Shenzhen | OneConnect Technology Co., Ltd. | China | <5 |
| Cheong Simon Kai Tse | Individual | – | <5 |
| Credify Pte Ltd | Credify Pte Ltd. | Singapore | <5 |
| UST Global (Singapore) Pte Ltd | UST Global, Inc. | United States | <5 |
| Huawei Int (Huawei International Pte Ltd) | Huawei Technologies Co., Ltd. | China | <5 |

17 The current owner of a patent adjusted by Patsnap using a standardisation algorithm for the variation in names that companies used when they filed patents.
18 If the Patsnap standardised current assignee is a subsidiary company, the parent company is shown. Based on data from Patsnap Discovery.
19 Values were rounded to the nearest tenth. In instances where a patent has more than one current assignee, each assignee is allocated a single count.
20 The current owner of a patent adjusted by Patsnap using a standardisation algorithm for the variation in names that companies used when they filed patents.
21 If the Patsnap standardised current assignee is a subsidiary company, the parent company is shown. Based on data from Patsnap Discovery.
22 Values were rounded to the nearest tenth. In instances where a patent has more than one current assignee, each assignee is allocated a single count.

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