

Singapore Blockchain Ecosystem 2019

Driving towards a decentralized world:
A glimpse into Singapore's vibrant and diverse blockchain landscape



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Writing, Contributions and Research: Kelvin Lee, Anouchka Bee Forey, Hanny Kusumawardhani and Riley Kim

Design: Francesco Cianciulli

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SECTION ONE

Welcome to Singapore

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The vibrancy of the Singapore blockchain ecosystem is in line with Singapore's ambition to anchor itself as a Smart Nation on the global map”



Preface

Creating a smarter and more connected world with blockchain

Digital technologies are transforming the way we live, work and play by enabling a more connected world with secure and frictionless sharing of information. Blockchain and distributed ledger technology (DLT) is an effective enabler of safe and seamless information flows in digital business environments.

Blockchain can not only transform existing businesses but also has the potential of opening up new business opportunities. It can facilitate greater transparency, open business models, portability of information and greater operational efficiency.

At Temasek, we have identified several structural trends that guide our direction as an investor – these include trends that are driven by technology, such as Smarter Systems, a Sharing Economy and a more Connected World. Innovative technologies such as blockchain are key enablers of growth, in areas such as digital financial services, which is set to generate US\$38 billion in annual revenue by 2025*¹, as well as other areas like digital advertising and healthcare. We track these technologies closely to better understand the impact they have on us as an investor and on society as a whole, across a wide range of sectors.

Over the years, we have embarked on various opportunities to collaborate and partner with government agencies and companies to advance the use of these technologies – for example, we have partnered MAS on Project Ubin to explore the use of DLT beyond traditional focus on capital markets and trade finance. This blockchain ecosystem report you are reading also highlights the various industry efforts that key players are putting into developing the space to foster a vibrant and innovative space to explore these technologies. The vibrancy of the Singapore blockchain ecosystem is in line with Singapore’s ambition to anchor itself as a Smart Nation on the global map.

There are many developments in the space that excite us, and we look forward to more opportunities to contribute to Singapore’s pioneering efforts to lead in the blockchain space.

Mr Chia Song Hwee

President & Chief Operating Officer,
Temasek International

¹ [Google, Temasek, Bain & Company e-Economy SEA 2019 Report](#), Temasek, 2019.

As digital transformation continues to disrupt how businesses operate, it will also help to develop new growth opportunities. The Infocomm Media Development Authority (IMDA) will help businesses and individuals to seize these opportunities and build greater capabilities in Singapore's Digital Economy. Developments in emerging technologies such as Blockchain have the potential to enhance Singapore's digital competitiveness. IMDA has worked closely with industry and government agencies in the development of the Singapore Blockchain Ecosystem 2019 report, an overview presentation of Singapore's vibrant and diverse blockchain landscape. This will help to further showcase the substantial progress made by both public and private participants in Singapore.

Today, blockchain technology remains nascent for many as it has not reached mainstream adoption, and a lot more can be done to grow the ecosystem. IMDA has taken the first step with the support of TRIBE Accelerator's launch of OpenNodes. This is a web-based engagement platform, that aims to bring together government agencies, corporates, and blockchain companies to foster innovation and collaboration in the blockchain community. The Singapore Blockchain Ecosystem 2019 report offers a glimpse of the Blockchain companies and projects in Singapore, and we hope this creates greater global awareness about the ecosystem in Singapore, whilst also providing potential international opportunities for these companies.

"We are pleased to collaborate with industry and government agencies to develop the Singapore Blockchain Ecosystem 2019 report that highlights exciting opportunities in Singapore's Digital Economy. In fostering innovation and collaboration within Singapore's blockchain community, IMDA has already taken the first steps with the development of OpenNodes to bring together stakeholders within the blockchain ecosystem into an engagement platform. To further spur vibrancy in Singapore's blockchain ecosystem, IMDA is also launching the Blockchain Challenge to grow and connect blockchain business networks. This Blockchain Challenge will feature themes from Government-led efforts, such as TradeTrust, as well as industry-led efforts. We look forward to seeing greater growth and innovations within the community."

Mr Philip Heah

Assistant Chief Executive, Technology & Infrastructure Group
Infocomm Media Development Authority (IMDA)

The Monetary Authority of Singapore (MAS) aims to promote an innovative and dynamic financial sector by working with the industry to harness the power of technology. Blockchain is one such technology that has the potential to transform many industries and economic activities. MAS has taken a proactive step of co-innovating with the financial sector on exploring the use of blockchain technology for payments and settlement through Project Ubin since 2016. MAS supports FinTech companies and financial institutions through funding grants for Proof of Concept experimentation under the Financial Sector Technology and Innovation (FSTI) Proof of Concept scheme, and with regulatory guidance through the Regulatory Sandbox. These efforts have catalysed widespread experimentation, and we are pleased to see continued interest and adoption of the technology in the financial services sector.

We are excited that the combined efforts of MAS, IMDA and the blockchain ecosystem have advanced the use of blockchain technology across sectors and in wide-ranging use-cases. Financial services are closely linked to all other business activities in the broader economy. The use of blockchain technology in other sectors creates new opportunities for the financial industry, especially in the areas of payments and financing. We believe that the next wave of blockchain innovation will be at the intersection of financial and non-financial sectors. The Singapore Blockchain Ecosystem 2019 highlights the confluence of blockchain activities in Singapore, and we hope that this will further promote Singapore's role as a regional hub for blockchain and FinTech innovation.

"The Singapore Blockchain Ecosystem 2019 highlights the confluence of blockchain activities in Singapore, and we are excited that the combined efforts of MAS, IMDA and the blockchain ecosystem have advanced the use of blockchain technology across sectors and in wide-ranging use-cases. Financial services are closely linked to all other business activities in the broader economy, and the use of blockchain technology in other sectors creates new opportunities for the financial industry, especially in the areas of payments and financing."

Mr Sopnendu Mohanty

Chief FinTech Officer

Monetary Authority of Singapore

Introduction

The world is continually changing, driven by technological innovations that can have a major impact on the way we live and do business. Organisations increasingly understand the need to innovate to stay ahead of disruption and have been looking to leverage emerging technologies to advance their businesses and modernise their core infrastructure. Blockchain, being one of the emerging technologies in this digital era, has gathered an overwhelming amount of interest and hype since 2013.

The value of a blockchain is advancement in the transparency and reliability of the network: participants can establish a trusted and immutable record of transactions without the need for intermediaries. The decentralised architecture of a blockchain — a distributed network of computers simultaneously running the software and validating the chain of transactions — is what ensures that the transaction record is not compromised. Decentralisation is critical as an architectural principle. It makes a blockchain network much less likely to fail, harder to attack and harder for bad actors to game the system.

The initial interest may have been focused on cryptocurrency. Over time, much interest has been gathered from entrepreneurs, startups, investors, global enterprises and governments in the underlying technology, recognising it as a potentially transformative technology with the ability to improve returns and disrupt existing business models. Enterprises are coming to understand the need for such a technology and are actively exploring the application of blockchain in their respective industries.

In Singapore, there are blockchain projects being applied in a variety of industries, from financial services, to trade, and even in art. OpenNodes recently released a map of the Singapore blockchain ecosystem, which demonstrates the vibrancy and diversity of blockchain initiatives being developed in the city state². This report aims to take a deeper look and examine some of these notable blockchain initiatives in Singapore.

WHY IS BLOCKCHAIN IMPORTANT FOR SINGAPORE?

According to the IMDA's Future Of Services report³, the blockchain market in Singapore has the potential to achieve a market spending up to US\$272 million market in 2022 and up to US\$2.6 billion market by 2030 with a CAGR of 32.5%.

Gartner predicts that blockchain's business value-add will grow to slightly over US\$360 billion by 2026 globally, then surge to more than US\$3.1 trillion by 2030⁴. In the longer term, projections indicate that the global blockchain market is expected to grow from US\$212 million 2016 to US\$8,683 million by the end of 2024, at a compound annual growth rate (CAGR) of 59.04%⁵.

Although blockchain development is leading in the FinTech sector, other industries are also in search for use cases that provide a return on investment to justify the cost and effort of implementing blockchain solutions⁶. Singapore has received recognition as one of the leading blockchain centres in the world where companies can collaborate, experiment and scale⁷.

2 [Ecosystem Map](#), OpenNodes. 2019.

3 ["Annex A-4: AI, Data and Blockchain"](#), IMDA.

4 ["The CIO's Guide to Blockchain."](#) Gartner. 23 September 2019.

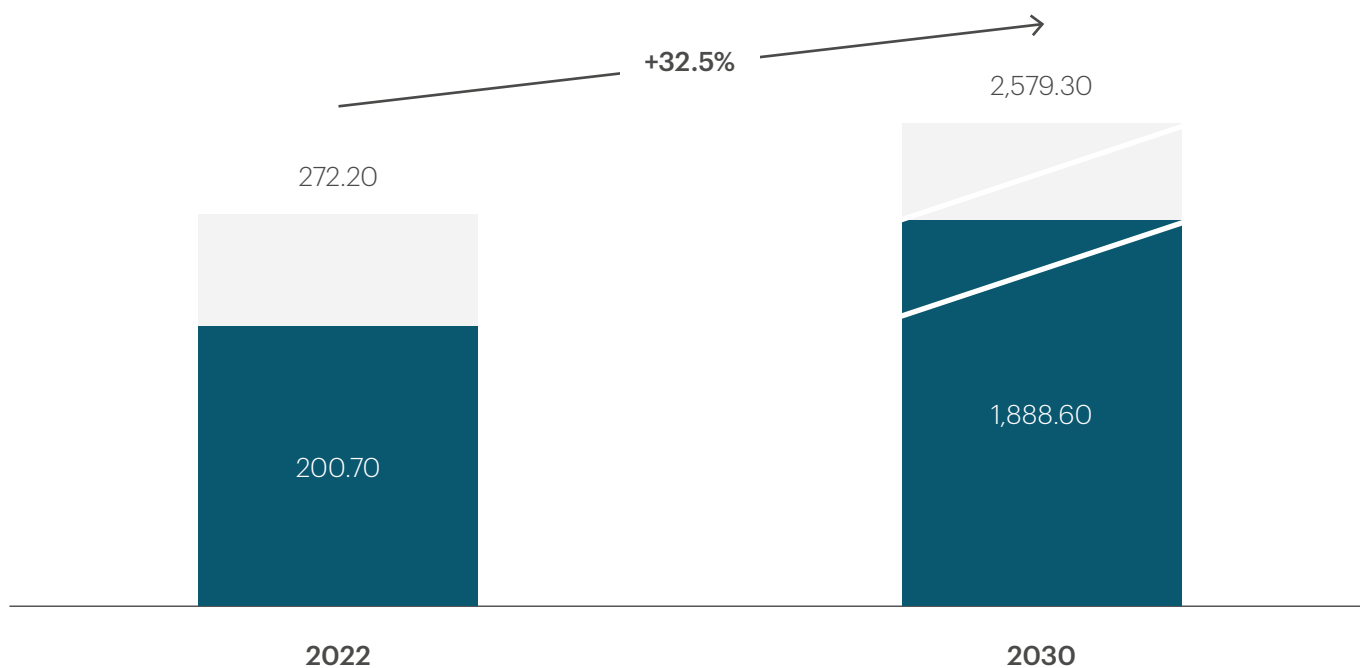
5 [Research And Markets. "Global Blockchain Markets to 2024 - Trends Analysis, Company Usability Profiles & Forecasts."](#) Research and Markets. April 2018.

6 [Deloitte's 2019 Global Blockchain Survey](#), Deloitte. 6 May 2019.

7 ["Is the Block Chain a Solution Looking for a Problem?"](#), MAS. 7 March 2019.

Singapore blockchain market size*

USD Million



*Singapore's Blockchain market size is triangulated based on data and insights from: IDC Worldwide Semiannual Blockchain Spending Guide; Gartner Forecast; Enterprise IT Spending by Vertical Industry Market, Worldwide, 2016-2022, 2Q18 Update; Gartner Forecast; Communications Service Provider Operational Technology, Worldwide by Country, 2016-2022; Gartner Broadband Access System by Region, 1998-2007; Gartner Consumer Communications Market Revenue 2007-2013; D&B Hoovers.

To further augment and support Singapore's efforts, IMDA has issued a series of Blockchain Challenges to promote awareness and adoption of the technology beyond FinTech, and encourage companies to explore business model innovation and/or transformation arising from the technology.

WHAT WE HOPE TO SEE FOR BLOCKCHAIN IN SINGAPORE'S ECOSYSTEM

Blockchain has a multi-disciplinary foundation, involving more than technology, and includes design thinking, legality, finance, economics, behavioural science and others. Singapore has been progressing towards an innovation-driven economy through investments in research and expanding related capabilities of its universities and research institutes.

One important step forward was the unveiling of OpenNodes in November 2019, a neutral engagement platform supported by IMDA. The platform aims to foster collaborations among key stakeholders of the blockchain ecosystem and consolidate efforts towards mass adoption⁸. We hope to see strong participation of the blockchain community, so that collectively, Singapore can continue to innovate with the emerging technology and generate new business possibilities.

These efforts help Singapore to build up the innovation capacity of its companies to drive economic growth. To this end, investing in building capabilities in emerging technologies such as blockchain would enable Singapore to keep pace in this vibrant and evolving space.

⁸ ["Blockchain accelerator TRIBE introduces OpenNodes to build an innovation melting pot"](#), e27. 21 August 2019.



Why Singapore?

In just five decades, Singapore has engineered a tiny post-war colonial settlement into an elaborate ecosystem designed to be highly conducive to the growth of both capital and entrepreneurial talent. 2019 is a special year for Singapore; this year's Singapore Bicentennial marks the 200th anniversary of Sir Stamford Raffles' arrival, the founder of modern Singapore. Singapore's evolution was built on its people and their ideas and it never let its size constrain its big thinking. 2019 also marked the year Singapore was awarded the smartest city in the world, according to the IMD Smart City index⁹ and was crowned by the World Economic Forum (WEF) flagship Global Competitiveness Report as the most competitive economy in 2019 in the world¹⁰. Residents from each city were polled on their ideas of the city's existing infrastructure and technology.

Mr Christos Cabolis, chief economist at IMD Business School's Competitiveness Centre, told The Straits Times: "Singapore topped the ranking because, according to its citizens, it is performing superbly in providing high quality infrastructure in the areas we study, while at the same time adopting technologies in an efficient way to make the lives of Singaporeans better."¹¹

This year, Singapore unveiled the Jewel — a S\$1.3 billion glass biodome where a towering rain vortex nearly twice the height of the Rhine Falls (Europe's most powerful waterfall) is housed within a megamall. Jewel serves as a symbol of Singapore's success and provides a valuable metaphor for how a country can create the conditions to enable technological innovations to thrive.

FERTILE FOUNDATIONS

The Jewel biodome houses a staggering 2,000 trees and palms, and over 100,000 shrubs; meeting the needs of such an ecosystem requires extensive supporting infrastructure for fertilisation and irrigation¹². Much in the same way, Singapore has deliberately engineered a fertile economic environment; rich in two key ingredients essential to innovation and investment — capital and talent.

For over a decade, Singapore has ranked among the top three countries on the World Bank's Ease of Doing Business Index¹³. Generous government grants exist to encourage companies to adopt new technology and expand globally. Additionally, Singapore offers one of the most highly educated talent pools for hire. The latest Global Talent Competitiveness Index ranks Singapore second in the world, and first in the Asia-Pacific when it comes to attracting talent. The Singapore Government also launched the Smart Nation Initiative in 2014 to create solutions that will change the country using infocomm technologies, networks and big data.

In 2017, Deputy Prime Minister Heng Swee Keat in his then prevailing role as Finance Minister said the government would invest S\$2.4 billion over four years to execute a nationwide plan to future-proof the economy and help local enterprises go digital¹⁴. "Technology is reshaping businesses, jobs, and lifestyles across the world. We must spot the opportunities in the digital economy, and make the most of our strengths as a nimble, well-educated, tech-savvy society," DPM Heng said.

9 [Smart City Index](#), IMD. 2019.

10 ["Singapore overtakes US as world's most competitive economy: World Economic Forum"](#), Channel News Asia. 9 October 2019.

11 ["Singapore tops world Smart City Index"](#), The Straits Times. 4 October 2019.

12 ["Foreign' plants for Jewel's gardens took almost 3 years to procure, transport and acclimatise"](#), The Straits Times. 11 April 2019.

13 ["The Countries Leading The Way In the World Bank's Ease Of Doing Business Ranking"](#), Forbes. 24 October 2019.

14 ["Singapore government reaffirms \\$1.7B commitment to smart nation, digital transformation"](#), ZDNet. 24 May 2017.

The inherently disruptive nature of innovation means that government is an important stakeholder in any innovation ecosystem.

On average, over 50,000 new businesses are formed in the city-state each year. According to the Singapore Department of Statistics, the number of tech startups in the country has been rising, from 2,800 in 2003 to 4,300 in 2016¹⁵. To add to that, a Bain & Company study in 2017 found that the number of recorded venture capital deals in Singapore quadrupled to 524, when compared to 2012¹⁶. This has driven the exponential growth in Singapore's technology ecosystem, giving investors more reasons to expand into emerging technologies such as blockchain.

These accolades and initiatives are attracting investment and talent into Singapore. Global tech giants such as Google, Facebook and Alibaba have established regional operations in the city, with over US\$10 billion of venture capital invested in local startups in 2018. According to the latest foreign direct investments (FDI) figures released by United Nations Conference on Trade and Development, FDI flowing into Singapore jumped reached an estimated US\$77 billion in 2018 alone, and Singapore reportedly accounted for received 25% of the US\$5.99 billion in capital invested in tech in the first half of 2019¹⁷¹⁸.

CONSIDERING THE CLIMATE

Climate shapes where and how life thrives in any given ecosystem. Singapore, a modern metropolis in the tropics, is well-versed in finding ways to make the climate work for, and not against its progress, even if that sometimes means placing a glass dome over a giant indoor waterfall. A parallel, perhaps, that can be drawn with Singapore's regulatory climate.

Two things distinguish Singapore's regulatory climate, particularly at the crossroads of technology and finance — a willingness to explore ideas and clarity. Firstly, other jurisdictions have been swift to bring down the banhammer on digital currencies and other emerging technologies. A poll by Ernst & Young indicated that regulatory complexity is the greatest

¹⁵ ["Innovation in the Lion City Magazines"](#), The Business Times. 4 September 2019.

¹⁶ ["Investing in Southeast Asia: What's Behind the Boom"](#), Bain & Company. 13 November 2018.

¹⁷ [World Investment Report 2019: Special Economic Zones](#), United Nations Conference on Trade and Development. 2019.

¹⁸ ["Singapore took 25% of US\\$6b in SE Asia tech investments in 1st half of 2019: Report"](#), The Straits Times. 16 August 2019.

barrier to widespread blockchain adoption, whilst regulatory changes are the primary driver of broader integration. The PwC 2018 Global Blockchain Survey also revealed that regulatory uncertainty is the biggest barrier to blockchain adoption¹⁹. However, things are different in Singapore.

Singapore has shown a willingness to explore and experiment with new and emerging technologies. One example is the Monetary Authority of Singapore (MAS) and how it encourages experimentation with innovative technology by partnering with the industry in experimenting with cross-border payments using blockchain and distributed ledger technology. OpenCerts by Government Technology Agency (GovTech) and TradeTrust by IMDA are other examples of the Singapore Government taking a lead on exploring the use of emerging blockchain technologies for practical use cases.

Singapore's regulatory climate takes a consultative approach so as to develop regulations that take into account market realities and industry practices. Speaking at the Singapore FinTech Festival in 2016, Ravi Menon, Managing Director of the MAS explained the three principles underlying Singapore's regulatory approach to innovation:

- 1) regulation must not front-run innovation so as not to stifle innovation prematurely, and regulators must run alongside innovation, 2) regulation comes in only when the risk posed by new technology becomes material or crosses a threshold, and the weight of regulation must be proportionate to the risk posed, and 3) the regulatory approach focuses on the balance of risks posed by new technologies.

The thriving business climate in Singapore is not just about its forward-thinking regulators but also the partnerships it has with countries and stakeholders near and far. In 2017, the Global Innovation Alliance was launched in a bid to create more opportunities for students, entrepreneurs and businesses to connect and collaborate with their overseas counterparts to gain more global experience. This will further strengthen Singapore's connections to major innovation hubs

around the world. To make trade across the world event simpler, Singapore has also signed 24 free trade agreements with several nations including the United States, European Union, Association of Southeast Asian Nations (ASEAN) and China.

The inherently disruptive nature of innovation means that government is an important stakeholder in any innovation ecosystem. Singapore's consultative and business-friendly regulatory environment provides both confidence and clarity to innovators, instead of the outright hostility or uncertainty that they face in other business environments.

THE BLOCKCHAIN BOOM

When Bitcoin entered the mainstream global techno-financial narrative, the Singapore ecosystem was well positioned to experiment with the technology underpinning it. The blockchain ecosystem in Singapore is vibrant, diverse and innovative - with span ranging from protocols to arts and even global enterprise powerhouses such as major financial institutions exploring blockchain solutions.

The entrepreneurial spirit underpinning this historic trading outpost continues to be reflected in the activities of companies exploring distributed technology within Singapore. In addition to those engaged in building blockchain solutions, the Singapore blockchain ecosystem includes a strong base of industry supporters that help to nurture and drive innovation. In the next section, 'The Singapore Ecosystem' delves more about some of the players in the wider ecosystem that are helping to shape the sector.

¹⁹ ["PwC Global Blockchain Survey"](#), PwC. 2018.

The Singapore Ecosystem

ecosystem /'i:kəʊsɪstəm/

the complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space.

Encyclopaedia Britannica

Singapore's blockchain market spending has the potential to reach between US\$1.9 billion to US\$2.6 billion by 2030, according to a separate finding by the IMDA²⁰. Recently, a Singapore Blockchain Landscape Map was co-developed by IMDA, together with Tribe Accelerator and it showed a subset of over 500 companies and entities with blockchain as their primary business or significantly engaging in distributed technology. Given its global reputation and track record of providing regulatory certainty and fertile foundations for commerce, many leading blockchain projects see Singapore as their desired destination. Along with token and protocol projects, security token exchanges, custody providers and cryptofinance companies are setting up shop in Singapore.

These companies and those looking to enter the blockchain space have the support of organisations like Tribe Accelerator, Singapore's first government supported blockchain accelerator. Recently, Tribe Accelerator with the support of the IMDA published a map of the Singapore blockchain ecosystem, showing companies and projects spread across 25 different sectors. These sectors include financial services, consulting, applications, protocols and solutions and infrastructure and ecosystem support. The companies covered in this mapping and the report will include a wide variety of companies in Singapore including:

- Kommerce, who built a trade and finance platform which allows merchants in frontier markets like Africa to safely trade with other merchants
- 1xchange, the first regulated private securities exchange built on a public blockchain
- InfoCorp, an integrated FinTech and AgriTech company aiming to bring inclusive financial services to the livestock industry in emerging markets

The report will be featuring these companies, government agencies, incubators, universities and more in detail.

WHAT MAKES AN ECOSYSTEM

A thriving ecosystem is one made of many different species. In a blockchain ecosystem, this includes incubator communities, industry-led associations, companies, universities and foundations. Here are a few examples of what makes the Singapore ecosystem special.

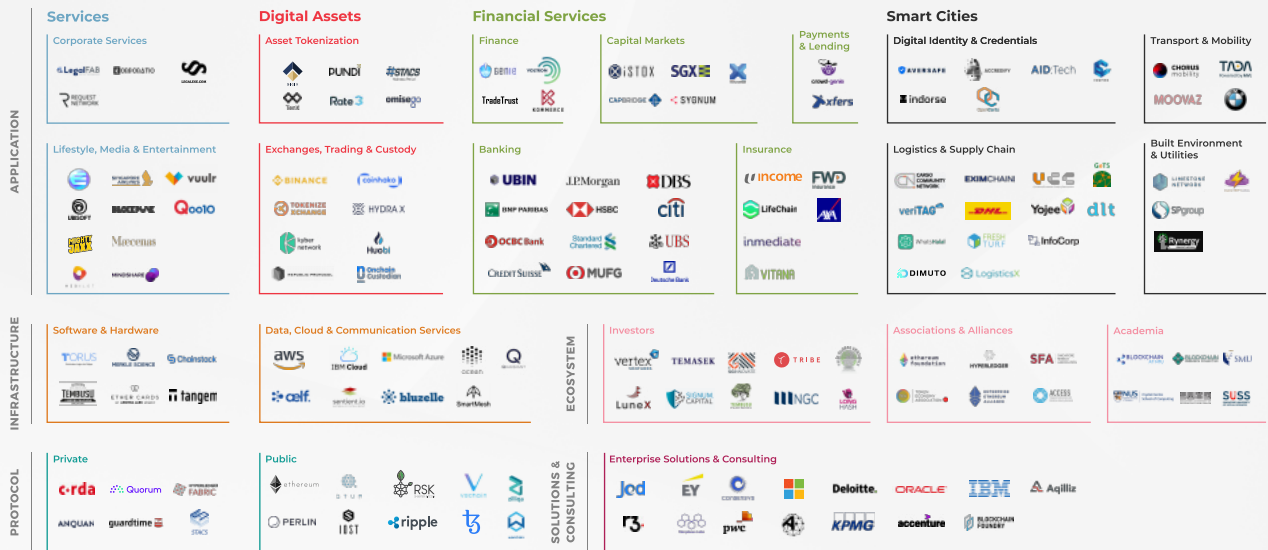
THE ECOSYSTEM BUILDER - TRIBE ACCELERATOR

In an industry that thrives on collaboration, there is a need for various blockchain organisations to work with one another to foster robust growth in the blockchain landscape. One company that has been making waves in the blockchain industry to address this need is Tribe.

As the first Singapore government-supported blockchain ecosystem builder, Tribe has played an instrumental role in laying the foundation for this nascent industry in Singapore. Since its inception

²⁰ ["Future of Services, Annex A-4: AI, Data and Blockchain"](#), IMDA.

SINGAPORE BLOCKCHAIN LANDSCAPE 2019



DISCLAIMER: This is not meant to be an exhaustive list of the companies in Singapore's blockchain ecosystem. The appearance of a company does not reflect an endorsement by IMDA and/or the Singapore Government of the said company. (Last updated Q4 2019)

Co-Developed by:



Source: [IMDA](#)

in 2018, Tribe has been transforming the way key stakeholders in the landscape interact and innovate. By bringing together government agencies, global corporations, top tier blockchain companies and promising startups, Tribe provides a neutral and hyperconnected platform that facilitates new innovations.

The effectiveness of coordination and collaboration in the blockchain space has been evident in Tribe's first initiative – Tribe Accelerator. This product-development focused accelerator has facilitated multiple innovative market-ready blockchain solutions by working closely with its extensive partner network and promising startups. For instance, it has facilitated the integration of GovTech's OpenCerts technology for Mighty Jaxx, an urban culture company developing its solution for authenticity, 'PWOOF': the first of its kind in the designer toys industry. By developing compelling use cases and solutions supported by technical excellence and experienced industry leaders, Tribe Accelerator aims to drive widespread adoption of blockchain that will resolve real world problems.

Following the success of its accelerator programme, Tribe's ecosystem building efforts have moved beyond the typical offline accelerator to provide a more comprehensive level of support to the industry. It has taken a digital approach and launched OpenNodes. These different aspects come together to form a cohesive, multifaceted approach towards developing the blockchain ecosystem in Singapore.

While Tribe has laid the building blocks for the local ecosystem, it is essential for more heavyweights in the industry to combine efforts in fostering innovation within the blockchain ecosystem before we are able to reap the benefits from the endless possibilities this technology has to offer.

SINGAPORE'S NATIVE TECHNOLOGY ECOSYSTEM

When the blockchain paradigm burst onto the world stage a decade ago, it did so on the back of a mature ecosystem of supporting technologies and computing infrastructure. Advancements in public key



Tribe Accelerator team. Source: [Vulcan Post](#)

cryptography, cloud computing, telecommunications and hardware, among other spheres, have all contributed to the 'black swan' emergence of blockchain.

Singapore's ability to ride the global technology wave has helped secure itself a third place ranking in the UN e-government readiness report as well as the World Economic Forum (WEF) Global Information Technology Report and Network Readiness Index. More recently, the larger umbrella initiative of reimagining and rebuilding Singapore as a Smart Nation has provided the added impetus to explore lateral technologies like blockchain in an effort to drive innovation on the home front.

Blockchain in Singapore has benefited from a heritage of a strong native technology ecosystem with decades of systematic efforts to embrace, deploy and improve automation, data processing, communication and security.

This in turn has allowed Singapore to emerge as a natural choice for an Asia Pacific hub for distinct categories such as:

1. Large global technology multinationals focused on both blockchain and non-blockchain developments, such as: IBM, Microsoft, Google, Facebook, Amazon, Oracle, Accenture and SAP.
2. Startup technology firms and SME players seeking regulatory openness and technology readiness have established themselves in Singapore. Investors and entrepreneurs who are bullish on Singapore's dominance as a digital hub have enabled the emergence of exciting new companies that have achieved international recognition. These include examples such as Bluzelle and Chainstack.

Government driven initiatives and homegrown research efforts focused on investments and grassroots technology development. Of particular note is the deeptech investor and accelerator - SGInnovate, supported by the National Research Foundation as well as Zilliqa (a public blockchain protocol that emerged from pioneering work at NUS Research Lab).

THE UNIVERSITIES - NUS, NTU, SMU, SUTD AND SUSS

56% of the world's top 50 universities now offer at least one course on cryptocurrency or blockchain, representing a 23% increase from a year ago²¹. National University of Singapore (NUS) was ranked tenth when it came to the number of crypto courses and non-coursework offerings such as the CRYSTAL (Cryptocurrency Strategy, Techniques, and Algorithms) Centre, an academic research lab and think tank, providing opportunities for Singapore to be at the forefront of research on blockchain²².

Announced in September 2018 and founded by NUS Computing faculty members, the CRYSTAL Centre aims to help shape technical ideas in the blockchain and cryptocurrency space. The centre will conduct research on topics ranging from scalable consensus protocols to analysis of cryptocurrency economics and highly available peer-to-peer (P2P) network designs²³. The centre will also engage the industry in hope of fostering a technical community of thought leaders and experts in the blockchain space.

Other universities in Singapore including the Nanyang Technological University (NTU), Singapore Management University (SMU), Singapore University of Technology and Design (SUTD) and Singapore University of Social Sciences (SUSS) are also paving the way for advancements in blockchain research. Aside from courses, NTU has a non-profit student club, Blockchain at NTU, which consists of blockchain enthusiasts with backgrounds ranging from computer science to business. Founded in July 2017, the club is dedicated to fostering a vibrant blockchain community in Singapore and is committed to building and strengthening the technical expertise and market awareness of its members while empowering them to pursue their interests in academic, enterprise or entrepreneurial endeavours.

As early as November 2016, SUTD signed a letter of commitment with the Netherlands Organisation for Applied Scientific Research (TNO) on a Blockchain Security Lab²⁴. SUTD and TNO have set up the Blockchain Security Lab in SUTD's Centre for Cyber Security Research: iTrust. By attacking blockchain in a testbed setting, controls are created on how to regulate, design, deploy and certify cyber secure blockchain applications.

Recently, a research team consisting of Assistant Professor Georgios Piliouras of SUTD and Stefanos Leonardos, postdoctoral research fellow at the iTrust Centre for Research in Cyber Security in collaboration with Nikos Leonardos from the National and Kapodistrian University of Athens was accredited with the Best Paper Award in the 1st International Conference on Mathematical Research for Blockchain Economy²⁵. The team developed a novel approach to untangle the centralisation phenomenon in blockchain mining by employing the rich economic theory of Oceanic Games.

The SUSS runs courses in blockchain, has the SUSS Blockchain and Fintech Club and organises blockchain events. One such event was in July 2019, the Convergence Forum, which offered insights into innovative solutions in financial technology and provided thoughtful discussions related to blockchain, financial markets, and emerging technologies. The highlight of the event was a keynote speech delivered by Commissioner Hester Peirce of the US Securities and Exchange Commission (SEC)²⁶.

Efforts by academia are vital in preparing the next generation for what is to come. According to a survey conducted by Coinbase²⁷, there is rising student interest in blockchain with enrolments in blockchain courses doubling in 2019; suggesting the momentum towards understanding and acceptance of blockchain technology will continue in the years ahead.

21 ["The 2019 Leaders in Crypto Education"](#), The Coinbase Blog, 28 August 2019.

22 ["NUS Crystal Centre"](#), National University of Singapore, 2019.

23 ["NUS Computing forms blockchain think tank CRYSTAL"](#), Connected To India, 24 September 2018.

24 ["SUTD and TNO committed to Secure Next Generation Critical Infrastructures"](#), Singapore University of Technology & Design, 25 November 2016.

25 ["SUTD researchers demystify centralization in cryptocurrency mining"](#), Singapore University of Technology & Design, 14 May 2019.

26 ["US SEC Commissioner Supports Creation of Non-Exclusive Safe Harbor For Crypto In Singapore"](#), Bitcoin Exchange Guide, 5 August 2019.

27 ["The 2019 Leaders in Crypto Education"](#), The Coinbase Blog, 28 August 2019.

THE ASSOCIATIONS - ACCESS, SINGAPORE FINTECH ASSOCIATION AND TOKEN ECONOMY ASSOCIATION

Associations are vital in any ecosystem to aid collaboration amongst industry players, support their members to succeed and meet other like-minded people to exchange ideas. Overall, they work with members to find solutions to problems and to promote best practices. In Singapore, blockchain startups and initiatives are represented by trade groups such as the Singapore Cryptocurrency and Blockchain Industry Association (ACCESS) and the Token Economy Association, Fintech-focused organizations like the Singapore Fintech Association, and protocol specific organizations like Hyperledger and the Ethereum Foundation.

ACCESS was founded in 2014 and believes in the transformative potential of blockchain. With responsible use and proper regulatory support, ACCESS aims to protect the use and development of digital currency applications and distributed ledgers. ACCESS is also part of a bigger global group of associations known as International Digital Asset Exchange Association (IDAXA).

IDAXA was established in 2019 when six national and regional trade associations – Blockchain Australia, ACCESS, Japan Blockchain Association, Korean Blockchain Association, Hong Kong Blockchain Association and the Taiwan Parliamentary Coalition for Blockchain & Industry Self-Regulatory Organisation signed a Memorandum of Understanding at the inaugural V20 Summit²⁸.

The Singapore FinTech Association (SFA) is a cross-industry and non-profit organisation that supports the development of Singapore's Fintech sector and works to evolve the local Fintech ecosystem. With more than 33 members, it covers the full range of industry stakeholders, from early-stage startups and innovative companies to the larger service providers and financial organisations. SFA partners with organisations globally on Fintech-related initiatives. In 2017 it launched its FinTech Talent Programme which has since trained more than 125 Fintech professionals in blockchain, cryptocurrency, cybersecurity and regulation.

The SFA also provide informative data about FinTech companies in Singapore. For example, in a survey conducted with PwC in August 2019, it found that more than 90% of Fintech companies in Singapore plan to grow their workforce over the next 12 months²⁹. It also revealed that 28% of respondents expect to double their headcount over the next 3 years.

With all elements in Singapore's blockchain ecosystem thriving, it is easy to see why it is growing so quickly and where companies are moving to Singapore. In 2019, AID:Tech, an Irish startup that delivers international aid using blockchain technology, moved its main operations and opened an office in Singapore. This was a simple decision for them supported by two defining reasons. According to its CEO, Joseph Thompson, "Firstly, the level of support we received across government and the private sector was far superior to any other location we looked at. Singapore is fast becoming the blockchain centre of Asia, which provides us with an opportunity to scale faster than any other region. We received support from multiple government bodies such as Enterprise Singapore who made both client and investor introductions. IMDA accepted AID:Tech onto their SPARK program. Lastly, the National Volunteer & Philanthropic Centre has and currently attends client meetings to further our inwards with new clients."

Secondly, ShengSiong, Singapore's second-largest supermarket chain, made an investment into AID:Tech. It not only provided funding but also the ability to integrate APIs into payments for welfare programs. AID:Tech then decided to move their data science offering to Singapore citing that the level of talent and quality of graduate students in Singapore was another very compelling reason for AID:Tech to grow their set up in Singapore.

Overall, the ecosystem is very healthy thanks to the academia that will empower the next generation, associations who look after their members and incubators who will help companies grow and survive.

28 ["Crypto Valley Association joins International Digital Asset Exchange Association"](#), Tokenpost. 14 October 2019.

29 ["Singapore FinTech Association: fintech talent set to grow"](#), Fintech Magazine. 21 August 2019.

Feature: IMDA Blockchain Challenge

A look at the IMDA's Blockchain Challenge

Technological innovation has been recognised as a major force in economic growth and findings from the World Intellectual Property Organisation study suggest that government plays an important role in driving investment in many breakthrough innovations, which have a transformative impact that can lead to a significant economic growth and provide benefits for the society. Infocomm Media Development Authority (IMDA), a statutory board in the Singapore Government, leads Singapore's digital transformation by embracing technology to transform its economy and ensure Singapore businesses and workforce remain relevant and globally competitive. As part of IMDA's efforts to help Singapore ride on emerging technological trends such as blockchain, IMDA facilitates and encourages innovation through the Blockchain Challenge, which was launched in early 2018.

"We see blockchain and distributed ledger technology, as an emerging technology with the disruptive potential to transform industries in the longer term," says Veronica Tan, Technology & Infrastructure Group, at IMDA, "as with any new technology, we want to see what can be done to support technology awareness and catalyse early adoption, to enable capability building".

INITIAL CHALLENGES

The first Blockchain Challenge invited participants to produce successful concepts that aim to solve industry facing challenges as identified by IMDA, with selected proposals receiving seed funding to implement their solutions. In supporting early movers to advance beyond the conceptual stage and into hands-on experimentation through the development of

prototypes, the first Challenge saw seven wide-ranging proposals:

- Cargo Community Network Pte Ltd, to explore the use of blockchain in the air cargo billing process between airlines and agents, focusing on air cargo billing, costing and reconciliation on blockchain;

"Singapore takes on a systematic approach to catalysing emerging technology innovation in Singapore's Digital Economy"

Veronica Tan

Technology & Infrastructure Group,
Infocomm Media Development Authority

- Distributed Ledger Technologies Pte Ltd, to explore supply chain information from electronics manufacturers to be captured and shared via blockchain;
- GroupM Singapore Pte Ltd, to explore the facilitation of advertising without the involvement of middlemen, and enhancing trust between advertisers and publishers, through smart contracts and in partnership with Singapore-based blockchain platform Zilliqa;
- LegalFAB Private Limited, to explore the secure sharing, signing, authentication and validation of legal documents on blockchain;

- Tradechain Pte Ltd, working with Finaque, exploring streamlining the supply chain financing using Blockchain Solutions Pte Ltd's Guardtime Keyless Signature Infrastructure;
- VeriTAG Pte Ltd, to explore transparency, authenticity, provenance tracking and immutable data capture via the use of blockchain network and Quick Response (QR) code tags for food supply; and
- Vuulr Pte Ltd, to explore transforming the monetisation of film and TV rights using the blockchain.

The first Blockchain Challenge was designed to catalyse the broader application of Blockchain in other areas beyond the financial sector. As explained by Tan, "There was already mainstream awareness of blockchain as the underlying technology enabling digital currencies, notably, Bitcoin and Ethereum, and the initial use cases for blockchain were primarily in the financial sector. However, with the evolution and development of smart contracts and permissioned blockchain networks, we believe that there is a real need and potential to look at use cases for blockchain in other sectors and industries."

ROUND TWO & THREE

The second Blockchain Challenge, launched in November 2018, saw two specific challenges issued. The first challenge, Building Business Networks, cited collaboration across multiple companies as one of the key challenges towards wider adoption of blockchain. IMDA looked to provide seed funding for ecosystem builders to implement engagement platforms to grow the blockchain ecosystem in Singapore. As DLT networks require collaboration between parties in order to develop their full potential, the aim was to develop a digital nexus of stakeholders interested in blockchain and enable community engagement initiatives to fill the gaps and needs in Singapore blockchain ecosystem. The selected proposal came from Tribe Accelerator to put in place the blockchain ecosystem engagement platform, now known as OpenNodes.

The OpenNodes blockchain engagement platform looks to help enterprises (i) navigate the blockchain landscape, and (ii) through a directory listing of projects, identify relevant blockchain business networks to partner. "As the benefits of blockchain typically come when the technology is applied in a multi-stakeholder environment, in order for enterprises to embark on blockchain, this would require them to identify other like-minded enterprises that operate in a similar value chain" says Tan. As part of the larger OpenNodes initiative, IMDA and OpenNodes developed a landscape map showing the depth of the Singapore blockchain ecosystem which highlighted companies spread across 25 different sectors.

The second challenge, Wireless@SG, looked to explore how to innovate on operational efficiency and/or business model innovation for the Wireless@SG programme (W@SG). The selected proposals included:

- 'The Singapore Experience' by ConsenSys, exploring the use of blockchain-based solutions for identity management of visitors and devices using Wireless@SG;
- 'MyRewards' by Aqilliz, a loyalty program application on Zilliqa's blockchain platform that interacts with Wireless@SG services offered by MyRepublic.

Figure 1 illustrates how the themes for the Blockchain Challenge evolve over time as the landscape in Singapore develops:

OBSERVATIONS FROM THE CHALLENGE

Deployment of blockchain is described as nascent due to challenges in business viability, governance and technology maturity.³⁰ Some of the initial projects supported in the Blockchain Challenge have the potential to develop successful business models. Distributed Ledger Technologies Pte Ltd is one such example. It operates a private permissioned trade network, where international traders are the

30 "7 Common Mistakes in Enterprise Blockchain Projects", Gartner, 1 July 2019.

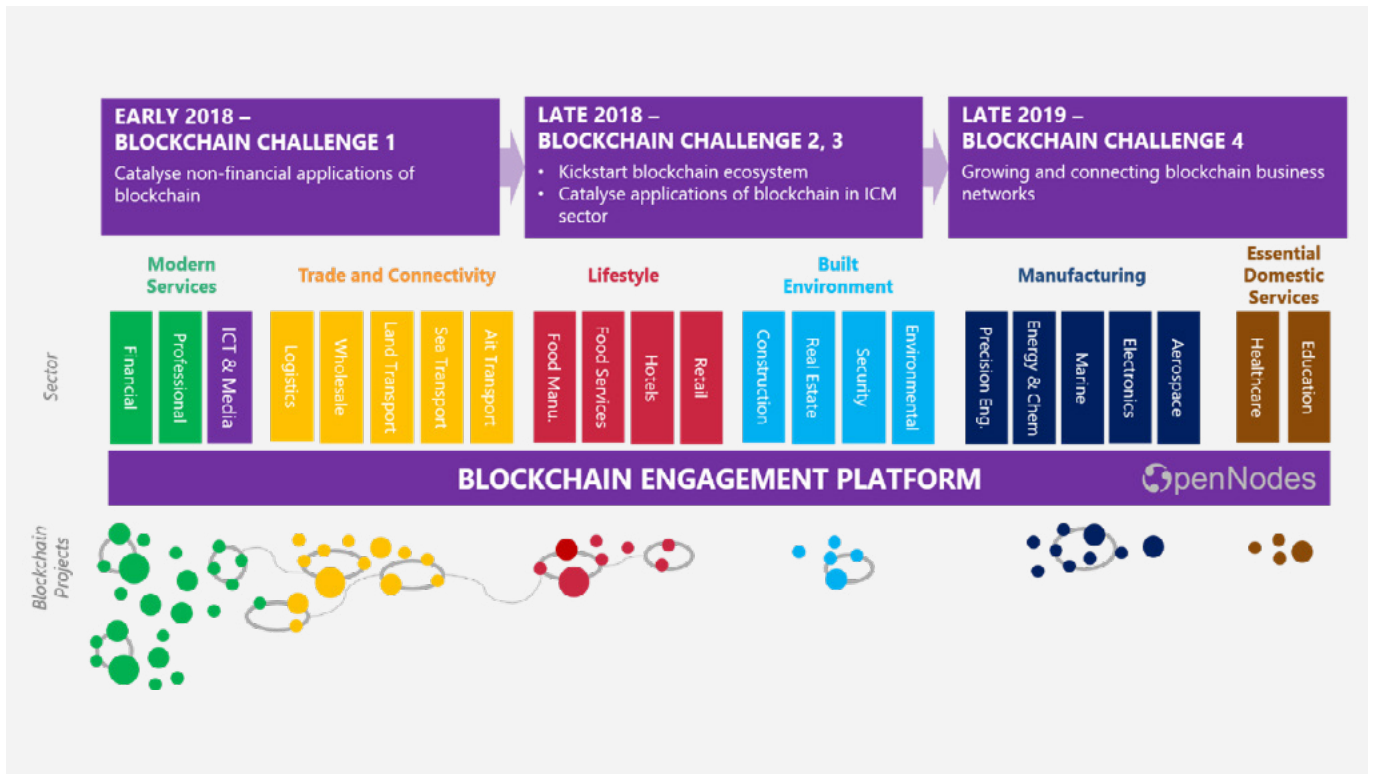


Figure 1 – Evolution of Blockchain Challenge Themes

target customers. The company proactively onboard stakeholders in the international trade ecosystem, such as banks, shipping and insurance into its Traders’ Trust Network. This lowers the barriers for the target customers to use DLT ledgers, as the ecosystem of business partners have already been onboarded and they can readily choose their list of preferred business partners from the Traders’ Trust Network to form a private blockchain ecosystem.

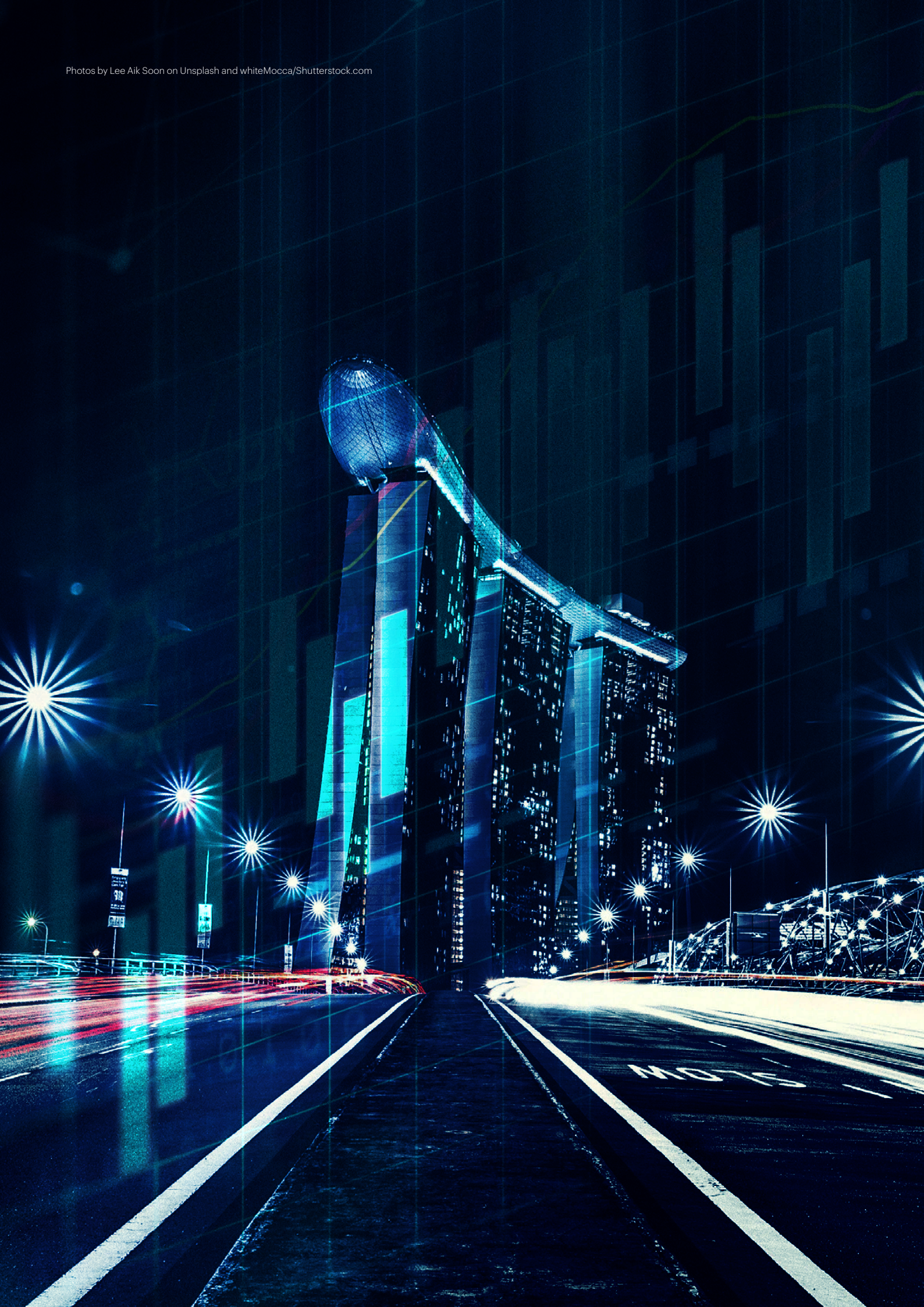
LOOKING BEYOND THE CHALLENGE

Beyond catalysing emerging technology innovation, IMDA also works closely with early adopters supported in the Blockchain Challenge, to understand and identify potential areas that may require regulatory or legal clarity or enablement. One such example is in the formation or scaling up of blockchain consortiums. DLT networks require collaboration between participating organisations to define the operating model of the network³¹. This is usually codified in the

form of commercial agreements, and negotiation of such agreements between network participants can be lengthy. The initial projects supported in the Blockchain Challenge typically involve a minimal viable ecosystem of organisations. As these projects look towards scaling up to include the broader value chain of stakeholders, if there are common issues encountered, template contract clauses can potentially be developed to facilitate commercial agreements.

Such efforts could potentially involve collaborations with other parts of government. Being relatively small, Singapore has the advantage of being able to take on a coordinated, whole-of-Government approach, where initiatives from different government agencies in Singapore augment and complement one another. As a whole, it is observed that Singapore takes on a systematic and ecosystems approach to catalysing emerging technology innovation.

31 This is typically the case for closed, permissioned ledgers where a consortium of organisations transact with one another on a specific use case (e.g. supply chain for goods)



SECTION TWO

The Future of Money

The Evolving Capital Markets Landscape

Creating new access to the capital markets

Blockchain has the potential to improve the process of capital raising and investing. Singapore is starting to see the increasing importance of private equity markets, as an increase in venture funding is enabling companies stay private longer. According to a report by Bain & Company, Southeast Asia recorded a 38% bump in deal value over the five-year average to US\$13 billion, while deal count increased to 76, up 18% over the five-year average³². As companies refrain from public offerings to pursue longer private life cycles, the need for capital efficiency, effective stakeholder governance become vastly more important. Moreover, the need for liquidity in private markets also becomes more pressing.

As capital is more abundant and available than ever before, new technologies for deploying and managing capital efficiently and securely are in demand. Blockchain provides the technological tools to securitise new assets, raise capital easily, facilitate compliance and due diligence processes, as well as create liquidity in private capital markets more quickly, efficiently and enable higher transaction volumes.

BALANCING REGULATION AND INNOVATION

Singapore boasts a long tradition of entrepreneurial pragmatism that characterises Singapore's approach to regulation and innovation, from reforming local banking regulations to adapting to digitalization in the 1990s³³. As a major financial hub,

Fintech is an integral part of Singapore's ambition to become a Smart Financial Centre³⁴. In a world where regulatory responses to disruptive technologies like ridesharing and cryptocurrencies has not always been welcoming, the regulatory environment in Singapore continues to be attractive for Fintech innovations with appropriate regulatory support provided to foster innovation with new and emerging business models.

As early as 2016, the MAS established a regulatory sandbox to enable Financial Institutions (FIs) and startups to experiment with innovative Fintech solutions in an environment where actual products or services can be offered to users within a well-defined space and duration. Innovators in the regulatory sandbox stand to enjoy relaxed regulatory requirements, where appropriate, which they would otherwise be subject to, for the duration of the sandbox.

The Payment Services Bill, which was introduced in Parliament for first reading on 19 November 2018, will bring unregulated payment service providers under the charge of MAS. Ravi Menon, Managing Director of MAS, said the Bill will enhance the regulatory framework for payment services in Singapore, strengthen consumer protection and engender confidence in the use of e-payments. "The Bill also illustrates our shift towards regulation that is modular, activity-based and facilitative of growth and development in the Singapore payments landscape," Menon said.

Singapore's transparent, open and forward-looking regulatory approach of "running alongside innovators" balances the need for regulatory oversight while embracing the upsides of technological advancement³⁵. As capital markets evolve and face increasing amounts of private and venture capital,

³² [Asia-Pacific Private Equity Report 2019](#), Bain & Company, 15 March 2019.

³³ ["The economic pragmatist"](#), Today Online, 25 March 2015.

³⁴ [FinTech Sandbox](#), Smart Nation Singapore, 29 January 2019.

³⁵ ["Singapore's FinTech Journey - Where We Are, What Is Next"](#), MAS, 16 November 2016.

blockchain presents an opportunity to improve efficiencies in fundraising and investor relations.

REGULATED PLAYERS

Unlike securities trading on traditional public exchanges, digital tokens are designed to be traded around the clock. As public markets look to increase liquidity, they may turn to using such new technologies in making securities and digital assets more publicly available.

Licensed and regulated by MAS, 1exchange (1X) is the world's first regulated private securities exchange built on a public blockchain. It is now working to help more companies and is also exploring partnerships with other financial institutions to increase access to a global liquidity pool.

Similarly, Funderbeam Markets, the Singaporean subsidiary of United Kingdom based funding and trading platform Funderbeam, has received a Capital Market Services license and a Recognised Market Operator (RMO) license. It seeks to provide a platform for the primary issuance of securities and a global secondary market for private businesses across Europe and Asia. According to Funderbeam, it uses the "coloured coin protocol by Chromaway on Bitcoin Blockchain" to power its global stock exchange³⁶. To date, the firm claims to have 39 high-growth portfolio companies on its marketplace and over 12,000 verified investors across 122 countries³⁷. Since its inception in 2013, it said almost US\$3 million worth of private equity has been traded on its platform.

iSTOX, is another a Singapore-based capital market platform that entered the MAS Fintech Regulatory Sandbox in May 2019, set to experiment with blockchain and smart contracts. iSTOX is currently working towards graduating from the sandbox by early 2020 to become a fully-regulated platform in Singapore to offer issuance and trading of digitised securities.

IMPROVING ACCESS TO THE CAPITAL MARKETS AND TOKENISATION

For years, traditional securities exchanges have dominated capital markets. The processes, restrictions and high costs for listing and compliance form barriers to entry for people seeking to place private assets onto public markets. Consequently, a vast amount of value is locked away in private hands. A McKinsey's report found that for private equity alone, the net asset value has jumped more than 700% since 2002; twice the growth in global publicly traded equities³⁸. Tokenisation is one possible way to unlock this potential.

Tokenisation brings the native benefits of blockchain to these new-age digital assets. Cost and time can be reduced through programming features such as automated administration of dividends payments and other corporate actions, accounting and disclosure, and enabling the settlement of derivative contracts in secondary markets. This in turn will improve investors' access to new asset classes and has the potential to improve liquidity and distribute risk.

Unlike traditional securities, digital tokens are programmable via their underlying smart contracts. This critical difference means that their use and distribution can be designed to comply with specific rules. Simple examples include controls

to ensure that tokens can be transferred only to certain counterparties or not at all during a lock-up period. The real promise of this programmability is the potential to reduce friction and cost in the lifecycle of capital market products.

Recently, a US\$30 million luxury condo in New York City became the first major asset to be tokenised on the Ethereum blockchain³⁹. In addition, the Perth Mint in Australia launched the world's first government-guaranteed gold-backed crypto token. Each unit is backed by physical gold that is guaranteed by the government of Western Australia and physically stored in a network of central bank-grade vaults.

36 ["How does Funderbeam use Blockchain?"](#), Funderbeam. 18 April 2019.

37 ["Funderbeam Secures Financial Services Licenses from the Monetary Authority of Singapore \(MAS\)"](#), Funderbeam. 25 September 2019.

38 [Private markets come of age: McKinsey Global Private Markets Review 2019](#), McKinsey. 2019.

39 ["Family office of 'shop king' Tang Shing-bor wants to use blockchain to 'tokenise' real estate holdings"](#), South China Morning Post. 12 June 2019.

Singapore's transparent, open and forward-looking regulatory approach of "running alongside innovators" balances the need for regulatory oversight while embracing the upsides of technological advancement.

TACKLING TOKENS

While other countries had raced to ban digital tokens, MAS issued its "Guide to Digital Token Offerings" to provide general guidance on the application of the securities laws in relation to offers or issues of digital tokens in Singapore. The guide contains case studies setting out various scenarios in which tokens are offered by companies and how securities laws may apply in each scenario. This comprehensive analysis offered by the MAS provides much needed clarity on how organisations ought to proceed when issuing digital tokens and serves to assist crypto-asset issuers in complying with securities regulations.

The guide states that offers of digital tokens which constitute a product regulated under the Securities and Futures Act, such as shares, debentures, units in business trusts, securities-based derivatives contracts, or units in a collective investment scheme, are subject to the same regulatory regime just like offers of securities made through traditional means⁴⁰.

TOKENS ARE THE NEW GOLD STANDARD

Tokenisation, powered by blockchain, allows for a simple and efficient ownership verification and transfer system to be built. When financial products such as shares are bought and sold, the title or legal ownership of those financial products is exchanged for money. This process of exchange is called settlement, and one model of settlement is 'delivery versus payment' (DvP), where securities and monies are simultaneously exchanged to ensure the delivery of securities occurs only if the corresponding payment is made.

At the 2018 Singapore Fintech Festival, MAS and Singapore Exchange (SGX) announced that as part of Project Ubin, they had successfully developed DvP capabilities for the settlement of tokenised assets across different blockchain platforms. The DvP prototypes demonstrated that financial institutions and corporate investors are able to carry out the simultaneous exchange and final settlement of tokenised digital currencies and securities assets on

40 [A Guide to Digital Token Offerings, Monetary Authority of Singapore](#). Monetary Authority of Singapore. 5 April 2019.

different blockchain platforms. Tinku Gupta, head of technology at SGX and project chair, said: “Based on the unique methodology SGX developed to enable real-world interoperability of platforms, as well as the simultaneous exchange of digital tokens and securities, we have applied for our first-ever technology patent.”

“This project has demonstrated the value of blockchain technology and the benefits it can bring to the financial industry in the short to medium term,” said MAS Chief Fintech Officer Sopnendu Mohanty, “the concept of asset tokenisation, as well as other learnings gleaned from this project, can potentially be applied to a broad spectrum of the economy, creating a whole new world of opportunities.”

One of these opportunities is gold. Digix is a Singaporean company that was founded in 2014. Using blockchain, Digix represent physical gold with DGX tokens, where 1 DGX represents 1 gram of gold on Ethereum. The transparency, security, traceability of the blockchain ensures that DGX tokens can be transacted and transferred with full visibility and auditability. The smart contract platform eliminates possible human error and risk of fraud that would otherwise be present in the supply chain of gold.

The combination of tokenised assets and a fluid, cross-border platform also creates the foundation for open marketplaces. Singapore Airlines (SIA) launched a blockchain-based loyalty token in their KrisFlyer program to increase the ease and flexibility in using these tokens to redeem not just flights but also spendable in various retail locations⁴¹. Known as KrisPay, SIA's KrisFlyer members can instantly convert KrisFlyer miles into KrisPay tokens that can be spent with participating merchants. There are multiple benefits to using blockchain including making it easier for SIA customers to use miles in their KrisFlyer account and allowing SIA to onboard new partners and reconcile payments.

“With the blockchain-based digital wallet, it is a straightforward process for participating merchants to connect with the program and for customers to

make purchases with their tokenised miles,” said Jan Reinmueller, head of KPMG's Digital Village in Singapore⁴². “The blockchain provides a distributed ledger that time-stamps every customer transaction in real-time, which provides significant cost and time efficiencies.”

WIN OR LOSE, IT'S ALL THERE

The idea of utilising tokens to incentivise participation on an open blockchain network as part of the protocol can be expanded to aligning incentives in any network. By writing terms and stipulations into a smart contract with directly linked value exchange such as automatic rewards or punishments, one can encourage the desired behaviour in the network. Due to the decentralised nature of public blockchains, there is also no single point of failure which instils robustness and trust in the network that promotes greater participation.

Investment options into early-stage projects or ventures have been limited to venture capital funds or accredited angel investors. The issuance of tokens opens up additional models for investment. Tokens can represent rights to a future good or service. This allows projects to raise capital in a new way and create buy-in from a potential user base even before the launch of a product.

Singapore is well positioned to capture the potential for blockchain in democratising capital markets. Regulatory clarity and an innovation-friendly environment stand the island nation in good stead as a financial hub, even as new technologies disrupt traditional capital markets.

⁴¹ [“Singapore Airlines’ Blockchain-Based Loyalty Program Takes Off”](#), Coindesk, 25 July 2018.

⁴² [Blockchain spotlight: Singapore Airlines](#), KPMG, September 2019.



1exchange, Singapore's First Licensed and Regulated Private Securities Exchange Sees First Ever Private Listing. Source: [1X](#)

Feature: CapBridge / 1exchange (1X)

The first regulated private securities exchange built on a public blockchain

In December 2018, MAS granted approval for 1exchange (1X) to operate its private securities exchange as a Recognised Market Operator (RMO)⁴³. 1X was the first and only licensed and regulated private

securities exchange, as well as the first of its kind on the Ethereum mainnet. 1X allows international investors greater accessibility to tradeable private equity, with an initial focus on Asian growth companies⁴⁴.

"The public capital markets have evolved significantly," said Haiping Choo, Chief Executive Officer of 1exchange, "smaller companies are trapped in a chicken-and-egg situation where they are too small to IPO, yet cannot raise enough funds to grow". 1X aims to provide a financing and liquidity solution for global

43 ["CapBridge Granted RMO Private Exchange License By MAS: "1exchange" Set To Be Among First Regulated Private Securities Exchanges In Global Financial Centre, Singapore"](#), Business Insider. 22 November 2018.

44 ["CapBridge taps blockchain for its private exchange platform"](#), Business Times. 23 April 2019.

private growth companies and with SGX, potentially also create a pipeline of companies who will eventually aim to list on SGX. Haiping adds, “Our vision is to create a more efficient and cost-effective way for companies to enjoy the benefits that come with a listing, such as global investor access and tradability, while retaining the benefits of staying private such as having optimal control and flexibility.”

With traditional investment into private equity requiring amount in excess of US\$5 million and holding periods of 5 years or more, the private equity market is geared towards institutional investors, rather than retail or accredited investors. The 1X platform allows broader access with smaller ticket sizes and the ability to hold or sell private securities, effectively circumventing the illiquidity that can be associated with investing in traditional private equity.

TACKLING FIRST PLACE

As the first regulated private securities exchange built on a public blockchain, 1X faced some challenges with no roadmap to follow. For one, regulatory compliance. “We had to find the right balance between company compliance and disclosures; and investor protection,” Haiping shares. Enabling the trading of growth-stage private companies means tailoring compliance requirements to these private growth companies, while ensuring investors enjoy a sufficient level of protection. 1X credits its ability to do this due to the ease of working with the MAS. “Singapore has the benefit of a progressive and forward-thinking regulator. MAS is adept and open to evolving technology and business models in the capital market space,” he adds, noting that MAS has always been seen as a leader in the regulatory landscape. Haiping explains, “Our approach has always been to work closely with regulators like MAS and be clear and transparent on our regulatory jurisdictions.”

Another challenge was building a user base. As a new exchange looking to develop a marketplace for companies who wish to list and investors who wish to trade, 1X had to ensure there was enough interest

and participation from both kinds of users to create value. They did this by leveraging their experience in developing digital investment platforms from running CapBridge, a licensed and online private equity investment platform for 4 years, and by drawing support from their partners SGX, United Overseas Bank (UOB), CIMB Bank Berhad, Hana Bank and Hanwha Securities, among others⁴⁵. 1X looked at other providers in the blockchain space and noted that their listing process were highly complex with multiple types of shares listed from the same company. In addition, some of their listing rules may not be able to provide the same level of transparency in order to provide greater investor safeguards. To avoid the same pitfalls, they decided to focus on products such as private equity with both proven track records and proper governance in place, via well-thought-out listing rules.

There was also the challenge of integrating and implementing new technology. “We had to ensure we met industry standards of security, availability and scalability,” said Haiping, “but technology alone does not advance business models. We had to take a commercial-centric approach and needs-based strategy to ensure relevance and growth.” By focusing on the customers’ needs, the 1X team identified the product’s key features before looking at the suitable solutions and architectures to address them. It was not about implementing a blockchain solution; it was about finding a solution that happened to be blockchain. After extensive research, the 1X team eventually decided public Ethereum was the ideal platform and selected ConsenSys as its technology partner.

THE VALIDATED NEED FOR LIQUIDITY

As a top tier financial market with one of the largest assets under management (AUM) portfolios in the world, 1X believed there was a solid base in Singapore upon which they could promote their private markets model. The platform has seen early trades, validating the need for liquidity for private growth companies.

In early June 2019, the CapBridge Group (the parent entity of both 1X and CapBridge) and CIMB Bank

⁴⁵ 1X is an investee of Singapore Exchange (SGX)

HOW IT WORKS

Investors invest in and trade shares of a company-specific special purpose vehicle, which in turn holds ordinary shares of the private company. Their investments are digitally represented and registered via smart contract on the public Ethereum Mainnet via the 1X platform. Recorded immutably on a distributed ledger, data cannot be changed or deleted once ownership data is registered in the smart contracts and investors are able to independently verify and validate their shareholdings in real time with their wallets, without the manual process of going through an exchange or a trust administrator.

Berhad signed an MOU to facilitate capital raising and trading of shares for private companies through the CapBridge investment platform and 1X, with a view to provide access to private capital and liquidity to the bank's customers in Singapore, Malaysia, Indonesia, Thailand and Cambodia. Later in the same month, the CapBridge Group entered into a strategic business partnership with Hana Financial Investment to expand in South Korea. Just a few weeks later, the CapBridge Group signed yet another MOU, this time with UOB, to provide access to private capital to the bank's customers across Asia^{46,47}.

In July 2019, following a six week campaign that saw numerous investors committing bids, Singapore-based boutique fund management company Aggregate Asset Management became the first to list tradeable private securities on the 1X platform. The placement of S\$5.6 million worth of tradeable private equities representing approximately 5% of the company's share value was over-subscribed.

1exchange shared that it has two to three additional upcoming listings in the works, including ST Integrated Engineering (STIE) who are looking to raise about S\$4 million to support its expansion and plans to list its equity on the platform⁴⁸. There are also ongoing efforts to expand and work with partners in other jurisdictions

in order to provide issuers access to global investors and vice versa.

VALUE, CREATED

The amount of resources required to list on 1X, as compared to a public listing, is minimal. As a 1X private listing can be done at a much lower cost and in a shorter time, companies looking to raise capital in order to enable growth or have exit options for early investors and/or employees can do so through the 1X platform. 1exchange believes that only continuous trading can provide sustained fair valuation whilst ensuring that incoming buyers can also enjoy liquidity of their holdings. 1X provides an easier and more flexible way to unlock shareholder value for private companies. More importantly, it levels the playing field for private equity investors to easily trade in and out of their purchased positions, creating more value for all parties.

46 ["Press Release: CIMB-CapBridge collaboration facilitates companies' access to private capital through investment platform and blockchain-enabled securities exchange"](#), CapBridge, 3 June 2019.

47 ["CapBridge, UOB in deal to provide companies in Asia with access to private capital"](#), Business Times, 4 June 2019.

48 ["ST Integrated Engineering to raise \\$4m via private listing on 1exchange"](#), The Straits Times, 28 August 2019.

Progress In Payments

What blockchain delivers to payments and processing

Singapore, a nation with a population of 5.6 million - of which 84% are internet users - is home to more than 200 banks. Its regulations are clear and supportive of innovation. In January 2019, the Parliament passed the Payments Services Act 2019. When the Act comes into effect, payment services providers only need to hold one license to conduct specified payment activities - including digital payment token services.

Singapore has been at the forefront of innovation in the payments sector for decades. Its successes include the launch of automated bill payment services like the General Interbank Recurring Order, the 1985 pilot of the Network for Electronic Transfers that eventually facilitated Singapore's ubiquitous Electronic Funds Transfer at Point-Of-Sale networks, the introduction of digitised monetary transactions with stored-value fare cards island-wide and more recently the 2014 launch of Fast and Secure Transfers system and the 2017 launch of the national e-payment service PayNow.

The Singapore government has outlined their commitment to pursuing e-payments as part of the Smart Nation initiative, to provide an open, accessible and interoperable national e-payments infrastructure, facilitate simple, swift, seamless, and secure digital transactions and enhance convenience and efficiency for citizens and businesses⁴⁹.

With a government committed to this specific vertical and financial institutions recognising the need to keep up with the times, adopting innovations in payments is not new to Singapore. Unlike the other emerging economies in the region, the current retail payment infrastructure in Singapore is highly evolved, normalised among the population and fit for purpose⁵⁰. As such, blockchain-related payment innovations must offer a significant improvement, to the right target audiences, over the existing systems already commonplace in Singapore.

Blockchain, implemented correctly, can bring additional efficiency, security and compliance when it underpins payment related transactions, reducing friction by providing trusted real-time verification of transactions without the need for intermediaries such as correspondent banks and clearing houses to reduce the number of steps needed⁵¹.


REMITTANCES: A FINANCIALLY INCLUSIVE NEIGHBOURHOOD

In an industry traditionally dominated by banks and a small number of tech giants, the payments landscape in Singapore today sees additional participation and competition from non-bank players ranging from startups seeking to get digital banking licenses, to established technology companies, retailers and more. While the retail payments infrastructure in Singapore is highly mature, there remain blue seas for blockchain-based innovations to change how Singaporeans send and receive money internationally and also how banks transfer money in Singapore and across the world.

49 [E-Payments](#), Smart Nation Singapore. 1 September 2019.

50 ["The Big Read: How e-payment ended the long reign of cash in Beijing, and the lessons for S'pore"](#), Today Online. 27 September 2017.

51 ["Coming in 2017: "Live" Blockchain Deployments Promise to Accelerate Payment Processing Services and Trade Finance"](#), American Express. 2017.



While the retail payments infrastructure in Singapore is highly mature, there remain blue seas for blockchain-based innovations to change how Singaporeans send and receive money internationally and also how banks transfer money in Singapore and across the world.

Singapore is less of a market on its own and more of a hub connecting the Southeast Asian region to the rest of the world; whether that is through foreign investors seeking opportunities in the region through Singapore, Singaporeans spending money abroad or the large number of foreign workers remitting their earnings back to their families from Singapore. These three broad areas provide interesting spaces in which blockchain-based payments can still offer significant value.

Singapore is considered the financial hub of Southeast Asia and plays a critical role in supporting the region to push it forward technologically and financially. According to the Ministry of Manpower, there are almost 1.4 million foreign workers in Singapore in 2019⁵². With a sizable foreign workforce, many send money home to their families in their home countries. According to World Bank, Singapore sent remittances all over the world including China (US\$2,763 million), Malaysia (US\$1,051 million), India (US\$886 million), Pakistan (US\$ 528 million) and Indonesia (US\$380 million) in 2017⁵³. A large number of this foreign workforce is from the Philippines with an estimated 180,000 Filipinos working in Singapore⁵⁴.

At present, Philippine rural banks have limited access to financial networks, and remittances from overseas can take five to seven days to be credited to a beneficiary's account. Using blockchain for bank-to-bank cross-border remittance promotes financial inclusion particularly in underserved areas, customers will see significant cost savings and near real-time transfers at the touch of a button.

In July 2019, the UnionBank of the Philippines successfully launched their PHX stablecoin. A stablecoin is a cryptocurrency pegged to another stable asset such as gold or a currency. The UnionBank of the Philippines has successfully transferred a tokenised fiat using PHX from OCBC Bank in Singapore

52 [Foreign workforce numbers](#), Ministry of Manpower, 2019.

53 ["Remittances: How Much Money Do Migrants Send Home"](#), Instarem, 27 May 2018.

54 ["No new Filipino workers for at least three weeks: Philippine government"](#), The Straits Times, 13 November 2017.

to an account in Cantilan Bank in Surigao del Sur, through the i2i blockchain platform.

Project i2i is implemented on Enterprise Ethereum to create a decentralised, cost-efficient, real-time inter-rural bank payment platform that operates autonomously outside of existing payment infrastructures and intermediaries such as the Philippines' PhilPass and SWIFT. The Project i2i platform works to connect rural banks as well as national commercial banks to the central bank, helping remote banks integrate with the domestic financial system while also improving banking access for local citizens.

Another aspect of using blockchain to enable payments is that its transparency can help consumers and regulators ensure they are not paying too much for remittance fees. Many of these workers remit money back to their home country on a regular basis. Unfortunately, the lack of transparency from banks and remittance providers leave low-wage workers paying a premium to move money across borders.

In Q1 2018, World Bank reported the global average cost of sending remittance at 7.13%, a slight increase from Q4 2017 (7.09%) but a 4.23% YoY decrease from Q1 2017 - and in Q4 2017, the average transaction cost of sending remittances from Singapore was 3.9%⁵⁵. This year, MAS Managing Director Ravi Menon urged banks and financial institutions to be more transparent with their customers and outlined transparency as an increasingly critical element going forward⁵⁶.

RETAIL PAYMENTS

While retail payments are currently dominated by credit cards and e-wallets, not all is quiet for blockchain on the retail payments front. Several

cryptocurrency ATMs by two operators - Daenerys and Bitcoin Exchange - have already sprung up around the city in Singapore, where people can exchange cash for crypto⁵⁷. Companies like Bizkey have also installed point-of-sales systems in convenience stores, hotels, restaurants and retail outlets in an attempt to encourage retail transactions with cryptocurrencies.

KOPitech, at the newly renovated Funan Mall, is food court 2.0. Kopitiam's new outlet KOPitech has integrated numerous payment modes, including in bitcoin, ethereum and creatanium⁵⁸. The conversion of cryptocurrencies to fiat will be done on a weekly basis by Kopitiam and its Fintech partner, with Kopitiam bearing the risks of any currency fluctuations. Stallholders will continue to receive their earnings in Singapore dollars, just like at any other outlet and customers will have the flexibility in choosing a number of payment options.

CHARITABLE PAYMENTS

The Commissioner of Charities Annual Report 2017, released in November 2018, showed that charities in Singapore pulled in S\$2.9 billion in donations in 2016, the highest sum since at least 2008⁵⁹. While this is promising, there is still the issue of some people not trusting the charities in fear of dishonesty. The Commissioner of Charities, Dr Ang Hak Seng, said: "As more people do their checks, it's harder to abuse the system. When donors have more trust (in fund-raising appeals), they will also give more."

Blockchain is inherently transparent and will allow parties that have access to it to see all of its transactions. In this scenario, this will benefit not just the donor, but the charity as well. Fraud is not a major problem in Singapore but proper record-keeping is. Dr Ang said that his office receives fewer than 30

55 ["Unveiling True Cost of Consumer Remittance in Singapore – Remittance Benchmarking Study"](#), Medici. 2018.

56 ["Call for banks to be fair in dealing with customers"](#), The Straits Times. 4 June 2019.

57 [Bitcoin ATM Singapore – find bitcoin machine locations](#), CoinATMRadar. 2019.

58 ["5 things to look out for at the revamped Funan Mall"](#), Channel News Asia. 28 June 2019.

59 ["\\$2.9b donated to charities in Singapore in 2016"](#), The Straits Times. 14 November 2018.

Photo by Eugenia Clara on Unsplash



complaints about fund-raising appeals a year. He said of the complaints, “Many are not out to scam donors, but they may not know how to keep records or do proper disclosure.”

One such company that is utilising blockchain to give consumers demand greater transparency and control over getting their value for money when it comes to donations is AID:Tech and their product, TraceDonate. AID:Tech is looking to solve the problem of a lack of transparency across welfare and aid. By providing a platform for banks, government bodies and non-government organisations, they can now transparently disburse payment to recipients. For individuals, ensuring that they can see how their money is being used is critically important to build trust with these organisations.

TAX REFORM

No discussion of payment innovations is complete without addressing tax regimes. One concern that surrounds the emergence of non-fiat cryptocurrencies is about their potential impact on the tax base, and in turn, public finances. In the United States, IRS criminal investigation division chief Don Fort described digital and virtual currencies as a “significant threat” to tax collection⁶⁰.

However, the Singapore Government and its respective agencies are keen to keep innovation alive in the payments space through ensuring that tax codes support investments in innovation. The Inland Revenue Authority of Singapore (IRAS), Singapore’s taxation agency, recently proposed the removal of the goods and services tax (GST) from cryptocurrency transactions that function or are aimed to function as a medium of exchange. IRAS released an e-Tax draft guide regarding the GST treatment for digital payment tokens⁶¹.

From 1 Jan 2020, the following changes will take effect:

- i. The use of digital payment tokens as payment for goods or services will not give rise to a supply of those tokens; and
- ii. The exchange of digital payment tokens for fiat currency or other digital payment tokens will be exempt from GST.

IRAS said⁶² the effort to end GST liabilities on cryptocurrencies follows worldwide development and growth in the space that has led various jurisdictions to have reviewed their stance. “Similarly, IRAS has reviewed its GST position to keep up to date with these developments,” the agency said.

Local experiments with blockchain-based payment processing services are proving to be efficient, secure and compliant. Singapore’s efforts in this space are creating a modern template, not just for itself but for the developed world at large, to enable trusted verification of all value exchanged with fewer intermediaries and hurdles.

60 [“Crypto Tax Avoiders Face IRS Roulette: Fess Up or Try Hiding”](#), Bloomberg. 1 August 2019.

61 [IRAS e-Tax Guide \(Draft\)](#), Inland Revenue Authority of Singapore. 5 July 2019.

62 [“Singapore’s Tax Agency Proposes to Exempt Cryptos From GST”](#), CoinDesk. 8 July 2019.

Feature: Project Ubin

MAS and the industry coming together to understand blockchain

Project Ubin⁶³ is a collaborative project between MAS and the industry to explore the use of DLT for clearing and settlement of payments and securities. DLT has shown potential in making financial transactions and processes more transparent, resilient and at a lower cost. The project started in 2016 with the aim of helping MAS and the industry better understand the technology and the potential benefits it may bring through practical experimentation. This is with the eventual goal of developing simpler to use and more efficient alternatives to today's systems based on digital central bank issued tokens.

Phase 1⁶⁴ of Project Ubin started as a simple experiment built on Ethereum to understand how blockchain can be applied to payments and settlements systems. It achieved the objectives of producing a digital representation of the Singapore dollar for interbank settlement, testing methods of connecting bank systems to a DLT, and making the MAS Electronic Payment System interoperate with the DLT for automated collateral management. Phase 1 proved the viability of blockchain for interbank settlement, but also highlighted the limitations of the technology.

Phase 2⁶⁵ focused on resolving the limitations and technical challenges highlighted in Phase 1 which were critical for enterprise usage of blockchain, including

scalability, performance, privacy and finality of transactions. Phase 2 also developed new mechanisms for decentralised multilateral netting while preserving the privacy of transactions. MAS and The Association of Banks in Singapore announced on 5 October 2017 that the consortium which they are leading had successfully developed software prototype of three different models for decentralised interbank payment and settlements with liquidity savings mechanisms. Three different prototypes were developed on the blockchain platforms of Corda, Hyperledger Fabric and Quorum, and the source-codes and technical documentations were released to promote further innovation in the blockchain ecosystem. One of the members of that consortium is J.P. Morgan.

J.P. Morgan channelled its knowledge of payments and blockchain into the development of JPM Coin, a digital coin representing US dollars and designed to facilitate instantaneous money transfers over a blockchain network.

"J.P. Morgan is in a leading position in blockchain innovation and will continue to invest in technology and improve user experience of payments," said Naveen Mallela, head of APAC Digital Treasury Services and the designer of JPM Coin. The development of JPM Coin is seen as a natural extension of J.P. Morgan's participation in the development of blockchain technologies, including the enterprise grade Quorum[®] platform, and its role as a leader in the US dollar clearing space.

Having proved that blockchain works for interbank settlement, Project Ubin started looking at interconnecting blockchain networks. Phase 3⁶⁶ (Delivery-versus-Payment) was a project with SGX on

63 [Project Ubin: Central Bank Digital Money using Distributed Ledger Technology](#), Monetary Authority of Singapore. 2019.

64 ["MAS working with industry to apply Distributed Ledger Technology in securities settlement and cross border payments"](#), Monetary Authority of Singapore. 9 March 2017.

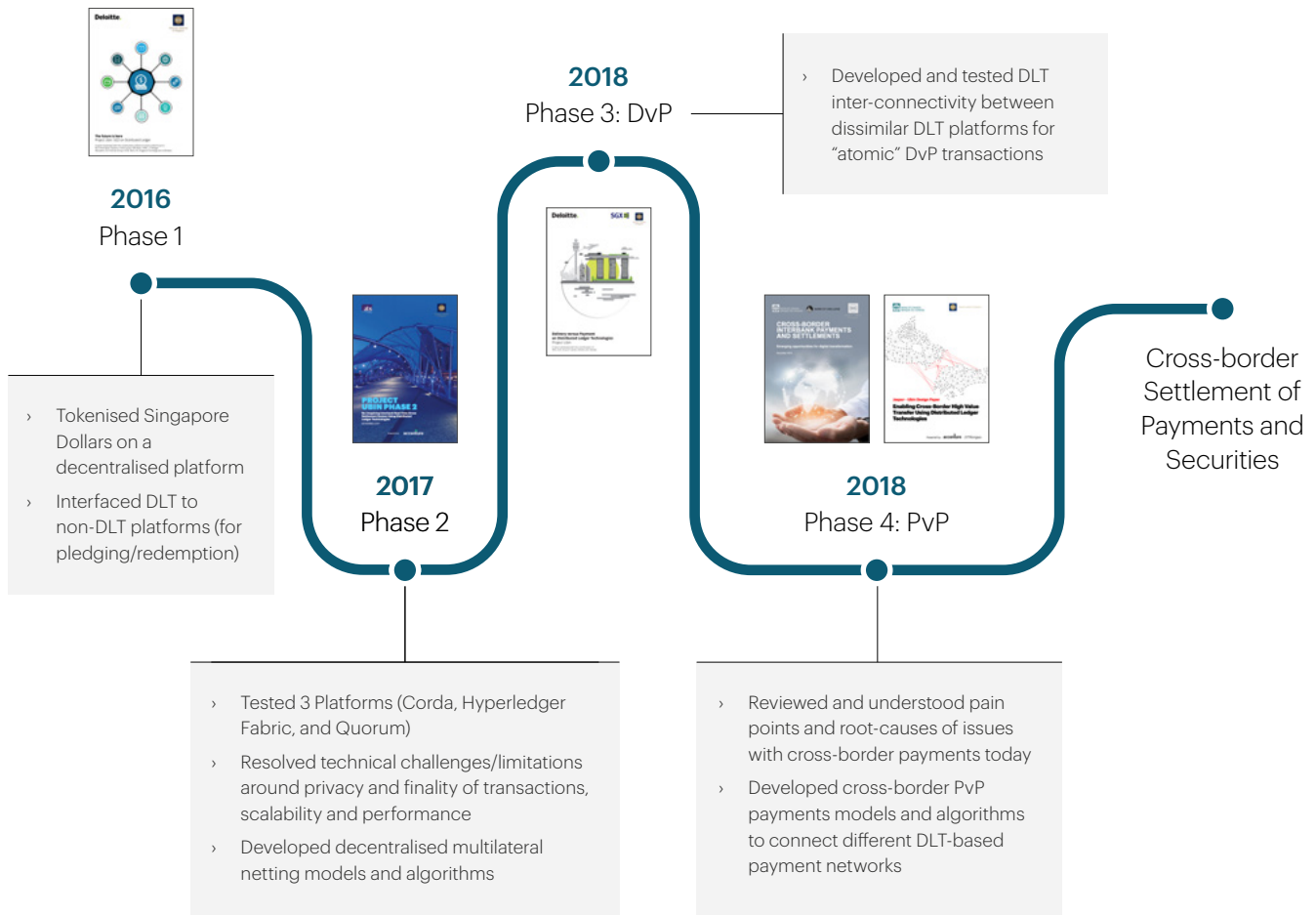
65 ["Source-codes of successful distributed ledger prototypes publicly released to encourage innovation in inter-bank payments"](#), Monetary Authority of Singapore. 14 November 2017.

66 ["MAS and SGX successfully leverage blockchain technology for settlement of tokenised assets"](#), Monetary Authority of Singapore. 12 November 2018.

Pushing the boundaries of tech

Contributing to a global body of knowledge

Proved technical concepts and resolved key challenges and limitations



developing capabilities for simultaneous exchange and final settlement of tokenised digital currencies and securities assets on different blockchain platforms. The ability to perform these activities simultaneously improves operational efficiency and reduces settlement risks.

Phase 4⁶⁷ (Payment-versus-Payment) looks at linking up blockchain payment networks for cross-

border payments. Phase 4 started as a collaboration with Bank of Canada and Bank of England on a technology agnostic review of existing payments models and new alternative models that could enhance cross-border payments and settlements. It then continued as a technical experiment to link up the experimental domestic payment networks of Ubin and Jasper by Bank of Canada, for cross-border payments.

67 [“The Bank of Canada, Bank of England and Monetary Authority of Singapore share assessment on emerging opportunities for digital transformation in cross-border payments”](#), Monetary Authority of Singapore. 15 November 2018.



The project demonstrated the ability to connect the two networks and allow Payment-versus-Payment (PvP) settlement without the need for a trusted third party to act as an intermediary.

The project is now into its fifth phase - Phase V. This phase focuses on developing the multi-currency payments model, one of the alternative models described in Phase 4, for the purpose of industry testing with commercial applications. This phase takes a step beyond technical experimentation, to explore and understand the broader ecosystem benefits of enabling business opportunities that were previously not possible or not cost-effective. The Phase V network will provide connectivity interfaces for other DLT networks to connect and integrate seamlessly, providing additional features to support use-cases such as DvP with exchanges, programmatic escrow and conditional payments for trade and trade finance.

Overall, Project Ubin is an exploratory research project with the industry. While there is a broad roadmap of research areas, each phase of the project is defined and scoped based on the prevailing challenges and concerns faced by the industry. The first two phases focused on building technology capabilities, while the last two phases were focused on interoperability of blockchain-based networks. From an innovation adoption perspective, the technology is at a good level of maturity. Phase V aims to also bring the broader ecosystem together to understand the business value of blockchain-based payments. Once technology and business are both at a good level of maturity, the next step would be in understanding legal and regulatory considerations and build the necessary framework for live adoption of blockchain for payments.

Financing The World's Trade

How can blockchain help Singapore keep its top rank as the world's leading maritime city⁶⁸?

The International Monetary Fund estimates that approximately 80%-90% of global trade relies on trade finance⁶⁹. Trade finance involves a complex range of activities from loans to letters of credit to certificates of insurance that help suppliers and buyers manage the funding gap as commodities ship across the world. In every transaction, there are risks for both buyer (importer) and seller (exporter). If importers pay upfront (cash-in-advance), they bear the full risk until the goods are delivered. On the other extreme, if importers only pay their exporters once the goods have been sold to the end user under consignment, exporters would bear all of the risk. It is in between these extremes that instruments of trade finance such as letters of credit and open accounts come into play to derisk transactions for both buyers and sellers and facilitate the trust that is required to trade⁷⁰.

Despite its massive scale, the trade finance industry suffers from both a lack of liquid capital and antiquated data management processes and infrastructure. Many small-to-medium sized enterprises (SMEs) cannot access the capital they need to finance their trades. A 2019 Asian Development Bank (ADB) report found that as many as 70% of all SMEs located in emerging markets lack access to adequate invoice

credit, resulting in a US\$1.5 trillion credit gap⁷¹. This credit gap is most pronounced in the Asian market where economies have scaled exponentially in recent years. By 2025, the World Economic Forum estimates that this gap in trade finance is expected to rise to reach a staggering US\$2.4 trillion⁷².

Data management in the trade finance industry is both inefficient and insecure: letters of credit are still paper-based and prone to fraud, and suppliers often face the risk of non-payment. Preparing for a trade can take 90-120 days and requires a tremendous amount of trust between transacting parties. For a trade finance deal, the technical and payment procedures needed for the international sale or purchase of goods, for a single commodities cargo by sea, can require around 36 original documents and 240 copies from as many as 27 parties⁷³.

The lack of an efficient infrastructure for establishing trust is also a barrier to bridging the trade finance gap. More than three-quarters (76%) of the banks surveyed by the ADB reported that anti-money laundering and know-your-customer regulations were major obstacles to expanding their trade financing operations to these SMEs. While these regulations are crucial to ensure the global financial system is not used to fund terrorism or launder money, they can inadvertently cut off legitimate companies in less developed markets from the financial support they need to grow.

68 ["Singapore tops list of leading maritime capitals for fourth time"](#), The Straits Times, 11 April 2019.

69 ["Statistical Coverage of Trade Finance - Fintechs and Supply Chain Financing"](#), International Monetary Fund, 31 July 2019.

70 ["Trade finance and the blockchain: Three essential case studies"](#), Deutsche Bank Corporate Bank, December 2017.

71 ["\\$1.5 Trillion Global Trade Finance Gap Frustrating Efforts to Deliver Crucial Jobs and Growth — ADB"](#), Asian Development Bank, 3 September 2019.

72 ["Blockchain Could Enable \\$1 Trillion in Trade, Mostly for SMEs and Emerging Markets"](#), World Economic Forum, 13 September 2018.

73 ["Commodities trade finance goes electronic after centuries of paper"](#), Reuters, 1 June 2015.

LOCATION, LOCATION, LOCATION

Singapore's history of being a trading port goes as far back as the 1300s and is in large part owed to its prime location between the maritime trade routes connecting East and West⁷⁴. Being 7 hours ahead of London and 12 hours ahead of New York, Singapore allows traders to complete the 24-hour trading cycle, giving flexibility to global trading operations. According to the Department of Statistics in Singapore, the country's trade exceeded S\$1,055 billion in 2018. Of that, over S\$500 billion was in the trade of services and almost S\$45 billion was spent on trade finance⁷⁵. As its trading volume continues to grow, almost doubling what it achieved in 2010, the reliance on trade finance will grow as well.

IMDA in partnership with MPA, Singapore Customs and the Singapore Shipping Association, is leading the development of TradeTrust. It is a digital utility that consists of a set of globally-accepted standards and frameworks that connects governments and businesses to a public blockchain to enable trusted interoperability and exchanges of electronic trade documents across digital platforms. TradeTrust will be developed to satisfy the requirements of the Model Law on Electronic Transferable Records (MLETR) published by the United Nations Commission on International Trade Law (UNCITRAL) to give electronic negotiable trade documents like electronic Bills of Lading (eBL), legal recognition. In November this year, DBS and Trafigura collaborated with IMDA to launch an open-sourced Blockchain trade platform, the ICC TradeFlow which is built on TradeTrust. The ICC TradeFlow platform is aimed at tackling the perennial problems behind the trillion-dollar trade finance market with a US\$20 million pilot trade transacted using TradeFlow for a Trafigura shipment of iron ore from Africa to China.

SINGAPORE BANKS EXPERIMENT WITH BLOCKCHAIN-BASED TRADE FINANCE

Commercial and investment banks in Singapore have also begun experimenting with blockchain: particularly in the area of trade financing. In November of 2018, BNP Paribas and HSBC Singapore successfully completed Singapore's first fully digitised end-to-end letter of credit (LC) transaction between two different companies⁷⁶. Just a month later, DBS became the first Singapore bank to enable an end-to-end cross-border blockchain trade platform, integrating banking and trade financing capabilities powered by DBS' API framework. Developed in collaboration with global agri-commodity trading company, Agrocrop International, and blockchain provider, Distributed Ledger Technologies, the solution was designed to provide Agrocrop's supply chain network with greater efficiency, cost savings and transparency.

With the implementation of the blockchain platform, Agrocrop and its counterparties were able to enjoy a more seamless and secure transfer of goods ownership and payments⁷⁷. Benefits include being able to offer supply chain participants with real-time updates on commodity prices and delivery information and trade financing approval for orders coming in from any part of the world. The streamlined process also bodes well for cost savings, cutting Agrocrop's average working capital cycle by about 20 days.

In September 2019, the China branch of Singapore's DBS Bank launched its first multi-tier financing facility on a logistics blockchain platform to help SMEs in China get faster access to trade financing⁷⁸. With this blockchain platform named "Rong-E Lian", trade financing can be provided in as little as 24 hours, compared with the weeks or even months using the traditional paper-based approach. DBS was said to be the first foreign bank in China's Greater Bay Area to digitalise cross-border settlements with a one-stop digital payments and collections

74 [Port of Singapore](#), National Library Board. 19 April 2018.

75 [Singapore's International Trade](#), Department of Statistics Singapore, 12 July 2019.

76 ["First fully-digitised trade transaction completed in Singapore"](#), BNP Paribas. 9 November 2018.

77 ["Agrocrop taps into DBS' APIs to launch blockchain trade platform for commodity trade"](#), DBS. 2018.

78 ["DBS launches first multi-tier financing facility on logistics blockchain platform"](#), Business Times. 11 September 2019.

solution called DigiDocs earlier in July 2019⁷⁹. In addition, DigiDocs also offers the online booking of foreign exchange rates, allowing DBS China's customers to select their preferred exchange rate according to market real-time quotes for remittance payments.

In October 2019, CIMB Bank's Singapore Branch and iTrust launched a blockchain trade financing platform, and successfully completed their first trade on the platform - the structured finance trade transaction on iTrust's blockchain and Internet of Things (IoT) platform of dairy products imported into China⁸⁰. The first trade paves the way for what CIMB's plans to push up to US\$100 million in trade financing transactions in the first year on the iTrust platform, with an average trade size of US\$1 million by a single borrower per trade. Explaining this step towards blockchain-based trade financing, Mak Lye Mun, CEO of CIMB Bank Berhad, Singapore Branch said: "Given the rapid technology shifts in the market today, we will continue to focus on digitalisation and customer experience to transform the way we finance our corporate customers, thus adding value to our services."⁸¹

CONNECTING GLOBAL TRADE

From startups to big banks to governments, industry participants across the globe are experimenting with deploying blockchain solutions. At least five large global consortia have emerged, bringing together both public and private stakeholders to work on different blockchain protocols and different aspects of trade finance.

In 2018, Singapore customs launched the Networked Trade Platform (NTP) to digitalise and streamline end-to-end trade processes⁸². "NTP is a transformational platform, which will take us from a traditional national single window which gives traders

a one-stop interface for all trade related regulatory transactions, to a one-stop interface that will enable them to interact with all business partners, stakeholders and regulators on trade related transactions," said DPM Heng Swee Keat, in his then prevailing role as Finance Minister. NTP is also in collaboration with MUFG Bank and NTT Data Corporation on a Proof-of-Concept which connects NTT Data's prototype platform using blockchain with the NTP, to facilitate secure and efficient cross-border trade data flows.

Recently, Standard Chartered Bank announced the successful completion of its first international LC transaction on Voltron^{83,84}. "Standard Chartered was able to digitise and simplify the end to end exchange of information between all parties in the transaction on the Voltron platform, including the issuance, advising and negotiation of LC and presentation of documents," the bank said.

Samuel John Mathew, Global Head of Documentary Trade, Transaction Banking, at Standard Chartered Bank further added that, "This pilot transaction marks the first of many that will follow from our participation with Voltron to digitise trade and enhance the client journey. As our clients increasingly look to technology to address the challenges of today's global trade environment, we are extremely optimistic and excited about the potential opportunities that Voltron brings to the industry with its demonstrated benefits in improved speed and reduced risks of settlement, as well as its flexibility in connecting banks, businesses and other third-party providers in its network."

Trade documents produced on external networks by a corporate's supply chain partners can be digitally sent, verified and processed through Voltron, enabling provide faster service levels, financing decisions and lower rates to their customers. Global trials of the

79 which includes Hong Kong, Macau and nine other cities in Guangdong province.

80 "CIMB Singapore to pump up to US\$100m in trade finance via blockchain platform in 12 months", Business Times, 17 October 2019.

81 "CIMB Bank Singapore and iTrust to Roll out Blockchain Trade Financing with Transaction Flows of up to US\$100 Million a Year for Corporate Clients", Business Insider, 17 October 2019.

82 "Singapore launches the Networked Trade Platform to digitalise and streamline end-to-end trade processes", Singapore Customs, 26 September 2018.

83 "Standard Chartered Completes First Transaction on Blockchain Trade Platform Voltron", CoinDesk, 7 August 2019.

84 Voltron, R3, 2019.

BLOCKDATA

| 5 LEADING CONSORTIA IN BLOCKCHAIN TRADE FINANCE |



Sources: Blockdata.tech

Voltron initiative took place earlier this year, and saw more than 50 banks and corporates participating in the simulation of multiple digital LC transactions, across 27 countries on six continents. Participants included ABN Amro, Alfa Bank, Banco de Crédito del Perú-BCP, Banorte, Bci, China Everbright Bank Hong Kong Branch, CIB, CommerzBank Commercial Bank of Qatar, Ekman & Co, LH Trading, MUFG, Natixis, National Bank of Egypt, RBI, SABB, Scylla, Standard Bank, Societe Generale and The Saudi British Bank, among others⁸⁵. According to R3, 96% of trial participants concluded that they would improve trade finance processes and reduce costs through Voltron⁸⁶.

Other global examples include:

- Marco Polo, a collaboration between TradeIX and R3 that has partnered with some major financial institutions including RBS's NatWest, BNP Paribas, Commerzbank, and ING. The collaboration combines R3's Corda Enterprise solution and TradeIX's TIX Core, an open infrastructure powered by DLT to streamline accounting for businesses to track payment guarantees and expedite receivables discounting.
- We.Trade, an European trade finance initiative by nine banks that include HSBC, Deutsche Bank, Rabo, KBC, Nordea, Santander, and Societe Generale. It focuses on SME trade finance in Europe using Hyperledger Fabric. The platform went live in July 2019.
- eTradeConnect, a blockchain-based trade finance platform developed by the Hong Kong Monetary Authority in collaboration with a consortium of twelve major banks in Hong Kong. Formerly known as the Hong Kong Trade Finance Platform, eTradeConnect aims to improve trade efficiency, build better trust among trade participants, reduce risks and facilitate trade counterparties to obtain financing by digitising trade documents, automating trade finance processes and leveraging the features of blockchain.

- komgo, a blockchain-based trade financing network formed by 15 of the world's largest commodity trade and finance companies. Since its launch, the komgo open financing platform has digitised letters of credit and expanded with the support for letters of indemnity, standby letters of credit and receivables discounting.

THE FUTURE OF BLOCKCHAIN-FINANCED TRADE

The emergence of blockchain technology has unlocked a shared vision for innovation across the trade finance industry. Not only can a blockchain mitigate risk by cryptographically securing and verifying documentation, it enables the digitisation and automation of documentary trade processes through smart contracts. A secure, digital blockchain-based platform provides faster settlement and reduces the cost and friction of working capital financing. Companies like Deloitte have highlighted the different areas in trade finance where blockchain presents an opportunity for enterprises to deploy an end-to-end solution for everything from tracking to bills of lading⁸⁷.

Using blockchain, leading enterprises and government organizations are coming together to strengthen the backbone of global trade. Over the past year, Singapore and the surrounding region have seen increased interest and activity around blockchain deployments in trade finance. As more industry participants from all sides of the marketplace onboard to blockchain-based trade financing platforms, the industry would experience network effects in terms of reduced cost base, and cash-flow gains. Moreover, real-time data coordination and streamlined settlement would help the industry unlock capital and remedy the growing credit gap, and enterprises that once struggled to secure financing can finally break into the market.

85 ["Voltron consortium grows to over 50 banks and corporates"](#), Finextra. 8 May 2019.

86 ["Over 50 Banks, Firms Trial Trade Finance App Built With R3's Corda Blockchain"](#), CoinDesk. 8 May 2019.

87 ["How Blockchain Can Reshape Trade Finance"](#), Deloitte. 2019.

Feature: Kommerce

How Kommerce take calculated risks to delivery prosperity

“Trade in Africa is difficult; high interest rates, currency spreads and bank fees eat away at merchant’s profits,” says Karen Teoh, COO and Crypto-Economist at Kommerce, and “complexity in cross-border logistics and limited access to capital further cannibalise the growth of the world’s fastest growing continent.” Founded in Singapore in 2017 by Harveen Narulla, Karen Teoh and Dustin Lau, Kommerce aims to respond to the large and persistent gap in trade finance in Africa. Kommerce have built a trade and finance platform which allows merchants in frontier markets like Africa to safely trade with other merchants outside Africa.

UNLOCKING TRADE, CREATING TRUST, ENABLING LENDING

It all started with an introduction to a Rwandan kiosk shop owner’s challenges with credit that became an exploration of systemic reasons for the trade finance gap in Africa, and the eventual realisation that blockchain could hold the keys to solving this problem.

Kommerce uses a hybrid public private blockchain architecture alongside game theory concepts to reduce defection risk - how do the risks and outcomes differ here to traditional trade finance mechanisms? “The traditional trade finance mechanism is the LC which was last amended in 1933 and that’s almost a hundred years old” said Teoh.

“The entities we are working with need financing to grow their businesses,” says Teoh, “their alternative

is mortgaging their homes on a monthly basis to make a living, betting their roof that nothing goes wrong and the bank never forecloses on them”. With sub-Saharan Africa accounting for 48.8% of the global 298.7m registered mobile money accounts globally, legacy financial institutions have already been leapfrogged by mobile money, and blockchain represents the next leap Africa can take in the race to catch up to the developed world⁸⁸.

A PROBLEM WORTH SOLVING

Harveen Narulla, CEO of Kommerce explains: “Developing credit history is a chicken-and-egg problem. It requires financing and actual business to be conducted and reliable data capture on deals that are faithfully completed. Without trade, it is not possible to capture meaningful data. Without financiers, it is not possible to do trade at scale. And without substantial trade and consistent trade history, financiers find themselves unable to assess lending risk and hence shy away.” Kommerce evaluated the risk, and decided it would be able to be the first to provide working capital to these budding entrepreneurs in Africa, who struggled to access traditional trade financing.

HOW IT WORKS

As explained by Teoh, credit reports in frontier markets can be faked for a price and cannot be trusted as a basis for extending credit, resulting in stopping of lending due to default risks over time. Through the Kommerce platform, financiers are able to verify the credit histories of importers whose trades they are financing and extend credit terms that reflect actual risk, based on actual transactions and transfers of value that occur on the Ethereum blockchain.

88 [“Sub-Saharan Africa has 48.8% of the total active mobile money accounts in the world”](#), Tech Point Africa. 27 February 2019.

Kommerce platform holds the traders deposit and goods as collateral, whereby goods are released when principle and fees are paid. Kommerce lends on secured risk. All escrow sums are handled electronically on the smart contract and the public Ethereum chain, while commercially sensitive information and documentation is handled on the Hyperledger Fabric private chain, saving not just time, but cost. Should the trader default, Kommerce is authorised to liquidate the goods to recover the financier's capital and its platform fees. Kommerce leverages game theory and risk management principles to calculate the margin of the deposit to minimise loss.

How is payment facilitated? Kommerce creates and issues their KTF token to function as a payment token for transfers of value within the Kommerce ecosystem and also as a "work" token to incentivise tasks and activities performed which add value to the Kommerce platform, such as downstream retail price discovery for commodities importers and real time logistics routing feedback. "The token is ERC-20 compliant," Teoh says, explaining that exchanges in these markets are more comfortable dealing with the ERC-20 token standard.

NOT ALL SMOOTH SAILING

Kommerce's second shipment on their pilot network faced off with mother nature - the ship carrying the cooking oil was clipped by a cyclone and the cans holding the oil were damaged. Between regulatory hurdles and insurance paperwork, more than a month was spent dealing with red tape until the insurance came through and covered their losses. During that month, as a result of the damage, the cans of oil leaked across the warehouse floor. While blockchain offers solutions to some problems, it does not solve all.

THE FIRST COMPLETED TRADE

In January 2019, Kommerce celebrated its first completed trade. Leveraging its on-ground operations team in Rwanda, Africa, Kommerce managed many moving parts, including the exporter, importer, logistics, warehousing, and cross-border clearance of goods to execute its first trade - a twenty foot container

containing 27.85 metric tonnes of IRRI-6 Grade 2 rice that was transacted on the border of Rwanda and Democratic Republic of the Congo (DRC), with a Congolese businesswoman acting as the importer.

The success of the first trade came despite a number of challenging additional socio-political circumstances: the trade was carried out during the Christmas to New Year period, DRC's General Election heightened militia activity in DRC and the DRC's ongoing Ebola epidemic.

OUTGOING TRADES INITIATED

Kommerce was always intended to be a bi-directional platform, enabling not just incoming trade to Africa, but to also facilitate outgoing trade from the continent. It is currently working on exportation of rubber from West Africa, as well as a sizeable metals deal.

Each jurisdictional expansion that Kommerce plans will bring new issues and challenges. Kommerce is committed to building its tech stack and UX to address new regulations and the specific obstacles of each new market with the same technical rigour and commitment to deliver prosperity as the first.



Feature: InfoCorp Technology

How InfoCorp Technology is looking at financial inclusion differently

Smallholder livestock farmers, which represent a large population of the livestock industry in most emerging markets, are unable to collateralise their 'livestock as an asset' to access formal financing. This will inevitably affect the ability to increase the quality and production of their cattle. This is compounded by the lack of access to livestock insurance to protect their livelihood when their cattle dies, especially when there is a major disease outbreak. Livestock insurance is not widely accessible to these farmers, mainly due to moral hazard and fraud issues.

FINANCIAL INCLUSION

Most Fintech companies place too much emphasis on traditional aspect of financial inclusion. While agritech companies focused on high-end, high-cost technology aimed at commercial farms that are economically sustainable. InfoCorp Technology's FarmTrek platform is designed to address this siloed problem by creating a platform used by the livestock and financial ecosystems to facilitate the development of the cattle value chain.

Founded in 2015 with headquarters in Singapore, InfoCorp Technology is a blockchain company that integrates the livestock and financial ecosystem through its FarmTrek platform in solving the financial inclusion problem by enabling smallholder farmers to convert their cattle into collateral for loans. FarmTrek is a blockchain ecosystem platform designed to cut across the agriculture, finance and technology industry silos.

It enables smallholder farmers to use their cattle as collateral for loans, opening up a previously untapped financial market and providing much needed liquidity for developing the cattle value chain. In doing so, FarmTrek also addresses food safety and cattle disease control.

IMPROVING LIQUIDITY WITH BLOCKCHAIN

Blockchain, being a disruptive technology, will face adoption resistance especially in industries that are dominated by traditional business models, incumbent and legacy processes. Better results can be achieved in the real world when blockchain is applied to a disruptive business model that is entirely new, such as the one explored by FarmTrek in the livestock industry .

FarmTrek encourages financial inclusion for smallholder farmers by improving liquidity within the livestock value chain. Smallholder livestock farmers would access working capital loans using their livestock as collateral, livestock insurance services and cashless payments. FarmTrek was successfully piloted with the Myanmar government and launched in 2019. Following this success, InfoCorp has expanded to Rwanda and showcased FarmTrek at the Afro-Asia Fintech Festival organised by MAS and Central Bank of Kenya. The company is also the first Singapore private sector member of Smart Africa Alliance with access to its 24 member countries. The company's innovation has been acknowledged as one of the winning business models for women entrepreneurs, co-funded by the United Nations to improve access to finance for women micro, small and medium enterprises (MSMEs) via the UN FinTech Innovation Fund. Bringing together the best talent across the globe, InfoCorp has staff in Rwanda, Myanmar, India, Vietnam, Argentina and the US.

THE CHALLENGE AHEAD AND WHAT NEXT

FarmTrek has faced a number of challenges in getting to this point, and anticipate the following challenges will continue to need to be addressed in the future:

1. Ownership of data. As the platform cuts across industry silos, there are constant debate over

the rights and ownership of the use of data generated by different stakeholders.

2. Pricing. The disadvantage of being a first-mover is that customers face difficulties in making purchase decisions due to the lack of comparable product.
3. Regulations. Blockchain is a controversial innovation. Governments, especially in developing countries, tend to view it with caution and curiosity. However, blockchain is just an enabler. The use of the technology has to solve the crux of the problem. FarmTrek takes a very conservative approach to the use of blockchain, and has deployed a largely private blockchain to address provenance of livestock and primarily serve as an immutable data store. This does not exclude possibility of advance use cases for blockchain in the future as the adoption matures.

The success of FarmTrek's business model hinges largely on government endorsement as livestock identification and traceability involves high national interest and government buy-in provides the legitimacy for support from the ecosystem, as well as establish the viability for scaling to the entire market. However, in some cases such as Myanmar, the model became too B2G2C-centric which solves the scalability problem but increased the time to market.

InfoCorp considering an alternative model that is more B2B2C-centric which utilises government endorsements whilst working directly with local private sector. This approach is being piloted in Rwanda and is showing a good trade-off between scalability and time-to-market. A B2C approach will be harder for adoption due to concern of legitimacy and insufficient financial incentives to drive farmers adoption. FarmTrek has genuine demand from countries with large population of smallholder cattle farmers. It is proven to be applicable in different parts of the world, both in Myanmar (representing Southeast Asia) and Rwanda (representing East Africa).



SECTION THREE

Digitising Health, Credentials and Identity



Decentralising Healthcare And Insurance

How the insurance and healthcare industries are leveraging blockchain

Access to efficient healthcare and robust insurance varies greatly across the world, as does the level of government participation and support in these countries. While innovation in the delivery of healthcare and the types of insurance available on the market are common-place, blockchain can help deliver on key digital opportunities to cut costs, increase efficiency, enhance customer experience, and improve data quality, collection and analytics⁸⁹.

The healthcare industry has changed drastically over the past few decades with the rise of centralised data systems, health data regulation and a mandate

to focus on digitising medical data. With these advancements, challenges with interoperability have created barriers. Information owned by healthcare providers, pharmaceutical companies and other stakeholders in the health and medical ecosystem do not interact with one another.

Due to the inability to securely share data and siloed management of medical records, patients spend precious time and resources with redundant medical processes (e.g. executing duplicate blood tests or physicals). In emergencies, physicians and other health professionals providing care may not have full visibility over a patient's medical history (e.g. explicit documentation highlighting patient allergies, prior or withstanding medical conditions, administration of controlled substances) in which case they risk giving improper treatment. This has driven up the cost of healthcare.

⁸⁹ [Blockchain and Insurance: New Technology, New Opportunities](#), ConsenSys Insights, June 2019.

THE COST OF CARING FOR YOUR HEALTH

Global healthcare spending is increasing at an annual rate of 5.4% through to 2022 and will reach a projected US\$10.059 trillion, an estimated 10.4% of global GDP devoted to healthcare alone⁹⁰. The Asia-Pacific region is slated to be one of the fastest growing healthcare markets globally, where growth is predicted to be at CAGR of 13.4% through to 2022⁹¹. Among the factors that drive this spending growth in the health space are aging populations, rapid population growth, advances in medical treatments and the integration of technologies like AI, robotics, big data, and blockchain.

According to the 2018 Bloomberg Healthcare Efficiency Index, Singapore's healthcare system is one of the most efficient in the world, second only to Hong Kong (Singapore lagged behind in the areas of life expectancy and relative cost)⁹². The Singapore government has put a national focus on health tech and healthcare innovation. Specifically, the Singapore Ministry of Health (MOH) has characterised Singapore's three major healthcare reform trends as the intended movement beyond "the hospital to the community," "quality to value," and "healthcare to health."⁹³

Singaporean health and public works projects are focused on improving patients' experience as they navigate the healthcare system without compromising healthcare delivery quality. Additionally, MOH has set a goal to reduce the health industry's inefficiencies by streamlining workflows and automating labour-intensive activities. These topics of concern lend directly to leveraging blockchain as a viable solution in the health technology space.

HEALTH DATA, CENTRALISED THROUGH DECENTRALISATION?

Health data is considered among the most sensitive personal information that can be aggregated

and provides ample opportunity for innovation through blockchain. However, the need to protect personal health information and the need to access this data can contradict one another. This concern can be addressed by enabling health data ownership and personalised permissioning for individuals. Blockchain shows promise to securely, privately and comprehensively collate and track patient health records.

MediLOT, a Singapore-based blockchain and healthcare analytics startup, is one example of a company taking on the challenge of exploring electronic health records solutions. MediLOT, a NUS spinoff supported by Singapore government-owned technology development firm SG Innovate, uses blockchain to build electronic health record platforms that are focused on "patient-centricity, privacy and equitable data sharing." Rather than storing entire data records, MediLOT stores a secure hash of the data⁹⁴.

Per MediLOT's Mid Year Progress Report⁹⁵, progress is being made: its Testnet is under development and set to be released in Q4 2019; the development of a patient-centric application that will allow users to access and grant access to their medical records continues with Proof-of-Concepts for both Android and iOS; and it has launched the MediTrac app, which serves as a dietary healthcare mobile application. Not least, MediLOT boasts that its highly secure solution adheres to stringent data privacy regulations, including GDPR.

SHIFTING THE INSURANCE PARADIGM

Trust is one of the major issues faced by the insurance market, but also one of the central issues that blockchain solves for. Trust is established by automatically embedding insurance into smart contracts, and the immutable nature of transactions on the blockchain further strengthens trust. Furthermore,

90 [2019 Global Healthcare Outlook](#), Deloitte. 2019.

91 ["The \\$11.9 Trillion Global Healthcare Market: Key Opportunities & Strategies \(2014-2022\)"](#), Business Wire. 25 June 2019.

92 ["These Are the Economies With the Most \(and Least\) Efficient Health Care"](#), Bloomberg. 19 September 2018.

93 ["Forging a Frailty-Ready Healthcare System to Meet Population Ageing"](#), Research Gate. 23 November 2017.

94 ["AMA With Dr Marcus Tan, Co-Founder, and Dr Dumitrel Loghin, Tech Lead of MediLOT"](#), Medilot Technologies. 15 June 2019.

95 ["MediLOT Mid Year Progress Report"](#), Medilot Technologies. 29 June 2019.

the execution of smart contracts upon fulfilment of conditions improve efficiency by automating previously inefficient, expensive and time-intensive business processes ranging from assessments, to claims and payments⁹⁶.

“Blockchain has evolved from its roots as a niche science to become a significant concept in business and the power that it has, will cause a paradigm shift to all areas of the insurance industry,” said Michael Gourlay, at the time of his announcement of joining Immediate as independent non-executive director and advisor this year⁹⁷. Immediate, is a collaborative ecosystem for blockchain based insurance.

Immediate as a concept was introduced by Insurance Marketplace, a Singapore online broker. Built on the Zilliqa blockchain, and in partnership with Deloitte and FWD (an innovative regional insurance group), Immediate is intended to be a “game-changing multisuite insurance product”⁹⁸. Immediate allows consumers to customise insurance coverage to their needs and stores insurance contract information in digital wallets. When a predetermined set of insured events occur, the smart contract triggers and the claim payout goes directly to the customers’ wallet.

Addressing another aspect of insurance is Hearti Lab, which launched a blockchain-based AI platform SURETY.AI to connect insurance companies with customers by offering micro-insurances. These micro-insurances are on-demand and affordably priced, which caters to Asia’s fast growing economies through the Decentralised Enterprise Insurance Network. The platform allows insurers and financial advisors to connect with customers and leverages AI for its communication channels (including chatbots), offers solutions to customer service, claims processing and fraud detection⁹⁹. Hearti Lab is also working with Healthcare partners to integrate their services and data into SURETY.AI.

A more focused insurance use case is posthumous processing of insurance claims for departed family members. Lifechain, piloted by Singapore Press Holdings, Singapore-based insurer NTUC Income, MetLife’s innovation LumenLab, uses blockchain to facilitate the life insurance claim process for the family of an insured member who has passed away. Lifechain allows SPH to securely encrypt and share the verification data used for obituary placement with NTUC Income, thereby kickstarting the claim process¹⁰⁰.

Another hyper-specialised insurance claims-based project out of LumenLab is Vitana, which is built with partners SwissRe, Cognizant and Vault Dragon. Marketed as the world’s first automated insurance solution using blockchain to offer pregnant women financial protection for gestational diabetes, Vitana is an interesting play in the blockchain insurance space by positioning maternal health and successful pregnancies as a focal-point for the insurance provider’s use case.

In drug traceability, secure supply chain tracking is necessary to prevent the distribution of counterfeit or illicit drugs. Counterfeit drugs pose risks that may compromise the safety and success of treatment or lead to addiction and drug dependence. They also carry the risks of unknown side-effects, some of which may be fatal. Blockchain presents an opportunity to securely track the production and movement of substances in an immutable record.

The key concern in healthcare can be addressed by enabling health data ownership and personalised permissioning for individuals. Why then does the healthcare industry in the blockchain market seem underserved? The Singaporean blockchain and healthcare projects seem to be taking that question head-on.

96 [Blockchain Solutions for Insurance](#), Accenture. 2019.

97 [“Former MSIG Singapore CEO joins insurtech firm Immediate”](#), Insurance Business Asia. 27 August 2019.

98 [“Insurance Market launches Immediate, a new Eco System for Blockchain Insurance, in collaboration with Zilliqa, FWD and Deloitte”](#), Business Insider. 2 May 2018.

99 [SURETY.AI](#), Hearti Lab Pte Ltd. 2019.

100 [“LifeChain: Blockchain initiative to automate life insurance claims verification”](#), Lumen Lab. 19 June 2019.

Certification On The Blockchain

Can blockchain make it safer and easier to validate an individual's skills and certifications?

Since the dawn of the internet, most forms of value or data that were previously represented in a physical format have steadily been on a path towards virtualisation. Everything from money to documents, certificates to personal profiles now largely exist in digitally. Adding to this, the exponential rise of social media platforms has seen a heightened level of application of user profiles and their associated metadata. As revolutionary as this change may be, it has been plagued by a fundamental problem: the increasingly complex construct of identity and the difficulty of guarding what is truly authentic.

CERTIFIED BY THE COMMUNITY

With the world being regularly rocked by scams and scandals surrounding identity theft and the lack of viable solutions, experiments are underway to apply blockchain to this troubled space.

One such experiment that was founded in Singapore in 2017 is Indorse - a social network that is tackling the problem of certification-based identity. Indorse uses the blockchain to create endorsements on user profiles against crowd-verifiable evidence. With Indorse, one or more users can verify and endorse another user's skills and are rewarded with tokens for doing so. To do this, a user has to attach a form of evidence for other members to verify so that every claim they make on Indorse can be attested. "If someone is an expert in NodeJS, they put up a claim and attach proof such as their GitHub repos," said David Moskowitz, co-founder of Indorse, "other members in the same domain on Indorse verify it. Based on the consensus, the claim is either 'indorsed' or flagged."

By utilising blockchain, Indorse is building a platform where the user is in charge of their own data as long as they are able to prove the authenticity of their claim. Advertisers are part of the business model and purchase space on the platform with cryptographic Indorse Tokens, or IND tokens. Moskowitz said a portion of these IND tokens are shared with the members who created the content, “in a nutshell, members are finally able to receive rewards due to their data, instead of watching passively as the revenue goes to companies holding their data,” he said.

Moskowitz foresees the mainstream acceptance of blockchain as a key driver for the Indorse platform. “We believe the use of blockchain will go mainstream in the next two years,” he says, “Indorse envisions a serverless, decentralised future, where the users will build their profiles and profit from their reputation and from sharing their skills and activities on the platform via reward tokens.”

AUTHENTICATION FOR THE GREATER GOOD

Verifying a person’s skills and certifications is vital for education institutions, employers and government authorities. Between 2016 and 2018, Singapore’s Manpower Ministry apprehended 33 foreigners for submitting forged certificates in connection with work pass applications. Thanks to blockchain, this could soon be a problem of the past.

In May 2019 Education Minister Ong Ye Kung announced that digital certificates, under a program called OpenCerts, will be given to students alongside the traditional physical ones¹⁰¹. “It allows for any education institute to issue OpenCerts, and for anyone to quickly check the validity of a digital certificate. This will in time make job application and hiring easier and smoother for both the applicant and the employer,” Minister Ong noted. OpenCerts, which marks the first time that blockchain is being used at a national level in Singapore, has been jointly developed by SkillsFuture Singapore (SSG), GovTech, Ngee Ann Polytechnic

and the Ministry of Education. Each digital certificate contains a unique cryptographic proof embedded in it, like a fingerprint. This will be corroborated with its code on the blockchain for any signs of tampering and crosschecked with a revocation list as well. The process is completed in a few seconds, with tampered files being highlighted on the platform. SkillsFuture Singapore (SSG) Chief Executive Ng Cher Pong said: “Employers will have a reliable source to verify certificates submitted by candidates and employees.”

Using blockchain is more secure than conventional means, where a centralised server is needed to store details within the certificate which makes it more vulnerable to breaches, per an observation by GovTech’s Government Digital Services Director Steven Koh. “We don’t store academic records of the certificate, and personal data are not published on the blockchain - so it’s more secure,” added Koh.

The emphasis on shared technologies like OpenCerts and new-age businesses such as Indorse lays the foundation for not just a strong focus on solving the identity problem but a distinctly Singaporean imprint on promoting blockchain in sectors beyond mainstream Fintech. Authentication of certificate information as a community-driven principle is well and truly finding a home in Singapore’s blockchain ecosystem.

101 [“Graduates to get fraud-proof, convenient digital certificates”](#), Today Online, 3 May 2019.

Feature: OpenCerts

Whether applying for further study or applying for a job, students are often faced with a requirement to provide verified copies of their educational certificates. While an additional administrative burden for the student, this can also prove to be an administrative burden for the educational institution. Ngee Ann Polytechnic, a Singapore Institute of Higher Learning (IHL) along with a number of other IHLs conducted a survey in 2017 and found that on average, seven man-months per year per institution were spent on performing such activities. For Ngee Ann Polytechnic, finding a way to improve the administrative burden, lessen the amount of paperwork and reduce the time and cost of manual verification looked to be a problem worth solving.

ENTER: OPENCERTS

Following its initial survey, the team at Ngee Ann Polytechnic with the support of other IHLs contacted GovTech. GovTech, a statutory board of the Singapore government focused on harnessing infocommunications technologies to make a difference to improve the lives of people in Singapore and furthering its Smart Nation initiatives, had already been thinking about blockchain, but it was the outreach from Ngee Ann Polytechnic that launched GovTech's first foray in the practical application of the technology.

Ngee Ann Polytechnic and GovTech developed a minimal viable product with GovTech that was supported by the Ministry of Education and SkillsFuture Singapore (SSG), a statutory board under the Ministry of Education (MOE). At the same time, these parties led the creation of the OpenCerts consortium. The project was ambitious and would require a new way of thinking about the overall certification paradigm.

UNDER THE HOOD

In building OpenCerts, the consortium looked at the various protocol options but determined that being on a private network or a hosted service may deter entities from other countries from using the product. "We wanted to drive global adoption by allowing anyone to be able to participate freely in using the framework and not be tied down to a single product vendor or deterred by other differences," said Steven Koh, Director of Government Digital Services at GovTech, explaining the decision to deploy on the Ethereum mainnet. This proved to be a simple decision made by the consortium early on and helped to shape some of the decision making and problem solving that would come along the way.

OpenCerts separates a traditional certificate into three parts - machine readable data (in the file), proof of existence (on the blockchain) and human readable templates (hosted as decentralised renderers) - these three parts raised questions to be answered around scaling, privacy, identity management, and decentralised rendering.

To successfully complete a transaction on the blockchain, a small amount of cryptocurrency and time needs to be committed. The OpenCerts consortium worried that schools that needed to issue a large number of certificates would face significant transaction costs and long processing queues if they were to commit individual certificate proofs. They needed to find a way to batch large amounts of certificates issuances into a single transaction. The solution? The use of a merkle tree. Merkle trees would allow them to create hashes of the certificates instead of using full files, reducing the amount of data needed to be maintained for verification. This means less data to be transmitted and lower transaction costs, thus improved efficiency. Another benefit was the added



With OpenCerts, we are harnessing the power of blockchain in a practical way. It allows for any education institute to issue OpenCerts, and for anyone to quickly check the validity of a digital certificate.”

Education Minister Ong Ye Kung

layer of security. As explained by Koh, “Since we don’t store academic records of the certificate and personal data are not published on the blockchain, there’s neither centralised database to hack nor data to steal from. This approach is much more secure than traditional system.”¹⁰²

While more secure, there remained the question of privacy and user control. Traditionally, users do not have fine control over the amount of data they share with others. Considering the example of providing identification at a building security desk: all that the personnel at the counter need to know is that the visitor is who they say they are, their name and photograph. By showing the building security officer government-issued identification, the visitor shares the information they need, but also sensitive information they don’t - such as their address, date of birth, identification number, and more. In developing OpenCerts, the consortium wanted to empower users to be able to determine how much information they share with another user. OpenCerts tackled this through the development and implementation of selective privacy, which allows users to obfuscate parts of the certificate without invalidating the entire certificate. Users are able to share only the information the other user requires while protecting the information they do not need. Those receiving information are able to see that information has been hidden, but have no way of retrieving that information themselves.

Identifying legitimate entities also proved to be a challenge. As explained by Koh, “We started this project in Singapore, but from the outset we wanted to extend the use of OpenCerts beyond Singapore.” To do this, DNS is implemented to bind the identity of a smart contract to a domain name, allowing users to verify the certificate they have received originates from a legitimate entity by the issuing domain name.

The consortium had initially assumed that the schools issuing certificates on the platform would be open to standardised data format and default

¹⁰² [“Graduates to get fraud-proof, convenient digital certificates”](#), Today Online, 3 May 2019.

certificate designs (as they believed that computer readable data was more important than the aesthetics of the certificate). The assumption proved to be wrong. The team launched the first version of OpenCerts based on their initial assumption and quickly learned that schools wanted their certificates styled in different ways. This required schools to create a pull request to a repository controlled by GovTech that then required code change, a time-intensive activity that GovTech was not able to scale with a lean development team. They worked to introduce decentralised template rendering in OpenCerts v2.

DEFINING SUCCESS

The first batch of certificates were issued to Ngee Ann Polytechnic's graduating cohort in 2018. It then took six months to rally 18 IHLs to join the initiative, then another six months for their students to graduate and for their certificates to be issued on the blockchain. This culminated in the announcement that in 2019, all Singapore graduates of N, O and A Levels, ITE qualifications, diploma and degree qualifications from polytechnics, LASALLE College of the Arts, Nanyang Academy of Fine Arts, Autonomous Universities and the National Institute of Early Childhood Development and Singapore Workforce Skills Qualifications would be issued digital certificates¹⁰³¹⁰⁴. This marked the first deployment of blockchain at a national level in Singapore.

In a speech by Education Minister Ong Ye Kung at Temasek Polytechnic's graduation ceremony in May 2019, he said "With OpenCerts, we are harnessing the power of blockchain in a practical way. It allows for any education institute to issue OpenCerts, and for anyone to quickly check the validity of a digital certificate. This will in time make job application and hiring easier and smoother for both the applicant and the employer."

BEYOND EDUCATION

In the midst of developing OpenCerts the consortium was grappling with the wide-ranging potential of the underlying technology. This led to the abstraction of the data provenance layer, now OpenAttestation, and built OpenCerts over it. Effectively, OpenAttestation was established as the underlying notary framework from which verification services for other applications could be created.

While OpenCerts has been widely seen as a success in Singapore, the consortium continues to explore ways to expand globally while maintaining their founding principles. As explained by Koh, "To encourage partnership and drive adoption, our engineering principle on using open-standards, open source and public permissionless blockchain for OpenCerts shall remain unchanged. OpenCerts will continue to be free for all students and employers to verify educational credentials."¹⁰⁵

103 ["Blockchain, OpenCerts and Partnership"](#), Steven Koh, 3 May 2019.

104 ["Convenient & Secure Authentication of Education & Training Certificates Through OpenCerts"](#), Skills Future Singapore, GovTech and Ngee Ann Polytechnic, 3 May 2019.

105 ["Blockchain, OpenCerts and Partnership"](#), Steven Koh, 3 May 2019.



SECTION FOUR

A Smarter Way of Doing Things

The Making Of A Smart City



The application of these technologies must benefit our grandchildren and re-engineer our country to improve lives for generations to come. And to do so, these efforts have to be sustainable, not just financially, but also with respect to resources and energy consumption”

Dr Janil Puthucheary

Leveraging blockchain and other smart technologies for a city of the future

What does Singapore have in common with New York City, Tokyo, and London? According to recent research by IDC, they will each invest more than US\$1 billion on smart city planning. Last November, Singapore was recognised for its investments in technology and connectivity infrastructure and received the Smart City Award at the Smart City Expo World Congress 2018 in Barcelona. Singapore is placing an important focus since it is growing fast as is the rest of the Southeast Asian region. According to the United Nations Population Division¹⁰⁶, the population of ASEAN will increase from 633 million people in 2015 to 717 million in 2030 and 741 million people in 2035. Population growth at this rate does have its issues.

Singapore’s success in building a digital economy, digital government and digital society has paved the way to aid other parts of the region. Recently, Singapore-based blockchain startup Limestone Network announced that they will dispatch blockchain technology in a mission to establish a smart city at the center of the Cambodian capital. The company focuses on smart city ventures across Southeast Asia by partnering domestic governments, with development across Southeast Asia on the pipeline for the next five years. Limestone Network aims to build a smart-city ecosystem for real estate and infrastructure across Southeast Asia.

¹⁰⁶ [“ASEAN+6 Population Forecast: Global Share, Aging and Dependency Ratio”](#), Ministry of International Trade and Industry.

According to Tony Cripps, CEO of HSBC Singapore, “Smart technologies that can make city transportation, urban energy usage, building and waste management systems, and even healthcare more efficient (and therefore cleaner and more sustainable) will help alleviate the challenges that accompany the rapid expansion of towns and cities across Asia – from Johor Bahru to Hanoi.”¹⁰⁷

DECENTRALISED ENERGY

It does not just stop at Southeast Asia and real estate. Eloncity is a Singaporean company that is looking to drive usage of greener electricity in Africa and also decentralised electricity which is controlled by communities. In a recent article in Forbes¹⁰⁸, Andy Li, CEO and Founder of Eloncity, touches on this idea of community, a strong African value which is also prevalent in the blockchain’s decentralised nature. “Many cities in certain countries in Africa have limited energy, preventing them to innovate and grow. Therefore, energy as a shared economy seems to be a good start.” says Li.

Power demand is not just an issue for Africa but for the rest of the world, with Singapore being no exception. According to statistics from the ADB¹⁰⁹, global power demand will soar by 58% in 20 years. Asia’s annual energy expenditure alone will increase from US\$700 billion to US\$1.6 trillion by 2035. And Singapore is starting to see innovative local companies like Electrify that are keen to change the way commercial companies buy electricity for the better.

PEER-TO-PEER ENERGY TRADING

Electrify provides intelligent price comparison tools to help customers find the most suitable plans for their needs and claims to have transacted more than 60 GWh of electricity for commercial and industrial

customers in Singapore since 2017; with about 500 companies saving a total of S\$1.5 million. The company is also building its peer-to-peer energy trading platform, Synergy, which connects a network of solar PV systems to energy users through the main grid. Earlier this year, Electrify tested stage one of the platform, called Synergy Alpha, and is expecting to release Synergy Beta before end of 2019¹¹⁰. In addition to tackling the local market, Electrify is also currently exploring collaboration opportunities with established energy players and regional utilities to bring the technology into markets like Japan, Thailand, and Australia¹¹¹.

“We’ve seen keen interest among companies and consumers in Singapore for renewable energy. This has led to the growing proliferation of solar rooftop installations, a trend that we’re expecting to grow by addressing a largely unmet demand for renewable energy,” said Martin Lim, CEO and co-founder of Electrify¹¹².

CREDIT WHERE CREDIT IS DUE

Another application of blockchain in the renewable energy sector is Renewable Energy Credits (RECs) trading. RECs are proof that energy was generated from renewable sources. Purchasing these credits can help businesses to meet regulations on renewable energy use. Blockchain can allow trading of RECs without the need for a centralised party to verify the transactions. This may mean a more reliable and efficient trading experience. In 2018, Singapore’s largest utilities company, SP Group, has launched a blockchain platform to allow companies to offset their use of non-renewable energy with investment in RECs.

This platform, which is effectively a marketplace, will support local, regional and international RECs to be available for both domestic and overseas buyers. To achieve this with security, integrity and traceability,

107 [“Smart City – The Way Forward For SEA Urbanization”](#), Asian Blockchain Review. 3 October 2019.

108 [“Africa’s Blockchain Potential Untapped, But How Can It Be Implemented?”](#), Forbes. 23 October 2018.

109 [Energy: Facts and Figures](#), Asian Development Bank. 2019.

110 [“The Synergy Alpha in Singapore”](#), Electrify. 30 July 2019.

111 [“Singapore energy startup Electrify to raise \\$5m series A”](#), Tech in Asia, 14 August 2019.

112 [“Singapore energy startup Electrify to raise \\$5m series A”](#), Tech in Asia, 14 August 2019.

SP decided to implement a blockchain-based solution to offer an improved system compared to their competitors. In a recent interview with ledgerinsights.com¹¹³, SP's Chief Digital Officer Samuel Tan, said, "Through blockchain technology, we enable companies to trade in renewable energy certificates conveniently, seamlessly and securely, helping them achieve greener business operations and meet their sustainability targets."

GETTING AROUND

Transportation is key to any smart city and can significantly impact the environment as well. Most of us have gone through the experience of buying a used car and having to trust the seller of the car on the authenticity of the service information provided. This is where protocols like the Ocean Protocol and Mass Vehicle Ledger (MVL) come in.

In July 2019, sgCarMart launched Singapore's first Know-Your-Vehicle used car data marketplace using the Ocean Protocol¹¹⁴. This allowed comprehensive information about a used car to be securely shared and accessed through their blockchain to help consumers make more informed buying decisions. Through the use of blockchain, smart contracts, and tokens, Ocean Protocol allows the origin of data and its trail to be established, recorded and traced.

CONNECTED TRANSPORT

MVL Chain has built an entire vehicle data collecting ecosystem based on blockchain. The vehicle data collecting ecosystem connects a lifetime data of the car from multiple possible services, from car dealerships, to mechanic shops to car rental companies. Participants from automobile-related companies, services or trade industry will be connected and will insert data related to driving, traffic accidents, repairs and other car-related transactions into the blockchain.

Participants who provide data related to their automobile usage will receive MVL points, a reward system used to encourage contribution to the ecosystem. These points could then be used in the ecosystem to pay other participants for goods and services such as petrol, repairs or car rentals. To further build on this, the MVL Foundation launched its unique own ride-hailing service, Tada, where drivers are awarded MVL points for providing rides. Drivers are given a higher number of points for longer distances and riders earn MVL points by writing reviews of their rides.

Singapore's investment into how blockchain can help build smarter cities is paying dividends, not just in Singapore but across the globe. Speaking at the Smart City Expo World Congress in 2018, Dr Janil Puthuchery, the Minister-in-charge of Singapore's GovTech, highlighted the need for "transformation through technology"¹¹⁵. He added that "the application of these technologies must benefit our grandchildren and re-engineer our country to improve lives for generations to come."

113 ["Singapore SP Group launches blockchain marketplace for renewable energy"](#), Ledger Insights. 2018.

114 ["sgCarMart and Ocean Protocol are partnering to build Singapore's first 'Know-Your-Vehicle' secure data marketplace"](#), sgCarMart. 5 July 2019.

115 ["Small city, big win: Singapore named Smart City of 2018"](#), Government Technology Agency. 20 November 2018.

Entertainment, Media And Advertising

How blockchain is putting consumers at the centre of it all

A HYPERCONNECTED DIGITAL METROPOLIS

For all its old world charm and modest bearing, Singapore is very much the epitome of an efficient, hyperconnected digital metropolis. More than three decades of systematic investments in telecommunication and media assets, as well as in digitisation and digital adoption in strategic mandates have contributed immensely to Singapore's national identity and economic prowess on the world's digital stage. The benefits as a safe haven are in turn powered by its ability to top the world's charts for peak internet speeds, smartphone and broadband penetration and utilisation rates, as well as social media and online business footprints.

With the advent of blockchain, Singapore finds itself riding a new wave of possibilities, namely online gaming, programmatic advertising and decentralised media marketplaces - all benefiting from decentralised economics and natively digital assets.

IN-GAME ECONOMICS: BEYOND BRAGGING RIGHTS

Online multiplayer game environments share several characteristics with their real world equivalents. For one thing, they both have adversarial stakeholders competing for limited resources and incentives within highly dynamic, constrained environments. What blockchain did for the security, ownership and digital nativity of cryptocurrencies, it is now doing for in-game assets and economic models.

On-chain games allow players to hold verified unique profiles and get direct control of their in-

game assets including gamer tokens, special credits, trophies, memorabilia, records and avatar upgrades. This heightened level of trust and ownership combined with efficiencies in hardware and networking can exponentially grow game ecosystems with downstream transactions, buyers and marketplaces. Players and developers are moving away from the mundane world of licensing models and platform controls, to one where they are the masters of their own digital fate.

The US\$100 billion global gaming industry garnered a special level of interest in Singapore in 2019. Cloud gaming trials on high-bandwidth 5G networks and low-latency hardware were jointly announced by game hardware pioneer Razer, telecommunication services provider Singtel and IMDA. This will be Singapore's first 5G consumer use-case trial and will focus on testing network readiness for 5G cloud gaming. If these trials are successful, they will pave the way for a revolution in the industry for high quality game development to be led beyond the confines of expensive consoles and traditional communication networks.

Singapore-based Enjin is preparing for this revolution by building utilities and marketplaces for blockchain powered game ecosystems. Enjin has developed its own proprietary blockchain wallet for transactions and purchases, a marketplace for collectibles and a developer platform to help other developers integrate their games into the blockchain environment. The firm's native crypto token, EnjinCoin has been ported onto Samsung's Galaxy S10 blockchain phone and being used to buy vouchers for alternative services (Uber rides, as an example) and other cryptocurrencies.

Further testament to the evolution in this industry comes from Ubisoft, the French gaming giant whose Singapore operations have gone on to become the largest AAA-rated studio in South East Asia and home to its 2019 Entrepreneurs Lab accelerator program.

Ubisoft recently came together with ConsenSys, Enjin and many others to form the Blockchain Game Alliance to spread awareness and encourage adoption of blockchain in gaming communities.

TRANSPARENCY IN THE MAINSTREAM

A noteworthy example of applying blockchain in a consortium-based model for transparency and auditability is Project Proton. In 2018, Zilliqa, the high-performance public blockchain protocol which emerged from research efforts at the National University of Singapore, announced a partnership for the digital advertising industry. It brought together influential players in the advertising ecosystem such as Mindshare, Rubicon Project, MediaMath, Integral Ad Sciences, Underscore CLT to evaluate the challenges in the digital advertising industry and how blockchain can provide a solution.

Proton specifically examines programmatic advertising or the automated buying, selling, placement and optimisation of digital advertising. The industry, in the United States alone was estimated to be worth US\$32.5 billion in 2017¹¹⁶ but fraught with ad frauds (conducted by malicious bots) resulting in an estimated loss of US\$16.4 billion¹¹⁷. In its earliest version, demonstrated an automated settlement lifecycle on the Zilliqa blockchain based on the concept of ‘viewability-verification’. Using this method, advertisers only need to pay for the ad impressions that have been deemed viewable, brand-safe and are free from any ad fraud. The results of a pilot run in March 2019 showed an increased 28% efficiency by using Project Proton’s smart contracts.

The evolution of Project Proton inspired the formation of Aqilliz, a Singapore-based platform that aims to leverage the Zilliqa blockchain to build solutions for the marketing industry and to create a meaningful value exchange between brands, platforms and consumers as well as evolve Proton with the help of industry partners.

DECENTRALISED CONTENT MARKETS: TRUST ON-DEMAND

The film and TV content industry is among the oldest organised services enterprises and has come to define mainstream culture and ideas on a global scale. With the digital media industry projected to grow to US\$119 billion by the year 2022, there is just cause for disruption-by-blockchain in this industry.

Vuulr is one such disruptor. This Singapore-based platform company was one of the first winners of the IMDA Blockchain Challenge Programme in 2018 and aims to change the economics and rules that govern the digital content landscape. Vuulr is building a global content marketplace where buyers, sellers and consumers of content can discover each other and their offers while transacting seamlessly and trustfully on the Ethereum blockchain. The traditional media buying process is rife with inefficiencies and is estimated to suffer from close to 75% loss of value in the overall transaction process, Vuulr is working to bring settlement times to less than 24 hours with associated cost savings for buyers and sellers, and allowing content sharing with a global, trusted audience in near real-time.

Partnering with leading Hollywood trade bodies (EIDR, MovieLabs, EMA), Vuulr also provides a Digital Supply Chain solution, implementing existing global data specifications for unique asset IDs, rights management, metadata and material delivery. Its proprietary Content Industry Supply Chain Protocol is built to support internationally accepted standards by global content generation and distribution agencies.

116 [Programmatic advertising - Statistics & Facts](#), Statista. 8 January 2019.

117 [“The ad fraud issue could be more than twice as big as first thought — advertisers stand to lose \\$16.4 billion to it this year”](#), Business Insider Singapore. 15 March 2019.



Photo by chuttersnap on Unsplash

Where Did It Come From, Where Will It Go?

How blockchain is creating value for supply chain and logistics

Singapore has come a long way since gaining its independence in 1965. Its role as the region's top logistics hub has served as a key factor in its progress. It is home to PSA International, the world's busiest transshipment sea port and largest transshipment container port¹¹⁸. PSA International is linked to over 600 ports worldwide. Furthermore, Singapore's Changi Airport has been voted as the world's best airport seven years consecutively, serving about 6,800 weekly flights to 330 cities, and is one of Asia's largest cargo

airports¹¹⁹. In order to keep its status as one of Asia's top logistics hub, Singaporean companies are looking to blockchain to give it an edge.

LOOKING UP

The logistics sector is facing a number of challenges, especially in the air cargo industry where the typical air cargo billing, costing, and reconciliation process can involve many stakeholders along the entire supply chain. These processes are also very manual, manpower-intensive and prone to error. This prompted Singapore companies like Cargo Community Network (CCN) to look at how they can digitally transform the industry and they found that blockchain will be key in helping them do this.

¹¹⁸ [Singapore largest transshipment hub in the world](#), Atlas Network. 20 February 2019.

¹¹⁹ [Here are the world's best airports for 2019](#), CNBC. 28 March 2019.

CCN partnered with Microsoft to introduce the world's first blockchain-based air cargo billing, costing, and reconciliation system¹²⁰. The system is set to transform air cargo billing processes, minimise billing discrepancies, accelerate billing reconciliation and provide near real-time revenue recognition to enhance efficiency for airlines, cargo agents, and freight forwarders involved in the entire supply chain. By using blockchain, stakeholders in the supply chain can now retrieve information from a single source in real-time, including shipment details from the flight manifest, freight status update, and airway bills to facilitate downstream billing and costing processes. Airlines and freight forwarders can also update their shipments and compute charges in real-time through the built-in smart contract feature for upfront reconciliation.

CERTIFICATION AND DOCUMENTATION REIMAGINED

In 2018, the Singapore International Chamber of Commerce and vCargo Cloud (VCC) unveiled the world's first Electronic Certificate of Origin (eCO) on blockchain¹²¹. A Certificate of Origin is an international trade document which certifies that the goods in a specific shipment have been wholly obtained, produced, manufactured or processed in the stated country. With the use of blockchain, this platform will enable trade documents to be easily authenticated with improved transparency, security, and efficiency. It permits instant verification of the trade documents utilising QR codes and runs on a private blockchain network that prevents fraud, alterations and third-party interference.

In addition to VCC, Global eTrade Services (GeTS), a subsidiary of CrimsonLogic, is offering eCOs on their Open Trade Blockchain (OTB) platform¹²². The OTB platform allows any entity in the trade cycle – be it the

buyer, seller, shipper or freight forwarder – to register their documentation on the platform. Other parties involved in the trade can subsequently verify that the documentation is legitimate through an automated matching process. The Chairman of GeTS, Eugene Wong, stated, "Blockchain will transform international trade and the OTB platform is the perfect solution to bridge and create a neutral layer of trust among multiple stakeholders, allowing them to collaborate and access to trade documents securely."¹²³ The OTB platform began its life in 2018 as the region's first cross-border blockchain platform that is aligned with China's Belt Road Initiative¹²⁴. The initiative is part of China's plan to be more interconnected with the world, primarily through infrastructure growth across many different countries. "Partnering with GeTS from Singapore on its OTB makes good business sense," says Xu Xucheng, general manager at Suzhou Cross e-Commerce. "We are already seeing an increase in cross-border trade volumes, and with GeTS' blockchain solution enhancing the security of the trade documents, it will definitely help to strengthen Suzhou's position as an e-Commerce hub for China." The GeTS platform has come a long way since it was launched in 2016 as a trade platform that allows businesses to manage compliance from different trading systems which would drastically improve efficiency which is vital in such a sector where delivering on time could make or break your company. Other companies are looking at tackling the Singapore-China link too, including Pacific International Lines, PSA International (formerly the Singapore Port Authority) and IBM Singapore, who successfully tested a blockchain platform on a supply chain network between Singapore and China.

120 ["Cargo Community Network partners with Microsoft to launch the world's first blockchain air cargo billing, costing and reconciliation system"](#), Microsoft. 13 March 2019.

121 ["SICC and VCC Launched World's First Electronic Certificate of Origin \(eCO\) on Blockchain"](#), vCargo Cloud. 8 May 2018.

122 ["Singapore's GeTS Launches World's First Cross-Border Blockchain For Trade Linking ASEAN and China's Digital Silk Road"](#), Crimson Logic. 18 July 2018.

123 ["Singapore Chamber issues blockchain certificates of origin"](#), Ledger Insights. 2019.

124 ["GeTS Launches Open Trade Blockchain to Join China's Belt Road Initiative"](#), Fintech News. 23 July 2018.

LAST MILE LOGISTICS

While the logistics sector is relatively efficient at moving goods between major distribution hubs, getting the goods to the end consumer is the most challenging part. The last mile logistics problem is estimated to account for over 50% of the total delivery cost.

To that end, LogisticsX, A Singapore-based logistics company, is developing a network that enables local businesses and individuals to act as recipients for parcels and then brings in “runners” to take them from the recipient to the end consumer. Along with efficiency gains, LogisticsX aims to reduce the incidence of missed deliveries and improve the employment conditions of freelance logistics couriers.

By building a DApp on top of the ICON network, the company hopes to improve traceability, transparency, security and efficiency, saving everyone in the process a lot of time and money, and also to improve the lives of those who work in the last mile industry. It is building an ecosystem that aims to seamlessly blend all the stakeholders in the delivery process, including e-commerce retailers such as Amazon, major global logistics companies such as DHL, individual delivery persons and consumers.

EVERYDAY TRACEABILITY

The consumer’s desire to understand the supply chain of their goods does not just stop at online consumer purchases but also the food they eat. WhatsHalal is one such company that integrates Halal traceability in the food chain, and their process is largely facilitated by blockchain. Blockchain ensures that the movements of an ingredient or product can be tracked even as it changes hands. Enterprise customers who wish to attain halal certification simply need to initiate the application on platform and several smart contracts will determine the assurance process, working in collaboration with consultants, labs and certification bodies.

It may come as a surprise that most halal food comes from non-Muslim countries¹²⁵. That’s a big part of the reason why Azman Ivan Tan started WhatsHalal to put halal food on the blockchain. “Lots of companies want to become halal (certified),” says Tan, explaining that food producers are chasing after 1.5 billion Muslim consumers, who contribute to the US\$1.4 trillion halal food industry. By verifying that meat has been slaughtered in accordance with halal principles, the service can benefit both food makers and consumers.

With numerous local companies and projects demonstrating the value of leveraging the real-time transparency and traceability offered by blockchain, Singapore appears poised to continue serving as the logistical centre of the region, well-placed to trade ever-more effectively across the region and the globe.

125 [“A tasty scheme to put halal food on the blockchain”](#), Tech in Asia, 4 March 2019.

Rethinking Power In Art

Using blockchain to democratise art

Over fifty years ago, Singapore's emergence as an independent country meant a mainstream focus on economic development, defence, housing, healthcare and education. But beginning in the 1980s, the country has seen a resurgent interest in arts and culture becoming part of the larger national mandate.

In 1988, the Advisory Council on Culture and the Arts was set up to look at how to transform Singapore into a culturally vibrant society and The National Arts Council was launched in 1991. As a result, in 2000 as part of The Renaissance City Plan, the Singapore Government injected an additional S\$50 million over five years, on top of its annual spend, in a bid to cement the city as an arts and culture destination of Southeast Asia. Singapore's desire to stake its claim in Southeast Asia's art landscape is not without its challenges with the likes of Hong Kong, Thailand and the Philippines making big strides in this area. To truly seek more adoption of the arts, Singaporeans need better access to a larger number of works from all over the world.

DEMOCRATISING ART INVESTING

With fine art, a small group of wealthy collectors invest in works by a smaller group of well-known artists who are represented by an even smaller number of elite galleries. However, a fundamental shift is underway¹²⁶. While many appreciate fine art, traditionally only a

select few were able to meet the high financial barrier of entry to participate in the fine art investment space. Singapore-based Maecenas aims to democratise art by eliminating intermediaries, improving liquidity and allowing investors to own a percentage of artwork through asset tokens compliant with the Ethereum ERC-20 standard that represent a share of the artwork and then on-sell to other investors. By leveraging the Ethereum public protocol, investors can effectively store their fine art share on any crypto wallet.

"What we're doing with the fractionalization or tokenisation of art is creating a stock market experience when it comes to investing in art," says Maecenas CEO Marcelo Garcia-Casil¹²⁷, "we're not going with this platform to art experts — we're bringing it to people who may be investing in art for the first time."

Veteran art dealer, Jose Freire, said in an interview with artnet¹²⁸, "You cannot take an Amazon approach to contemporary art, because it doesn't protect the artist or the value—and you need to protect the artist, and a dealer needs to protect the value of the art they're selling to their collectors". That is exactly what blockchain can do.

REBALANCING POWER (AND PROFIT) TO CREATORS

In addition to fine art, there are huge opportunities to leverage blockchain to rebalance the centre of power and distribution of profits across other types of art - such as collectibles. The collectibles market is especially fraught with piracy, and between piracy and the fragmentation of the supply and value

126 ["Why is art so expensive?", Vox](#). 20 May 2019.

127 ["Owning a Warhol: How bitcoin could change the art world", CNN Business](#). 19 April 2019.

128 ["In Hong Kong, Team Gallery's Jose Freire Says Goodbye to Art Fairs—and Reveals What He's Going to Do Instead", Artnet News](#). 29 March 2018.

chain and middle men, creators see little of the profits from their work.

Singapore-based startup Blockpunk, working with anime creators to create unique digital and physical collectibles that are available globally and direct from the source, are trying to tackle this head-on. “Decentralization can give power back to the creators,” said Julian Lai-Hung, CEO and Co-founder of Blockpunk, explaining that with this model, fans can be sure that proceeds go directly to their favourite creators. In turn, fans can gain access to exclusive extras and have the ability to resell art work in a digital format that is secured on the blockchain.¹²⁹ Blockpunk use Non-Fungible Tokens to allow creators to sell digital works and merchandise on its platform, and recently announced the launch of its NFC-enabled art prints.

Another point that Julian made was, “There’s a lot of piracy because when fans watch a new show, they want to consume the merchandise right away and the merchandise is usually not available quickly so the pirates take advantage of this to fulfil this demand.” Piracy is a significant issue for all forms of art. But as a decentralised digital ledger that publicly records transactions, blockchain promises to revolution the way value is exchanged and authenticated, and is creating a new wave of excitement in the world of art.

Another Singapore company making waves in this space is Mighty Jaxx. Founded in 2012, the company designs and manufactures collectibles and lifestyle products, and collaborates with global brands and music labels to expand its global presence. They will be leveraging on the OpenCerts platform to allow the company to issue and validate tamper-resistant and permanent certificates to every collectible, allowing collectors to verify its provenance¹³⁰. This gives collectors the flexibility to purchase, receive, store, share and verify on the go.

Over the past decades, there has been a steady increase in the number of art galleries and this is a sign that Singapore is building its reputation in arts and culture. The Minister for Culture, Community and Youth, Grace Fu, recently commended the strong spirit of Singapore’s art sector at the 2019 S.E.A. Focus, an inaugural fair to help Singapore’s artists and galleries build capabilities and position¹³¹. Combining the country’s government funding and art-focused schemes with its strong foundations in technology has given Singapore a creative edge.

129 [“Julian Lai-Hung of BlockPunk on creating a blockchain anime studio: Startup Stories”](#), KR Asia, 18 September 2019.

130 [“Collectibles startup Mighty Jaxx raises S\\$2.15m in pre-Series A round”](#), Business Times, 2 July 2019.

131 [“ASEAN’s contemporary art scene”](#), The ASEAN Post, 14 July 2019.

In Summary



In Summary

Blockchain as a paradigm, is for the networks of the future. As the year draws to a close, Singapore is at an increasingly vital intersection point in the global network. A connected marketplace in a resurgent Asia, Singapore's advancement with blockchain has been characterised by clinical preparation, bold experimentation and growth by sustainable adoption.

For the past four years, ConsenSys has been deeply invested in this growth story and has been witness to Singapore's emergence on the global blockchain arena. We often find that technology, while an important base layer, is only part of the overall roadmap to success. Tomorrow's blockchain-powered world needs a lot more to be done in the areas of end user empowerment, effective regulation and public policy, heightened grassroots awareness as well as systematic efforts around community building.

The 2019 Singapore Blockchain Ecosystem report - the first of its kind - is one such effort, developed in proud collaboration with Temasek, IMDA and MAS.

A strong local ecosystem is arguably what makes Singapore an understated powerhouse on the global blockchain stage. Singapore's rise in this space is the collective story of its stakeholders that have helped mirror a natural ecosystem - one that prioritises symbiotic growth, support and balance over radical change, quick results and disproportionate advantage. This has led to a visible rise in:

- **Calculated adoption and steady investment** by Singapore's private sector which brings capital, velocity and a native market for new business ideas and blockchain solutions.
- **Forward-looking legislation and effective public policy** by government agencies that are often the principal sponsors of initiatives to build greater trust and reliability.
- **Objective, non-partisan education and learning** with the aid of Singapore's universities, blockchain interest clubs, as well as independent researchers and think tanks.
- **Creativity and open-source engineering** thanks to the efforts of Singapore's blockchain developers; quite often the unsung heroes of this revolution who take risks so that others may boldly follow.

The launch of this report at the 2019 Singapore Fintech Festival is a fitting tribute to how the local blockchain ecosystem has answered the Festival's clarion call from its earlier years: "Dream big, start small, move fast".

Heading into 2020, there is one additional message that may be worth reinforcing: "The best is yet to come".

Vinay Mohan
Managing Director
ConsenSys Singapore



*Singapore takes on
a systematic approach
to catalysing emerging
technology innovation
in Singapore's Digital
Economy"*

Veronica Tan

Technology & Infrastructure Group,
Infocomm Media Development Authority