November 2018

Blockchain Innovation

A Patent Analytics Report

Prepared by IP Australia

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Yohan Ramasundara
President, ACS

Andrew Johnson
Chief Executive Officer, ACS

Foreword

ACS has a vision for Australia to be a world leader in technology talent, fostering innovation and creating new forms of value.

To support this vision, we have a focus on the innovative creation and adoption of best of breed technology in Australia.

Blockchain has been hyped as one of the most transformative and disruptive technologies on the immediate horizon. Already, Australia's financial services sector is investing heavily in proofs of concept, along with the Australian Stock Exchange and government departments including the Digital Transformation Agency.

Blockchain is an open, distributed ledger that records transactions sequentially (in blocks), and each new block is validated by third parties to provide trusted verification.

Patents give exclusive commercial rights for devices, methods or processes that are unique and beneficial in exchange for public disclosure of the invention or innovation.

In today's environment, patent growth rates are exceeding economic growth rates, pointing to the rise in knowledge-based professions and the knowledge economy. Patent applications and registrations remain a valuable insight into the business problems and commercial use cases that organisations and individuals are focused on solving.

The purpose of this report is to assist business and government understand and assess the degree to which blockchain technology is a critical enabler for continued economic growth. This can be achieved by understanding the size of the blockchain market; the types of use cases of blockchain patents; and the degree to which patent applications are being registered in Australia compared to other nations.

We would like to thank the Patent Analytics Hub of IP Australia for undertaking the research and preparing this report.

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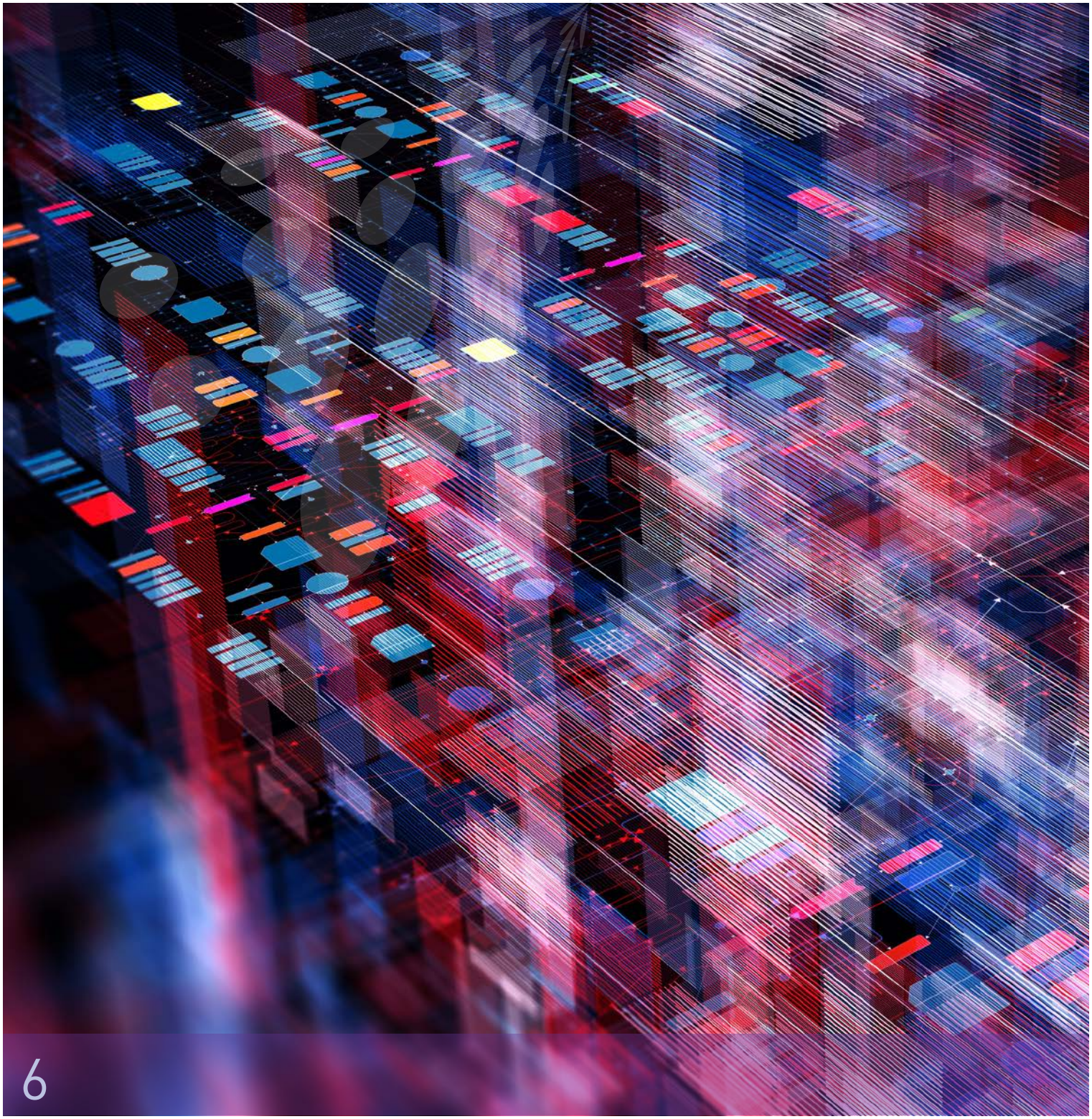
01

SUMMARY



Summary

Blockchain is an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way. It is a foundational technology with the potential to underpin new ways of connecting and recording information across all areas of technology.

Recent patent applications show blockchain technology is an area with strong growth. Since 2013, patenting of blockchain-related technologies has exploded, with annual growth between 140 and 230%. Applicants are commonly large corporations or newly established companies. The young nature of the technology is reflected in the age of the most active companies – six of the top ten companies were established in the last ten years.

The following report outlines findings from patent families filed since 1999, analysing trends, innovators, filing destinations and commercial players in this space.

KEY REPORT FINDINGS

3,021 patent families have been filed in blockchain technology.

Blockchain patent filings have grown 140% or more each year since 2013.

92% of blockchain-related patents are in an active state.

Coinplug is the top global innovator in this area, with 75 active patent families (92% granted).

China is the largest filing destination.

Australia ranks sixth globally, with 49 patent families in blockchain.

Document management is the major problem being addressed by the top innovators in the field.

Only 14% of active patent families have at least one granted patent at this point in time.

02

Introduction

Blockchain is an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way.[1] It is a foundational technology that has the potential to underpin new ways of connecting and recording information across all areas of technology.

Initial uses of blockchain were associated with cryptocurrency transactions, but wider uses are being explored as understanding of the technology develops. These uses have been recognised in numerous forms such as record-keeping, agreements, contracts and registers. In the health industry, blockchain is being explored as a way to support secure information exchange of patient records and the tracking of pharmaceuticals from their manufacture to their administration to patients. In the consumer world, blockchain technology is seen as a way to track supply chains from produce to fashion labels. It is also seen as a way to simplify security processes such as those relating to passenger screening.[2]

The global blockchain market was estimated at US$708 million in 2017, and is forecast to grow to US$60.7 billion by 2024.[3] Understanding how blockchain technology is commercialised, identifying potential partners and determining what capability currently exists in Australia is important in assisting the Australian ICT industry to leverage opportunities as this technology matures.

[1] Harvard Business Review: https://hbr.org/2017/01/the-truth-about-blockchain

[2] Computerworld UK: https://www.computerworlduk.com/galleries/security/how-could-blockchain-be-used-the-enterprise-3628558/

[3] Global News Wire: https://globenewswire.com/news-release/2018/02/14/1347823/0/en/Blockchain-Market-Size-is-anticipated-to-reach-USD-60-7-billion-by-2024.html

Why patent data?

Patents can be used as indicators of innovative activity. By extraction and analysis of data associated with patent documents, we can measure aspects of inventive activity such as scope of inventions, intensity of activity and collaboration between innovators. These metrics can be developed across technology sectors and by measures including individuals (inventors), institutions (applicants), countries and regions.

Patents are granted for devices, substances, methods or processes that are new, inventive and useful (Appendix A), giving exclusive commercial rights in exchange for full public disclosure of the invention. This means that patents are a source of data on innovation trends in science and technology.

As a basis for this analysis, we searched the worldwide patent databases for inventions relating to blockchain technologies. The search was configured to include both explicit reference to blockchain and the foundations on which the technology was built. The search found 3,021 unique patent families filed worldwide since 1999. Details on the search methodology are provided in Appendix B.

The authors and purpose of this report

IP Australia is dedicated to building prosperity for Australia, and ensuring that Australians benefit from great ideas. Using patent analytics to provide evidence of innovation trends, we leverage our unique access to intellectual property (IP) data, knowledge and expertise to deliver value to the broader economy.

This patent analytics report was prepared in partnership with the Australian Computer Society (ACS) as part of IP Australia's commitment to support Australian research and innovation. ACS is the professional association and peak body representing Australia's ICT sector. It aims to deliver authoritative independent knowledge and technology insights, building relevant technology capacity and capability that catalyses Australian innovation, and speeds the adoption of technology for the benefit of commerce, government and society.

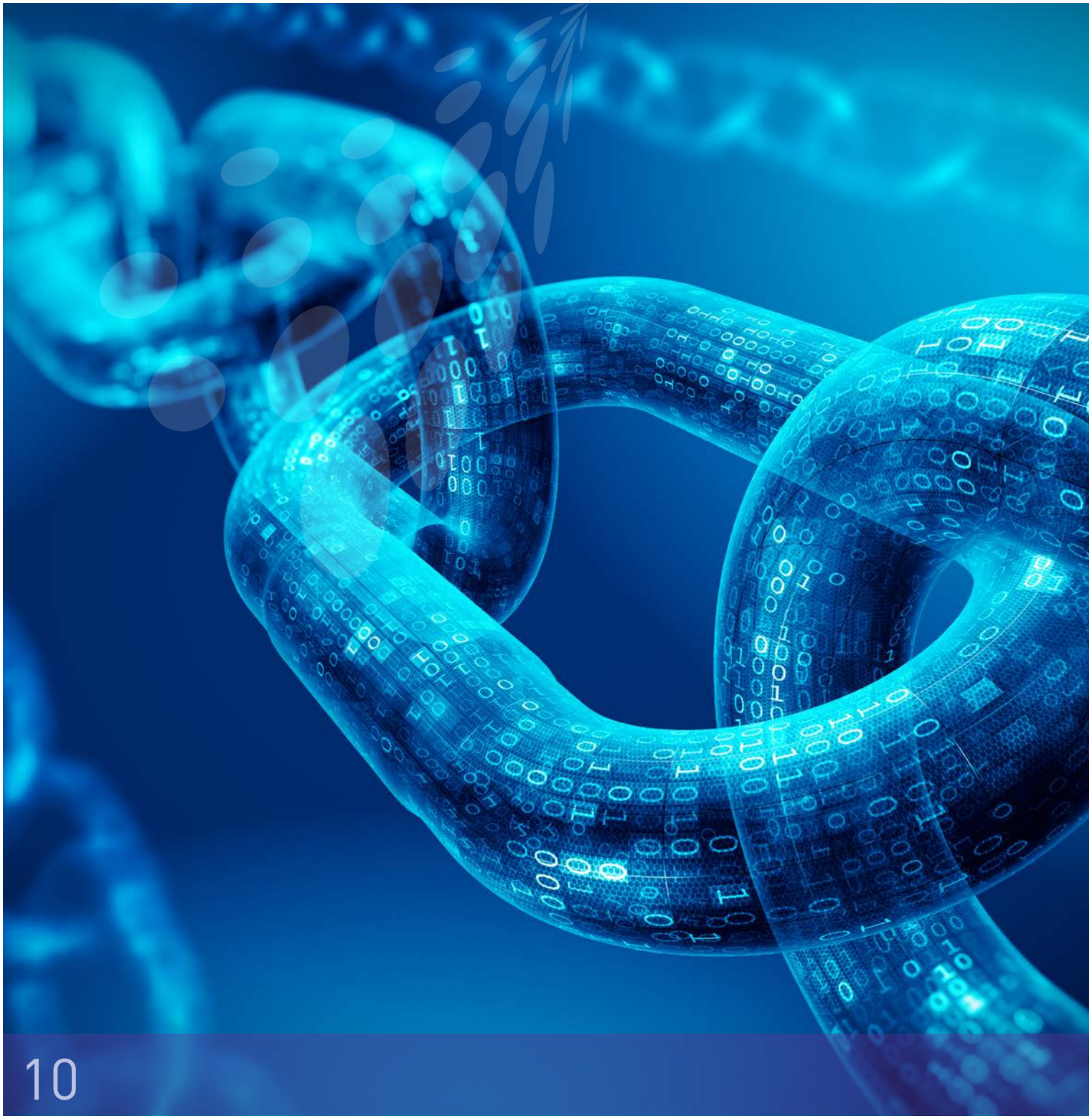
ACS is at the forefront of education and policy development in Australia's ICT sector, contributing to building capability in the development of, and response to, emerging technologies.

To support the needs of ACS, IP Australia has analysed the development of technology relating to blockchain. In its 2018 ACS Australia's Digital Pulse report,[4] ACS noted that the demand for blockchain skills was recently identified as the fastest-growing skill on the online platform Upwork.[5] This report provides insight into innovators in this field – based on patents filed – to provide potential connections for research, development and commercialisation.

[4] ACS Australia's Digital Pulse 2018: https://www.acs.org.au/content/dam/acs/acs-publications/aadp2018.pdf
[5] Computerworld: https://www.computerworld.com/article/3235972/it-careers/blockchain-moves-into-top-spot-for-hottest-job-skills.html

03

TIMELINE

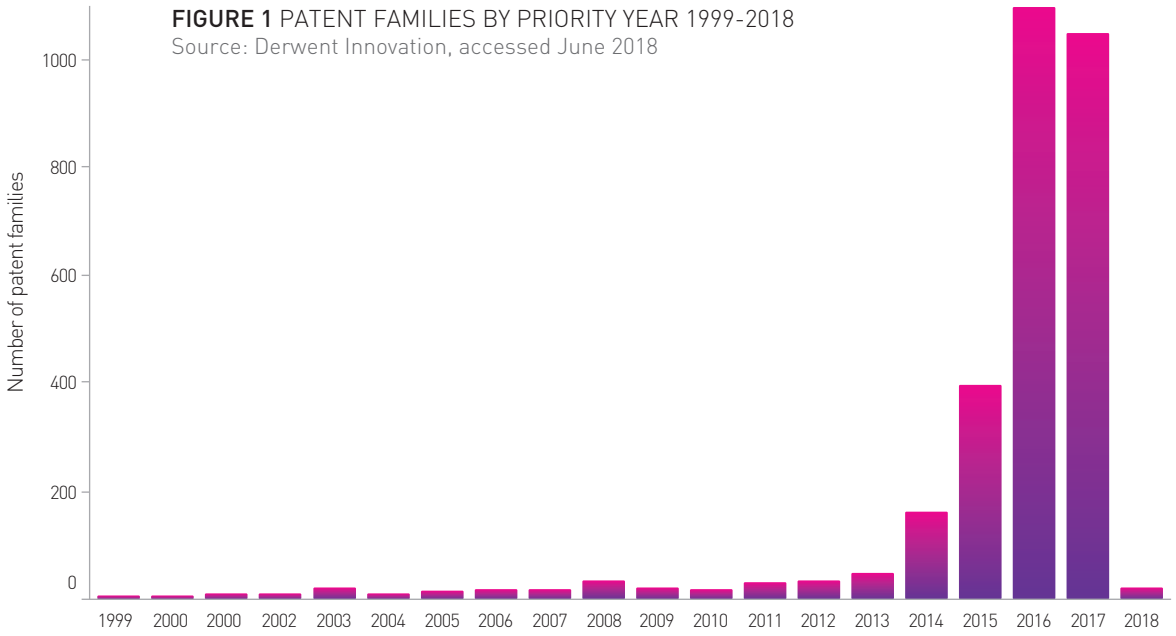


Timeline

Analysing the filing of patent families across time provides a picture of the growth or decline in innovation.

Additional in-depth analysis can help understand the underlying factors and their correlation to these trends. This information can inform strategies around research, development, collaboration and commercialisation.
Figure 1 shows the number of patent families by earliest priority year. Figure 2 shows the proportion of patent families that have been allocated one of three legal statuses: Alive, Dead or Indeterminate. A family is Alive if at least one family member is active or in force. A patent family is considered Dead when all family members have lapsed, expired or been withdrawn. The remaining patent families are considered as Indeterminate as the lack of legal status information for family members prevents their classification.

FIGURE 1 PATENT FAMILIES BY PRIORITY YEAR 1999-2018
Source: Derwent Innovation, accessed June 2018

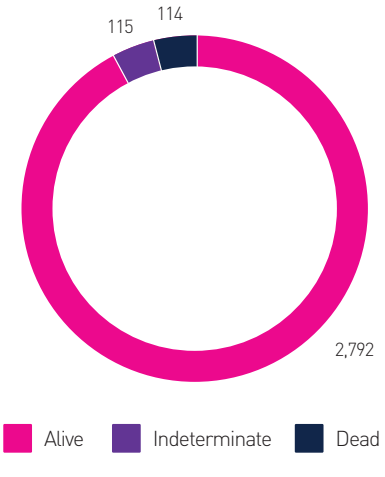


Patenting activity over time shows that growth in blockchain patent filings has increased each year since 2013 (49 patent families). There was 231% growth in 2014 (162 patent families), 143% in 2015 (393 patent families) and 178% in 2016 (1,091 patent families). The growth has been highest in the United States and China.

Of the 3,021 unique patent families captured in this report, 2,792 (92%) are in an active state, with patent protection being sought or in force (Alive). The very low levels of patent families in an inactive state (Dead) may be reflective of the both the recent patenting activity in this technology area and importance of blockchain IP.

Data for 2017-18 is incomplete due to a lag in publication of patents. The dip in this period reflects incomplete data rather than a declining trend in applications.

FIGURE 2 PATENT STATUS OF FAMILIES
Source: Derwent Innovation, accessed June 2018



04

PATENT DESTINATION

FIGURE 3: PATENT FAMILIES RELATING TO BLOCKCHAIN TECHNOLOGY BY PATENT DESTINATION
Source: Derwent Innovation, accessed June 2018

CHINA	1,581	AUSTRALIA	87
UNITED STATES	951	CANADA	69
SOUTH KOREA	220	INDIA	65
JAPAN	137	TAIWAN	53
EUROPE	131	DENMARK	36

Patent destination

Applicants must file patents in each country for which they wish to have patent protection. The patent destination for inventions indicates where innovators choose to protect their invention.

Reasons for protection include the country being a target for commercialisation or that the country is important for further research. Figure 3 shows the number of patent families filed in different jurisdictions that have at least 30 patent families relating to blockchain technology. See Appendix A for more information about the patent filing systems.

With blockchain technology, applicants file the greatest proportion of patents within their own country.

1,581

CHINA

China, with 1,581 patent families, is the largest patent destination for blockchain technology. Of the 1,581 families, 1,495 are filed by at least one applicant that is of Chinese origin.

951

USA

The United States ranks second globally as a destination, with 951 patent families. Of these families, 720 applications are from domestic applicants.

87

AUS

Australia is the sixth largest patent destination with 87 patent families having at least one patent application filed. Australian applicants account for 35 of the 87 Australian patent families while applicants from the United States have filed 38 patent families in Australia.

05

TECHNOLOGY ANALYSIS

Technology analysis

Technology analysis can be used to identify the level of activity in specific technology areas within an overall field. This analysis can help innovators understand areas of commercial interest and inform commercialisation strategies and research directions.

Technology overview

We initially divided the 3,021 patents into two broad functional categories – blockchain applications and data processing (Figure 4). These two categories were based on patent classification symbols International Patent Classification (IPC) and Cooperative Patent Classification (CPC) and keywords. See Appendix C for more information about the technology classification.

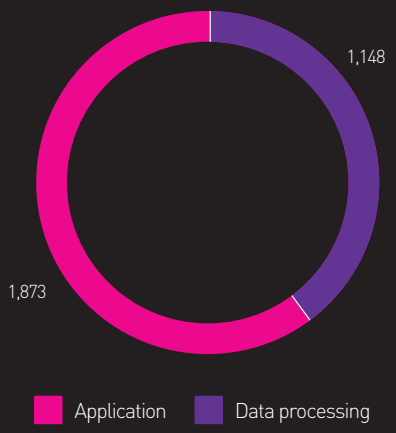
There are 432 families that contain at least one granted patent, which represents only 14% of families within this report. This low proportion is potentially due to the fact that patents take at least two years to be granted by patent offices and the majority of applications are very recent.

The blockchain applications category (1,873 patent families) relates to uses of blockchain technology in payment and transaction systems, financial services, business administration, shopping and Ecommerce.

The data processing category (1,148 patent families) includes networking and data transmission, encryption and security, data manipulation and error correction, data storage, search, and recording.

From this broad analysis it is clear that most blockchain innovation is occurring in technology application. Each of these two broad categories have been analysed in more detail to provide further information about innovation trends in specific technologies.

FIGURE 4 TECHNOLOGY ANALYSIS OF PATENT FAMILIES RELATED TO BLOCKCHAIN TECHNOLOGY
Source: Derwent Innovation, accessed June 2018



Blockchain application patents

The 1,873 patent families related to blockchain applications were further divided into four sub-categories by IPC, CPC and keywords, based on different types of application (see Appendix D for more information about the sub-category analysis). These sub-categories are:

PAYMENTS AND TRANSACTION SYSTEMS

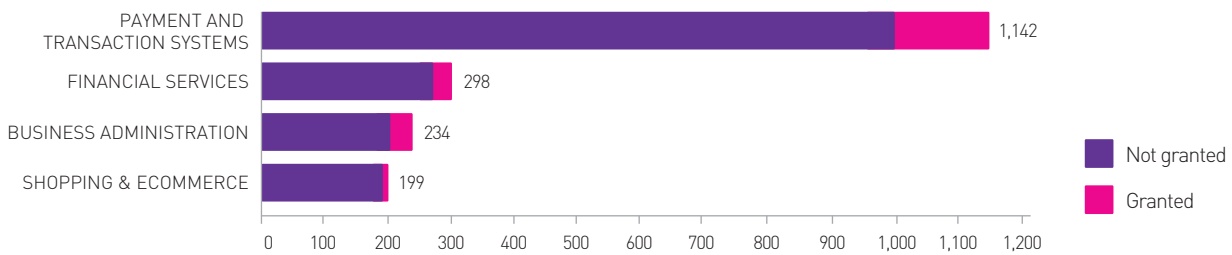
FINANCIAL SERVICES

BUSINESS ADMINISTRATION

SHOPPING AND ECOMMERCE

Figure 5 shows the number of patent families in each sub-category by their current legal status of granted or not granted. A patent family is considered to be granted when at least one member of the family is granted and in force in any jurisdiction. Of the patent families in this sub-category, 12% have had a family member granted.

FIGURE 5 PATENT FAMILIES RELATED TO APPLICATIONS OF BLOCKCHAIN TECHNOLOGY
Source: Derwent Innovation, accessed June 2018



THE ASX HAS PAID

$14.9 MILLION

FOR A 5% EQUITY INTEREST IN DIGITAL ASSET HOLDINGS

PAYMENT AND TRANSACTION SYSTEMS

The sub-category of blockchain payment and transaction systems includes patents directed to the use of blockchain technology in money transfer. This category has the highest proportion of patent families of all the sub-categories of blockchain applications, with 61% (1,142 patent familes). Typical examples of patents in this sub-category are held by Digital Asset Holdings, nChain, Socure and Swirlds.

Digital Asset Holdings[6] is a multinational software company founded in 2014, with headquarters in the United States. Digital Asset provides distributed ledger technology to regulated financial institutions. Their system described in application WO2016164310 allows unilateral access to data in a distributed ledger for authorised users with verified credentials. This family has active patents in Canada, China, Europe, Japan, Singapore and the United States, and a patent granted in Australia.

Australia's biggest stock exchange, the ASX, is developing a private blockchain with Digital Asset Holdings as a post-trade solution for the Australian equity market. The ASX has paid $14.9 million for a 5% equity interest in Digital Asset Holdings, a fee that will also fund development of the privately distributed ledger solution.[7,8]

nChain[9] is a blockchain development company founded in 2015 and based in the United Kingdom. The company conducts research and development in tools, protocols and applications for blockchain infrastructure to improve the use of blockchain technology for all businesses. On 11 April 2018, nChain was issued the first granted European patent for blockchain technology, EP3257191. The invention covers a technique that works for any digital content that requires a license – using a blockchain system, the access and license are both validated. This patent is also being pursued in Taiwan.

Socure[10] is a software company established in 2012 and based in the United States. Socure aims to put trust in digital identity using Socure ID+, a predictive analytics platform that authenticates identities in real-time using data from traditional and non-traditional sources. Socure ID+ has been widely adopted by major financial companies, including two of the top five United States banks (and three of the top ten), due to its accuracy and innovative approaches.[11] The platform, described in application WO2014145431, uses financial transaction and social media information to derive an authenticity score for identity

[6] Digital Asset Holdings: https://www.digitalasset.com/about
[7] Medici: https://gomedici.com/an-overview-of-blockchain-technology/
[8] ASX: https://www.asx.com.au/services/chess-replacement.htm
[9] nChain: https://nchain.com/en/
[10] Socure: https://www.socure.com/
[11] Business Wire: https://www.businesswire.com/news/home/20180604005149/en/

verification. This patent family has had members granted in the United States and Australia. The family has active patents in China, Singapore and Europe.

Swirlds Inc.[12] is a software company founded in 2015 and based in the United States. It has patented a platform designed to build fully-distributed applications without the need for a cloud server – detailed further in patent WO2017040313. Patent protection is being pursued in Canada and the United States.

FINANCIAL SERVICES

The sub-category of blockchain-related financial services includes patents that involve banking, stock trading and management of currency and cryptocurrencies (298 patent families). Examples of patents in this sub-category are held by Nasdaq and Coinplug.

Nasdaq[13] was founded in 1971 and is the second largest stock exchange in the United States. Application WO2017134281 describes the use of a computer that interfaces with a blockchain, and matches purchased and sold stock exchange transactions. The matched information is stored in the blockchain as a confirmation of the stock transaction. The family has a patent granted in the United States.

Coinplug, Inc.[14] is a South Korean company established in 2013 that provides digital currency exchange platforms based on blockchain technology. Coinplug is discussed in more detail in the Applicant section of this report. Coinplug has developed a technology – discussed in application US2017316497 – incorporating biometric data in user authentication. The patent family is active in South Korea and the United States.

BUSINESS ADMINISTRATION

The sub-category of business administration captures the use of blockchain technology in transaction applications that do not involve money. These include record keeping, medical records and management of contracts (234 patent families). Examples of patents in this sub-category are held by eIngot and SkuChain.

eIngot is a company based in the United States. The company has used blockchain technology in medical record access and management. Application

[12] Swirlds: https://www.swirlds.com/
[13] Nasdaq: https://www.nasdaq.com/
[14] Coinplug: https://www.coinplug.com/

WO2009006609 describes a program that builds an electronic medical record database by combining electronic records from multiple repositories. The platform enables a patient or authorised emergency personnel to easily access the combined medical record. The family has patents granted in both the United States and China.

SkuChain Inc.[15] was founded in 2014 and is based in the United States. SkuChain uses blockchain technology in supply chain, logistics and shipping management. Patent US9641338 explains the use of blockchain technology in logistics by incorporating a distributed consensus system in item tracking. The consensus system enforces and records a chronological order of events into a public order ledger, which enables effective item and container tracking. The patent family is active in China and Europe. Patent US9436923 describes the use of a distributed consensus network to enable custody tracking of an item in a supply chain. Both families have patents granted in the United States.

SHOPPING AND ECOMMERCE

The sub-category of shopping and ecommerce relates to patents that use blockchain in purchases from online or traditional shops and in online gaming (199 patent families). An example of patents in this sub-category is held by Beston Technologies Pty Ltd.

Beston Technologies[16] was founded in 2015 with headquarters in Adelaide, South Australia. The company aims to connect consumers directly to producers and has bridged this with the online application Oziris. The application provides a way to track the produce's location and its delivery. Application AU2016277684 describes the invention of Oziris. It outlines the use of a unique product identifier that encompasses location information and stores these in a blockchain system to prevent counterfeits and enable tracking of the product. The patent family is active in Australia and has been granted in the United States.

[15] Skuchain: http://www.skuchain.com/
[16] Beston Technologies: https://www.bestonmarketplace.com.au/blog/manufacturer/beston-technologies-pty-ltd-3/

Data processing patents

We further divided the 1,148 patent families related to data processing into three sub-categories by IPC, CPC and keywords, based on different data processing uses of blockchain technology (see Appendix D for more information about the sub-category analysis). These sub-categories are:

ENCRYPTION AND SECURITY

NETWORKING AND DATA TRANSMISSION

DATA MANIPULATION, MANAGEMENT AND INTERROGATION

In the category of blockchain in data processing, 19% of patent families have had a family member granted. Figure 6 shows the number of patent families in each sub-category.

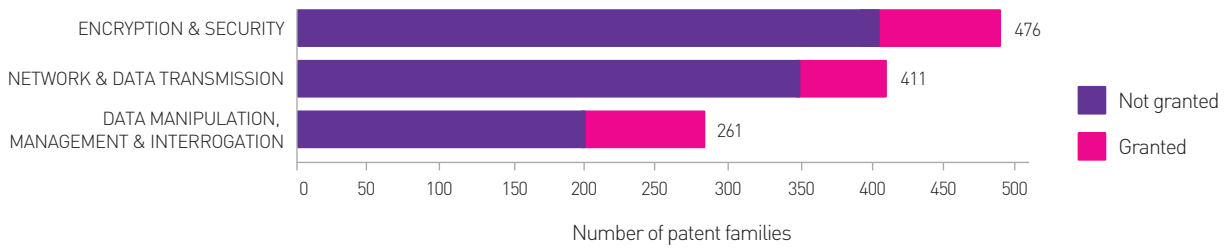
ENCRYPTION AND SECURITY

The sub-category of encryption and security includes patents that relate to encryption of data and the ciphering of records and information (476 patent families). Examples of patents in this sub-category are held by Qualcomm and Irdeto.

Qualcomm,[17] a multinational company based in the United States, was founded in 1985. It provides semiconductor and telecommunication equipment with a specific focus on wireless communication. Application WO2012170039 describes a unique strategy to secure wireless communication channels for a group of computers by establishing a session key, where the key is a combination of a shared secret key and the computer identity key. This family has patents granted in China, Europe, Japan, South Korea and the United States.

Irdeto [18] was founded in 1969 and has headquarters in the Netherlands. It is a subsidiary of the multinational media group Naspers. Irdeto is a leading cyber security company, focused on software security for digital platforms such as media and entertainment, connected transport, and the internet of things. The company has a platform cyber security system, Cloakware, to protect digital devices and environments with technologies relating to encryption keys and protocols, conditional access and rights management. Patent US2008025509 explains a network encryption technology that can scramble a stream of data using different ciphers while the data is sent between computers, changing encryption for each transfer event. This family has patents granted in Australia, China, Europe, India, Japan, South Korea and the United States.

FIGURE 6 TECHNOLOGY ANALYSIS OF PATENTS RELATING TO DATA PROCESSING
Source: Derwent Innovation, accessed June 2018



[17] Qualcomm: https://www.qualcomm.com/
[18] Irdeto: https://irdeto.com/

NETWORKING AND DATA TRANSMISSION

The sub-category of networking and data transmission relates to patents focused on the transfer of data between the blockchain network and the network itself (411 patent families). Examples of patents in this sub-category are held by Philips and Marvell Technologies.

Philips[19] is a multinational technology company that was established in 1891. It is based in the Netherlands and is a subsidiary of Koninklijke Philips N.V. The company has a broad range of products and solutions for healthcare, domestic applications and the automotive industry. Patent US8837736 describes an invention that provides robust, efficient and secure distribution of identification keys by splitting the key into multiple segments and applying a cryptographic function over these segments before distribution. The family has patents granted in China, Europe, Japan, South Korea, Taiwan and the United States.

Marvell Technologies[20] was founded in 1995 and is a multinational company based in Bermuda. The company has a focus on network infrastructure and wireless connectivity solutions. Patent US8560848 describes the use of an encryption module, nonce module and security module in wireless network transmission. The encryption module is used to encrypt packets; the nonce module generates a nonce for the encrypted packets; and the security module checks the encrypted packet includes the nonce. The patent family has members granted in China, Japan, South Korea and the United States.

DATA MANIPULATION, MANAGEMENT AND INTERROGATION

This sub-category includes data manipulation, management and interrogation within the blockchain network (261 patent families). Examples of patents in this sub-category are held by Microsoft and Tencent.

Microsoft Corporation[21] is a global leader in computing and operation systems software. Patent US8677336 describes the company's work in data storage using blockchain technologies. The storage algorithm improves execution time by optimising the ordering of data within the storage media. This patent family has grants in China, Europe and the United States.

Tencent[22] is a Chinese multinational, founded in 1998, with subsidiaries specialising in internet-related services and products, entertainment and artificial intelligence. Application WO2009076854 describes a data storage system using blockchain technology. This patent has been granted in China, India and Vietnam.

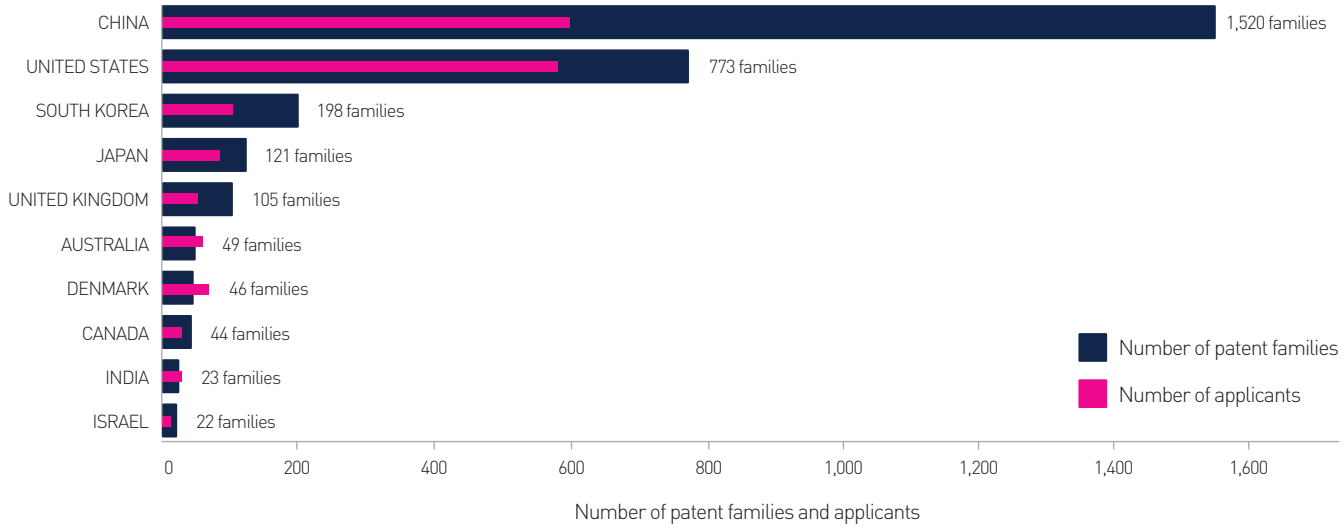
[19] Philips: https://www.philips.com/a-w/about/company.html
[20] Marvell Technologies: https://www.marvell.com/
[21] Microsoft: https://www.microsoft.com/en-au
[22] Tencent: https://www.tencent.com/en-us/

06

Global applicants

Applicant analysis can be used to identify entities that are innovative leaders in a sector. It can also be used to identify countries that are hot spots for research and development. This analysis can help innovators understand who has a commercial interest in the technology and where they carry out this activity. This information can inform collaboration and commercialisation strategies.

FIGURE 7 PATENTS RELATED TO BLOCKCHAIN TECHNOLOGY, BY APPLICANT ORIGIN
Source: Derwent Innovation, accessed June 2018



Applicant origin

Analysis of patent applicant origin indicates which countries have the most investment or interest in a specific area of innovation. Figure 7 shows the number of patent families originating from each country (shown in blue). Country information is derived from applicant address data. Additionally, the number of applicants that have contributed to the overall country performance has been labelled in pink.

China and the United States currently dominate global blockchain innovation. Despite China and the United States having an approximately equal number of applicants, Chinese applicants file twice as many patents for blockchain technology as applicants from the United States.

China

Chinese applicants have filed 1,520 patent families (more than half of the total patents filed). Those families have been filed by 585 different applicants.

USA

Applicants from the United States rank second globally with 773 patent families from 569 different applicants.

AUS

Applicants from Australia rank sixth globally in blockchain technology, with 49 patent families. There have been 55 different Australian applicants that have contributed to these patent families.

TABLE 1 TOP GLOBAL APPLICANTS WITH GRANTED PATENTS IN BLOCKCHAIN TECHNOLOGY[24]

PATENT FAMILIES (GRANTED)	APPLICANT	INVENTORS	COMPANY DETAILS	TECHNOLOGY
69	coinplug	Jay Wo Hong	Est. 2013 South Korea	• Cryptocurrency • Identity verification • Fintech
12	BLOCKCHAIN	Praveen Jayachandran	Est. 2016 United States	• Blockchain platform
7	accenture	Giuseppe Ateniese	Est. 1989 Ireland	• Consultancy • Digital solutions
7	Microsoft Azure	Srinath Setty	Est. 1975 United States	• Operating systems • Cloud computing

Top applicants

Entities file patents to protect their ideas and products. The number of patent families filed by an applicant in a particular technology can be indicative of market presence or of a desire to build such a presence.

GRANTED FAMILIES

Table 1 summarises information on the top four applicants with patent families granted in blockchain technology. Coinplug is the company with the most patent families that have granted patents as part of the family (69). 92% of its blockchain patent portfolio has been granted. Each of those patent families was granted in South Korea and the United States. Based on patent measures, they are the world leader in this technology.

IBM[23] comes in second place with 12 families that have at least one family member that has been granted (20% of their total patent portfolio). Ten of those families had members that were granted in the United States. IBM has the broadest reach across the globe, with its patents also being granted in Europe, the United Kingdom, China, South Korea, Germany, Japan and Taiwan.

Accenture and Microsoft round out the top four applicants with seven patent families each.[24]

[23] IBM: https://www.ibm.com/blockchain

[24] Company details from Bloomberg https://www.bloomberg.com and company websites

ACCENTURE'S DIVERSE APPROACHES TO THE APPLICATION OF BLOCKCHAIN TECHNOLOGY

Blockchain technology has recently gained rapid traction in the capital markets industry as one of the most exciting technological developments. In 2015 an estimated US$75 million was invested in blockchain efforts specific to capital markets. This investment was up from US$30 million in 2014, and it is estimated that by 2020 US$600 million will be spent on blockchain and related technology initiatives.[25]

Consultants are key to the start-up of many new businesses. The field of online consultation has been described as lacking proper sharing and auditing. Blockchain has been labelled as a great way to bridge the trust gap.[26]

Accenture is a global management, consulting and professional services firm that aims to be at the forefront of blockchain innovation. The company offers services in strategy, consulting, digital, technology and operations.[27] It had the highest number of blockchain-related job openings in 2017, more than double the next company in the field, IBM.[28]

Accenture began as a business and technology consulting division of accounting firm Arthur Andersen. In the early 1950s it conducted a feasibility study for General Electric on the commercial use of computers for business accounting.[29] Now, headquartered in Dublin, Ireland, this Fortune Global 500 company operates in 53 countries across more than 40 industries.[30]

In this patent study, Accenture has been identified as an innovator of blockchain-based technology across a variety of applications.

Accenture has applied blockchain distributed databases to provide an autonomous selection of competing commodity suppliers (such as electricity, natural gas or water). It offers its services under certain conditions where changes in marketplace offers and user consumption habits may change in real-time (see US20170206522).

Accenture has also applied distributed blockchain databases for the validation and distribution of antivirus signatures (see US20170279818); the facilitation of secure distribution of electronic files on a computing network; and a secure electronic healthcare record management system (see US20170300627).

Accenture has applied blockchain distributed databases to provide an autonomous selection of competing commodity suppliers.

The company has produced rewritable (hybrid) blockchains that, instead of having to jettison a blockchain and recreate a new one due to inappropriate content, a trusted party may simply rewrite the existing blockchain while also preserving the validity of the blockchain (see US20180032273).

[25] Accenture: https://www.accenture.com/us-en/service-blockchain-capital-markets
[26] Cointelegraph: https://cointelegraph.com/news/blockchain-unlocks-consulting-model-for-experts-of-all-kinds-worldwide
[27] Accenture: https://www.accenture.com/au-en/company
[28] Forbes: https://www.forbes.com/sites/jeffkauflin/2018/03/09/why-accenture-has-the-most-blockchain-job-openings-in-the-world
[29] The Chicago Tribune: http://articles.chicagotribune.com/2005-07-28/news/0507280218_1_arthur-andersen-electronic-computer-ham-radio-operator
[30] Accenture: https://newsroom.accenture.com/fact-sheet/

A PATENT PROVIDES AN EXCLUSIVE MONOPOLY TO THE APPLICANT FOR UP TO

20

YEARS

PATENT FAMILIES OVERALL

In this section we have analysed the total number of patent families filed by entities overall. Table 2 summarises information on the top four applicants. While the top two applicants are the same as those for granted patents, third and fourth place are different. The Alibaba Group is the entity with the third most patent families filed (57). While they have a large number of patent families, all of them were filed in 2016-17 and none of them have been granted. The Bank of America has filed 49 patent families, all in the United States.

TABLE 2 TOP GLOBAL APPLICANTS IN BLOCKCHAIN TECHNOLOGY, ALL ACTIVE PATENTS[31]

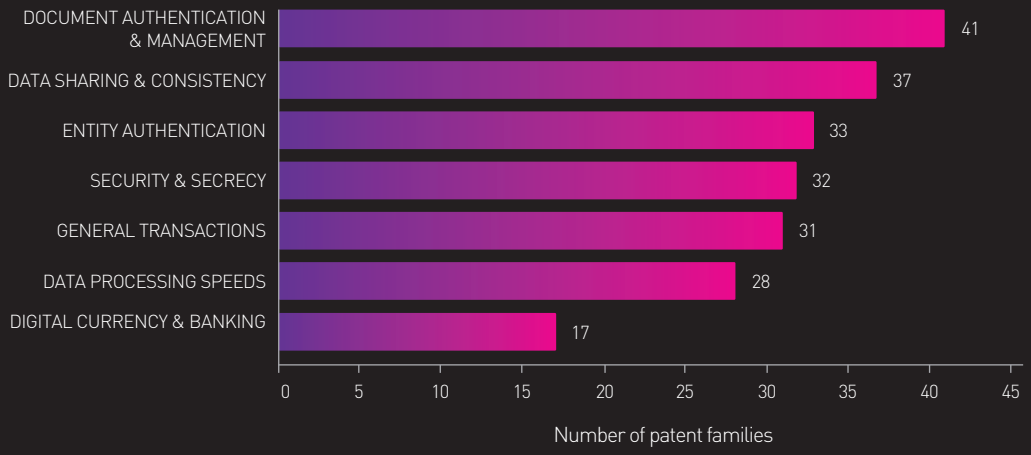
PATENT FAMILIES	APPLICANT	INVENTORS	COMPANY DETAILS	TECHNOLOGY
75	coinplug	Jay Wo Hong	Est. 2013 South Korea	• Cryptocurrency • Identity verification • Fintech
61	BLOCKCHAIN	Praveen Jayachandran	Est. 2016 United States	• Blockchain platform
57	Alibaba Group	Hong-Lin Qiu	Est. 1999 China	• Ecommerce
49	Bank of America	Joseph Castinado	Est. 1874 United States	• Digital security

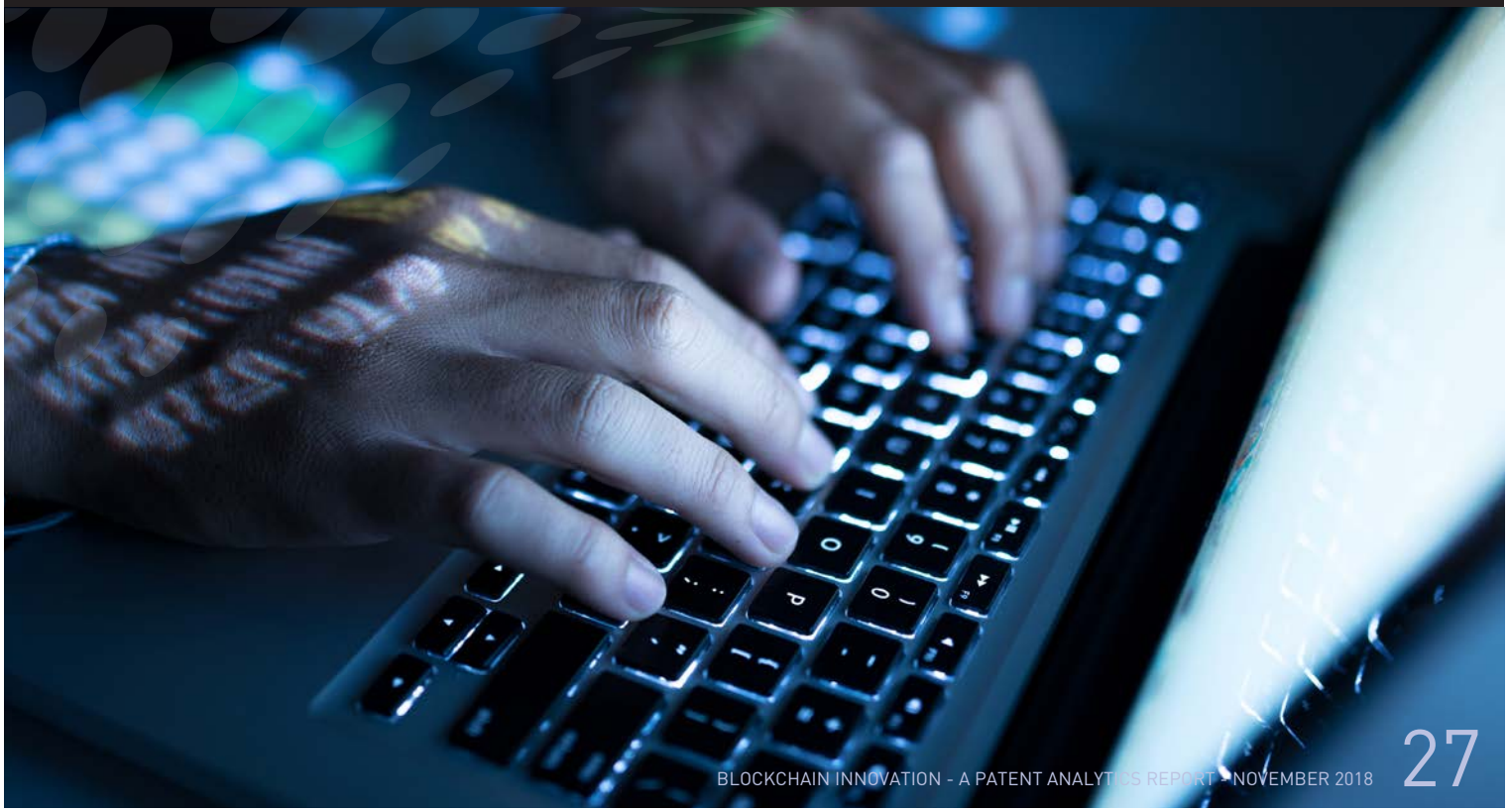
[31] Company details from Bloomberg https://www.bloomberg.com and company websites

The problems the top blockchain innovators are trying to solve

We investigated the problems that the top four companies have tried to address using aspects of blockchain technology. As shown in Figure 8, patent families of the top four companies have been categorised by problems that they are trying to solve. We have focused on the patent families with a priority year from 2015 to 2018 to ensure the analysis of the most contemporary problems faced by the top applicants. Two of the top four global entities, Coinplug and Bank of America, are solving problems in all six areas described below.

FIGURE 8 PROBLEMS THE TOP FOUR APPLICANTS ARE TRYING TO SOLVE
Source: Derwent Innovation, accessed June 2018





DOCUMENT AUTHENTICATION AND MANAGEMENT

The patent families in this category address problems of document forgery, the deployment of smart contracts and the handling of documents in general (see Table 3).

TABLE 3 SAMPLE OF PATENT APPLICATIONS FOR TOP APPLICANTS ON DOCUMENT AUTHENTICATION AND MANAGEMENT

PUBLICATION NUMBER	PRIORITY YEAR	APPLICANT	SOLUTION USED
US20180137465	2016	IBM	Handling different types of contract templates stored in a blockchain, where the type of template accessible is determined by the event type and event records entered.
US20180121923	2015	Coinplug	Verifying the authenticity of a bank's transaction records by comparing the initial generated record and the second record generated at the request of a customer.
US20180101848	2016	Bank of America	Using a private blockchain system to enhance and expedite validation of documents to be transferred between two different storage devices.
WO2018106995	2016	Alibaba	Validation and authentication of documents between users by at least one person checking the document then uploading onto a central server which distributes the checked document to all other users of the blockchain.

DATA SHARING AND CONSISTENCY

This category relates to patent families addressing how data is distributed over the blocks in a blockchain, the consistency of stored data and how to secure the transfer of information over the network (see Table 4).

TABLE 4 REPRESENTATIVE PATENT APPLICATIONS OF THE TOP APPLICANTS ADDRESSING THE PROBLEM OF DATA SHARING AND CONSISTENCY

PUBLICATION NUMBER	PRIORITY YEAR	APPLICANT	SOLUTION USED
US20180152289	2016	IBM	Generating a compact representation of the whole blockchain and providing stable datasets as check points to ensure the data stored in the local storage device is consistent with the whole blockchain.
US20180109516	2016	Coinplug	Registering only root values of the Merkle tree model that represents the whole blockchain instead of the entire blockchain to a local computer.
US20180139186	2016	Bank of America	Using uniquely generated hashes for each shared data record to help the system distinguish between data records to be shared from other data records.
CN107590738	2017	Alibaba	Using a voting system to select a consensus node that is in charge of data sharing and data consistency in order to simplify the processing steps needed to check the whole blockchain.

ENTITY AUTHENTICATION

This category relates to patents that have tried to improve identity checking, falsification of people and detection of identity theft (see Table 5).

TABLE 5 REPRESENTATIVE PATENT APPLICATIONS OF THE TOP APPLICANTS ADDRESSING THE PROBLEM OF ENTITY AUTHENTICATION

PUBLICATION NUMBER	PRIORITY YEAR	APPLICANT	SOLUTION USED
US20170330180	2016	Coinplug	Authentication of individual access to specific transactions based on a person's ID and the transaction ID.
US20170279800	2016	Bank of America	Using biometric data to generate a unique identifier to grant the user access to the blockchain.
WO2018032995	2016	Alibaba	Determining first and second check values of the user and validating the user's identity by these two values.

SECURITY AND SECRECY

This category relates to the patent families that are trying to solve the problems of privacy and encryption of data and transfers (see Table 6).

TABLE 6 REPRESENTATIVE PATENT APPLICATIONS OF THE TOP APPLICANTS ADDRESSING THE PROBLEM OF SECURITY OR SECRECY

PUBLICATION NUMBER	PRIORITY YEAR	APPLICANT	SOLUTION USED
US20170178263	2015	IBM	Method of protecting the media content of a provider where the content is being held on a server and only delivered to a media player application upon authentication.
WO2017104899	2015	Coinplug	Using a blockchain-based electronic wallet system as an authentication system that incorporates public keys as a unique identifier.
US20170214699	2016	Bank of America	A system that tracks resource availability and converts non-secure instruments into secure instruments that require user and signature validation before granting access.
CN108009441	2017	Alibaba	Using a blockchain platform to verify transaction requests before transferring the resources to the user.

GENERAL TRANSACTIONS

This category captures solutions related to transactions and exchange of data, tracking of and determining the type of transfers (see Table 7).

TABLE 7 REPRESENTATIVE PATENT APPLICATIONS OF THE TOP APPLICANTS ADDRESSING THE PROBLEM OF GENERAL TRANSACTIONS

PUBLICATION NUMBER	PRIORITY YEAR	APPLICANT	SOLUTION USED
US20180143912	2016	IBM	Coalescing and correlating transactions that are captured in a blockchain to identify parties that have pending transactions.
WO2016163608	2015	Coinplug	The use of blockchain to track transactions between parties without the need to recognise a public address or the use of QR-codes.
US20170244757	2016	Bank of America	Using a blockchain system to enable a user to transfer information from one bank to another without the need of an aggregator.
CN107341702	2017	Alibaba	A smart contract system in a blockchain to determine the best contract template to use, based on the business transactions needed.

DATA PROCESSING SPEEDS

The category includes patent families that are solving problems related to the processing speeds of data from various sources within the blockchain (see Table 8).

TABLE 8 REPRESENTATIVE PATENT APPLICATIONS OF THE TOP APPLICANTS ADDRESSING THE PROBLEM OF DATA PROCESSING SPEEDS

PUBLICATION NUMBER	PRIORITY YEAR	APPLICANT	SOLUTION USED
US20180082023	2016	IBM	Using a cognitive data processing system environment such as artificial intelligence and natural language processing within a blockchain to improve speed and accuracy of correlating patient health records.
US20180060836	2016	Bank of America	Compiling data from batches that are related to each other into blocks of a blockchain and ordering the data into a life cycle.
WO2018095275	2016	Alibaba	Using data storage instructions that capture identity, key pair, and timestamp the data before storage into the blockchain.

DATA CURRENCY AND BANKING

These patents aim to solve issues surrounding digital currencies and monetary transactions, including payments and stock exchanges (see Table 9).

TABLE 9 REPRESENTATIVE PATENT APPLICATIONS OF THE TOP APPLICANTS ADDRESSING THE PROBLEM OF DATA CURRENCY AND BANKING

PUBLICATION NUMBER	PRIORITY YEAR	APPLICANT	SOLUTION USED
US20180089644	2016	IBM	Record keeping of cryptocurrency transfers in a debit and a credit transaction pair and storing the transactions in a second storage location on the blockchain.
US20170308872	2015	Coinplug	Reducing the number of transactions by accumulating the reduction amount in one blockchain until the amount equals a standard unit and then executing the transfer.
WO2017081534	2015	Bank of America	Employing alias mapping within a blockchain and pairing links between aliases as a way to track payment transactions.

07

Australian applicants

There are two types of patents available in Australia: a standard patent and an innovation patent.

A standard patent protects an invention that is new, involves an inventive step that is not obvious, and has use in industry. The innovation patent is Australia's second tier patent and has a lower inventiveness requirement in comparison to a standard patent.[32] It should be noted the Australian Government has recently accepted the recommendation of the Productivity Commission to phase out the innovation patent.[33]

This report identified 49 patent families filed by 55 Australian applicants in blockchain technologies. As noted earlier in this report, Australians have filed 35 patent families into Australia. Table 10 shows that 27 of those patent families were via the innovation patent system. Eight patent families were filed as standard patents. Australians have also filed 14 patent families only in jurisdictions other than Australia.

In the entire patent landscape, only 59 patent families contained patents filed through second tier patent systems around the world (2% of all patent families). In comparison to applicants from other countries, Australians have made a higher proportional use of second-tier patent systems (55%) in blockchain technology. Due to the lower threshold for this type of patent, and the fact that the innovation patent is not enforceable overseas, this may overstate the level of innovative activities of Australian patent applicants in blockchain technology.

[32] IP Report 2018: https://www.ipaustralia.gov.au/ip-report-2018/patents

[33] PC (2016), Intellectual Property Arrangements, Productivity Commission Inquiry Report, Canberra: http://www.pc.gov.au/inquiries/completed/intellectual-property/report/intellectual-property.pdf

TABLE 10 PATENT APPLICATIONS FILED BY AUSTRALIANS

APPLICATION TYPE	NUMBER OF PATENT FAMILIES
Australian innovation patents	27
Australian standard patents	8
Patents only filed outside Australia	14

Table 11 summarises the seven Australian companies that have either filed standard patents in blockchain technology in Australia or who are using the international patent system, allowing for protection overseas. Each Australian company noted in the table holds a single patent family.

TABLE 11 AUSTRALIAN PATENT APPLICANTS IN BLOCKCHAIN TECHNOLOGY[34]

APPLICANT	INVENTORS	COMPANY DETAILS	TECHNOLOGY
bloxian	Kunal Chhabra Ajitha Thayaharan	Est. 2017	Blockchain platform
identitii	Elliot Shepherd Eric Knight Daniel Friedman Ben Buckingham Nick Armstrong	Est. 2014	Fintech, Payments, Compliance
MONEY CATCHA	Jonathan McDonald Ruth Hatherley	Est. 2015	Fintech
DATA 61 CSIRO	Xiwei Xu Ingo Weber Mark Staples Regis Riveret Paul Rimba Alexander Ponomarev Guido Governatori	Government agency Est. 2016	Blockchain platform
tbs X3	Jason Williams Mark Toohey Alex Taylor	Est. 2016	Product verification
ENOME	Govert Van Ek Nuno Cristina Martins Oliver Peter Curtis Nicholas Anthony Curtis John Bulich	Est. 2015	Health record management
bron.tech	Vojdan Kardalev Emilija Poposka Kardaleva	Est. 2016	Data provision

[34] Company details from Bloomberg https://www.bloomberg.com and company websites

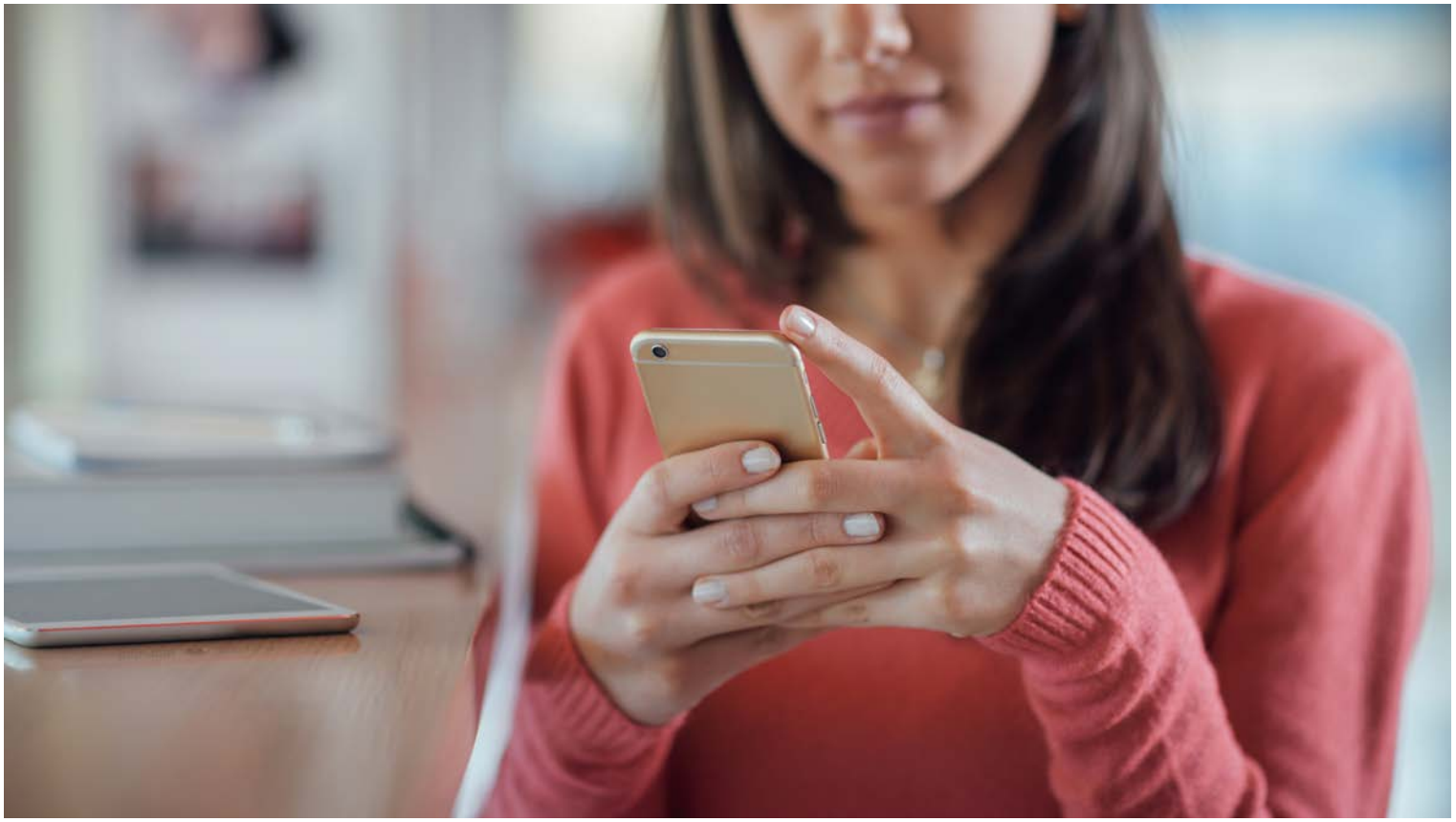
Moneycatcha and E-Nome are great examples of recent Australian success stories. They have each filed standard patent applications through the international patent cooperation treaty (PCT) in the last two years. This filing strategy means that they are in a position to seek protection overseas.

Moneycatcha

Moneycatcha Pty. Ltd., is an Australian start-up founded in 2015. Moneycatcha's two blockchain platforms, Homechain and Regchain, aim to streamline mortgage approvals and future-proof organisations against fraud, risk and regulatory pressures. Homechain is an end-to-end mortgage application processing system and speeds up processing time from 42 days to five days. Regchain is an ongoing residential loanbook risk review tool, helping financial institutions comply with and report to regulatory bodies. Moneycatcha holds one patent family WO2017205902 describing an improved security and transparency blockchain mortgage brokering system. In February 2018, HSBC linked up with Moneycatcha to implement Regchain to overhaul its regulatory reporting capacity.[35]

Homechain is an end-to-end mortgage application processing system and speeds up processing time from 42 days to five days.

[35] The Australian: https://www.theaustralian.com.au/business/technology/hsbc-links-up-with-moneycatcha/news-story/6996f442610e41a6e520280e311b6d07



E-Nome

E-Nome's medical record management platform allows individuals to take control of their own health records on a smartphone with security and privacy.

E-Nome is a start-up founded in 2015 focused on developing blockchain-based electronic health record storage and management solutions. E-Nome's medical record management platform allows individuals to take control of their own health records on a smartphone with security and privacy. The platform also consolidates scattered health records, and safely and securely shares the compiled data. Application WO2018009979 describes how E-Nome's secure blockchain data management system is tailored for electronic health records. E-Nome has linked with The Garvan Institute of Medical Research to assess E-Nome's platform as a potential solution for secure storage of genomic information, and the collection and management of research data.[36]

None of the patents filed by Australian applicants were co-filed between two separate companies. This means that the patent data provides no evidence of Australian research collaboration in blockchain innovation. This characteristic is reflective of the field in general.

[36] Garvan Institute: https://www.garvan.org.au/news-events/news/blockchain-tech-garvan-partners-with-e-nome

08

CONCLUSION

THE NUMBER OF PATENT FILINGS HAS GROWN BY BETWEEN

140% & 230%

FROM 2014-16

Conclusion

The report explores the patent landscape of innovations relating to blockchain technology.

The technology is dominated by Chinese applicants, making up 50% of the total families captured within the report. The largest applicant from China is Alibaba, filing 57 patent families. Globally, the top players within this technology are Coinplug from South Korea with 75 patent families and IBM with 61 families.

Applicants are using blockchain technology to solve problems in document handling and management, and predominately applying the technology into payment and transaction systems. Very little collaboration was identified in terms of the co-filing of applications by companies.

Australia's role in the area of blockchain technology is active, with 49 patent families originating from Australian inventors, ranking Australia sixth globally in patent applications. Australia is also ranked sixth globally as a destination for filing blockchain patents, with 87 patent families filed in Australia. The seven Australian companies that have patents in blockchain technology are Bloxian, Moneycatcha, Identitii, Data61, E-Nome, TBSx3 and bron.tech.

Over the past five years, the number of patent filings has grown by between 140 and 230% each year from 2014–2016. Only 4% of patent families are dead. 14% of patent families have granted patent application members. This low proportion is reflective of the early state of the field.

Based on the available patent data, significant growth and further IP certainty in blockchain technology is expected in the coming years. Further monitoring of the patent landscape will allow the field to be fully appreciated.

09 Appendix A

Patents, applications and publications

A patent is a right that is granted for any device, substance, method or process that is new, inventive and useful. Australian patent rights are legally enforceable and give the owner, or patentee, exclusive rights to commercially exploit the invention in Australia for a period of up to 20 years. In this report, an application refers to a single patent filing. A patent application is usually published within 18 months of its earliest filing date (also known as the priority date). We consider that the priority date is most relevant for our analysis as it is the closest date to that when the invention occurred.

There are two major routes for filing a patent application: the international route and direct filing. The international route involves filing a Patent Cooperation Treaty (PCT) application, which establishes a filing date in all 152 contracting states.[37] Subsequent prosecution at national patent offices, referred to as a national-phase entry (NPE), is made at the discretion of the applicant. A patent can only be enforced once it has been granted and a PCT application must enter the national phase to proceed towards grant.

PCT applications have been excluded from the analysis of patent destinations because they do not represent an enforceable right in any jurisdiction. European patents are enforceable in designated contracting states to the European Patent Convention at the date of filing of the application.[38]

The most recent legal status action was used to determine the status of a patent family. A family is considered alive if at least one family member is active or in force. A patent family is considered dead when all family members have lapsed, expired or been withdrawn. The remaining patent families are considered as indeterminate as the lack of legal status information for family members prevents their classification.

Patent families

Applications filed in different jurisdictions but claiming the same priority are known as patent families. Patent families enable us to analyse inventive activity regardless of the number of countries in which protection is sought. Patent families are commonly used in analytics as they generally represent a single inventive concept. We determine patent families based on the Derwent World Patent Index (DWPI). DWPI patent families give a unique family ID to patents that share a common inventive concept.[39] For metrics in this report, the number of patent families is typically used. There are some exceptions where individual applications are used, as each application represents a legal right in a country. When analysing the number of applications or families per applicant, related commercial entities have been grouped under a single harmonised applicant name. When individual publication numbers are quoted, we have chosen a representative publication from the respective patent family. Where possible, PCT or United States patent applications have been quoted as representatives as they are in English.

Classification

Patents are classified by technology into the hierarchical International Patent Classification (IPC) system. A further classification system, as referenced in this report, is the Cooperative Patent Classification (CPC). The CPC began in 2013 and is a bilateral system developed by the European Patent Office (EPO) and the US Patent and Trademark Office (USPTO), providing significantly more depth to the hierarchy of the IPC.[40] For more information on the coverage of the CPC, see the CPC Annual Report 2016.[41]

[37] WIPO: https://www.wipo.int/pct/en/pct_contracting_states.html
[38] EPO: Guidelines for Examination - Designation of Contracting States
[39] Clarivate Analytics: https://clarivate.com/products/derwent-world-patents-index/
[40] EPO and USPTO: https://www.cooperativepatentclassification.org/
[41] EPO and USPTO: https://www.cooperativepatentclassification.org/publications/AnnualReports/CPCAnnualReport2016.pdf

Appendix B

Data extraction and analysis

We used five phases of data extraction and analysis:

- **Phase 1**: Development of a search strategy (See right)
- **Phase 2**: Data mining using Derwent Innovation. The unique DWPI family members relating to blockchain technologies were identified and used as the basis of the analysis
- **Phase 3**: Data cleaning, focusing on consolidating applicant names and ensuring the return of correct records using Derwent Data Analyser and national patent office legal status actions
- **Phase 4**: Data categorisation according to the technological focus of the patent families. The technological focus was determined by taking into account the CPC and IPC symbols and keywords for the patent families
- **Phase 5**: Data analysis using Tableau 2018.1 for calculation and visual presentation of patent metrics

Search strategy

The search was limited to patent applications with an earliest filing year on or after 1999. Patent applications were retrieved when the following keywords or phrases appeared in the abstract, title and first claim. No classification symbols were used in the search as the patent classification of blockchain related technology is still immature.

Keywords used to search Titles, Derwent abstracts and first claims field	Blockchain* or (block ADJ chain) or (merkle ADJ tree*) or (public* or electronic* or distribut* or decentral*) NEAR3 ledger*) or (eos ADJ io) or bitcoin or (bit ADJ coin) or litecoin or ethereum or namecoin or (crypto* NEAR3 currenc*)

Note: In the search query the use of '*' act as a wildcard character for text and spaces.

The search results were further filtered to remove patents related to non-computer related technologies. The filters below were applied in a hierarchical manner to remove any irrelevant patents

EXCLUDED TECHNOLOGIES	IPC/CPC SYMBOLS	KEYWORDS
Related to mechanical	B0, B1, B2, B3, B4, B5, B6, F1, F4	writing block*, video block*, MPEG, heat*, voltage*, vehicle*, unit*, pull*, drive*, memory*, thread*, box*, motor*
Related to chemical/ biological	C0, C1, C2, C3	poly*

Appendix C

Technology analysis

This technology analysis categorises all search results (DWPI families) based on their classification into one of two categories: Application and Data processing. The categorisation is represented in the order of its hierarchy below. The table below provides the IPC or CPC subclasses captured in each technology area, the sub-technology it relates to and a description to further define it.

TECHNOLOGY OVERVIEW			
SUB-TECHNOLOGY	DESCRIPTION	IPC/CPC SYMBOLS	KEYWORDS
Application	Uses of blockchain technology in payment and transaction systems, financial services, business administration, shopping and Ecommerce	G06Q	(*coin*), (*currency*), (*pay*)
Data processing	Networking and data transmission, encryption and security, data manipulation and error correcting and data storage, searching and recording	H04L, G06F, G11B, G09C	blockchain*

Appendix D

Sub-technology analysis

This sub-technology analysis further refines the categorisation for blockchain patent families. The categorisation is carried out in the hierarchy as shown below. The tables provide the IPC or CPC symbols captured in each technology, the sub-technology it relates to and a description to further define it.

BLOCKCHAIN APPLICATION			
SUB-TECHNOLOGY	DESCRIPTION	IPC/CPC SYMBOLS	KEYWORDS
Payment and transaction systems	Relates to the use of blockchain technology in money transfer		pay*, sale*
Financial services	Relates to financial services and includes patents that involve banking, stock trading and management of currency, and cryptocurrencies	G06Q 40	currency*, mone*, bitcoin*, bank*, financ*
Business administration	Relates to other transaction applications that do not involve money	G06Q 10, G06Q 50	informat*, contract*, document*, auth*, audit*, time*, ledger*, vot*
Shopping and Ecommerce	Relates to patents that use blockchain in purchases from online or traditional shops and in online gaming	G06Q 30	

BLOCKCHAIN APPLICATION			
SUB-TECHNOLOGY	DESCRIPTION	IPC/CPC SYMBOLS	KEYWORDS
Encryption and security	Relates to encryption of data and the ciphering of records and information	G06F 21, H04L	encrypt*, ciph*, cryp*, encod*, signa*, auth*, secur*
Networking and data transmission	Relates to patents directed to the transfer of data between the blockchain network and the network itself	H04L 6	transmission*, network*, link*, comm*, connect*
Data manipulation, management and interrogation	Relates to data manipulation, management and interrogation within the blockchain network	G06F	Stor*, record*, memory*, manage*, process*, debug*

BLOCK
CHAIN

About ACS

ACS is the professional association for Australia's Information and Communication Technology (ICT) sector. More than 40,000 ACS members work in business, education, government and the community. ACS exists to create the environment and provide the opportunities for members and partners to succeed. ACS strives for ICT professionals to be recognised as drivers of innovation in our society, relevant across all sectors, and to promote the formulation of effective policies on ICT and related matters. Visit acs.org.au for more information.

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