
# *Blockchain patents unchained*

## *A patent landscape on blockchain and digital currencies*

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*Is it worthwhile to patent on blockchain? Who is currently doing it and why?*

*In this brief report we examine who is behind the development of new technologies enabling blockchain. We look at patent data to identify companies/assignees claiming novel technologies and solutions. We also identify who is using patent protection to get control of this promising market and who is positioning their blockchain systems and platform implementations in various sectors.*

Yes, you are reading yet another post about blockchain, the "hot" topic everyone (from speculators to idealists) is talking about. There are countless news portals, blogs[1], social aggregators[2], chats, forums, and active communities[3] on the internet perpetually updating us on new cryptocurrencies, new ICOs (Initial Coin Offerings) being launched, and new metrics for monitoring their highly volatile market capitalization[4].

Isn't all this information enough? What else can be said about blockchain?

We wondered whether checking a different source would provide an overview or, at least, some additional hints about the state of this technology. **Patent documents** are in fact a vast source of technical, formal information produced worldwide and registered in national and regional IP offices. They can help reveal who has a strategic interest in protecting new technologies and processes. They also provide valuable hints about the evolution of technologies.

An analysis of patents can hopefully shed some light on the current developments related to blockchain. Working with this initial hypothesis, let's undertake some patent searches and see what we get.

## Searching for blockchain patents

IFI CLAIMS patent database is an excellent place to search because it provides patent data which has been centralized, integrated, and normalized. All we have to do is enter our searches into the simple interface and we receive patent data containing all the data fields we need for our analysis.

First, we must try to include all of the concepts related to blockchain. Different terminology is used for closely related or equivalent technologies, so the first step is to identify this terminology. One option is to use the Pearl concept search service provided by WIPO (the World Intellectual Patent Office) where

1. Coindesk (https://www.coindesk.com), cointelegraph (http://www.cointelegraph.com), newsbitcoin (https://news.bitcoin.com), cryptonewsbytes (https://cryptonewsbytes.com), Coinmania (https://coinmania.online), bitcoinist (https://bitcoinist.com) etc.
2. Subrredits (/r/Bitcoin, /r/Ethereum, /r/ethtrader, /r/Ripple, /r/btc, /r/BitcoinCash,…), telegram groups, etc.
3. bitcointalk (https://bitcointalk.org), hackernoon (https://hackernoon.com), coincrunch (https://coincrunch.io), coinmarketcal (https://coinmarketcal.com), cryptorelease (https://www.cryptorelease.org), Blockchain Berkeley (https://blockchainatberkeley.blog), etc.
4. Coinmarketcap (https://coinmarketcap.com), Cryptocompare (https://www.cryptocompare.com), icogeeker (https://www.icogeeker.com), cryptopanic (https://cryptopanic.com), Coinlive (https://coinlive.io), Coinspectator (https://coinspectator.com), etc.

we can get a preliminary idea of the terminology that has been used in patents related to this field (figure 1).

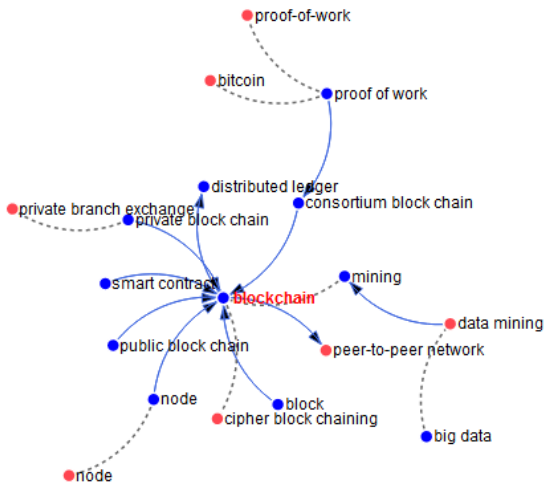



Figure 1: Terminology in patents associated with blockchain. Source: WIPO Pearl

We must also make sure that we include all relevant synonyms defining blockchain-based systems. For this, our knowledge of the field or the advice of an external expert may help. Then we can write down and combine these keywords into thorough, coherent search equations such as the following:

> *Blockchain OR (block AND chain) OR "distributed ledger" OR proof-of-work OR bitcoin OR (bit AND coin) OR ethereum OR litecoin OR ICO OR "Initial Coin Offering" OR "private branch exchange" OR "smart contract" OR "cipher block chaining" OR cryptocurrency OR (node AND token AND transaction) OR "digital currency" OR "Tokenized Equity" OR cryptocoin NOT "block polymer"NOT "block copolymer"*

We are now ready to conduct these searches in selected patent data fields (in this case the text fields: abstract and claims). We do that in CLAIMS Direct 2.1, the IFI CLAIMS patent database web service and user interface through which we are able to get all relevant worldwide patents in just one go. Using CLAIMS Direct, we can save reports, combine them, and conveniently export all results in a tabular format (.csv) containing all patent fields and metadata, plus normalized data such as citations, homogenized assignee names, and more.

After tidying and filtering non-relevant results in our retrieved data[5], a set of 4447 **patent documents** is obtained, including 3800 patent applications, 307 granted patents, 298 applications for utility models, and 48 granted utility models.

## Evolution of blockchain patent filings

The volume of patents filed during the last two years really stands out. The hype seems to be real.

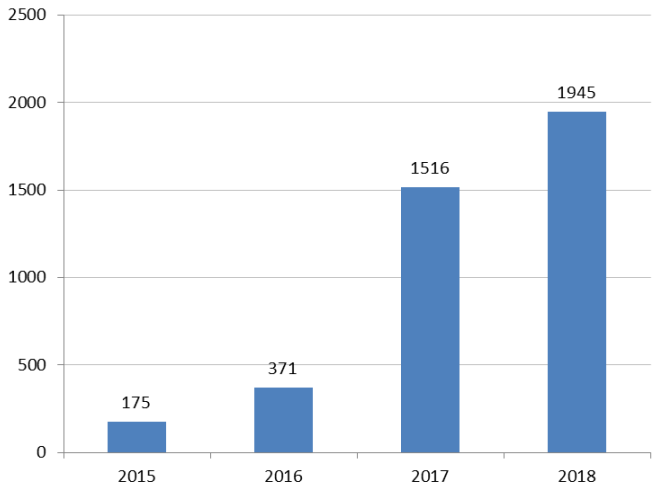



Figure 2: Evolution of the patentability of inventions related to blockchain (up to October 2018)
Source: IALE Tecnologia, data from IFI CLAIMS, visualization generated with Matheo Software

## Countries where blockchain is protected

Country code fields tell us where patents are protected, indicating regions of strategic interest. Most of the patents have been filed in China (49%). The US is the second chosen jurisdiction for filing blockchain patents (19%); 12% of patent documents are worldwide applications that have gone via the Patent Cooperation Treaty (PCT) through the World Intellectual Property Office (WIPO). Korea and Japan are also leading countries for blockchain patent filings. Other key regions where protection is sought are

5. For example, for clarity and convenience, patent results specifically associated with telephon pbx and VoIP systems were filtered out. Moreover, some patents containing “block chains of polymers” were disambiguated from the unrelated chemical domain and also excluded.

Australia, Canada, Taiwan, India, and Singapore. Great Britain is the leading European country for blockchain patents, followed by Germany.

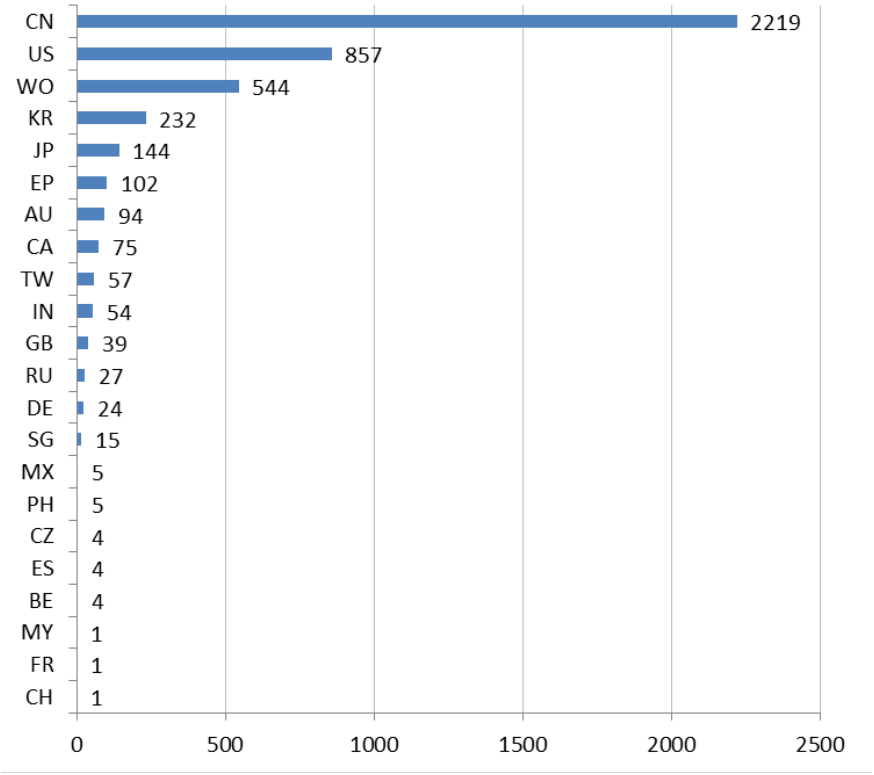



Figure 3: Country code of blockchain patents
Source: IALE Tecnologia, data from IFI CLAIMS

## Who is patenting on blockchain

**Top patent assignees** are South Korean fintech **Coinplug**, pioneer bitcoin protocol creators **Nchain Holdings**[6], financial services multinational **Mastercard**, ecommerce giant **Alibaba**, **Bank of America**, **Accenture**, phone operator **China Unicom** and tech firms such as **Intel Corporation** and **IBM**.

6. https://bitcoinpatentreport.com/2018/02/21/the-truth-about-the-patent-portfolio-of-dr-craig-wright/

Other relevant assignees are **Toronto-Dominion Bank** which is patenting a techology for a point-of-sales system and asset tracking[7]; **Black Gold Coin**[8], patenting methods for identity verification in the USA and Australia; **British Telecom**[9], claiming cybersecurity measures for protecting blockchains; information provider **Thomson Reuters**, also working on identity and data verification; online blockchain platform **Coinbase**[10], owning granted patents for bitcoin transaction methods (US9436935B2); and Chinese code review platform **Bubi Network**[11].

We also find big tech companies such as **Sony**, which has filed inventions of electronic devices for maintaining a distributed ledger. Sony Entertainment obtained a grant in 2010 for a patent (US7856102B2) on methods and apparatus for providing message authentication codes using a pipeline and involving cypher blocks. **Dell** and **Fujitsu** are also active in secure distribution transaction ledgers and secure data sharing systems, and **Tyco** has granted patents on architectures for access management (US10055926B2).

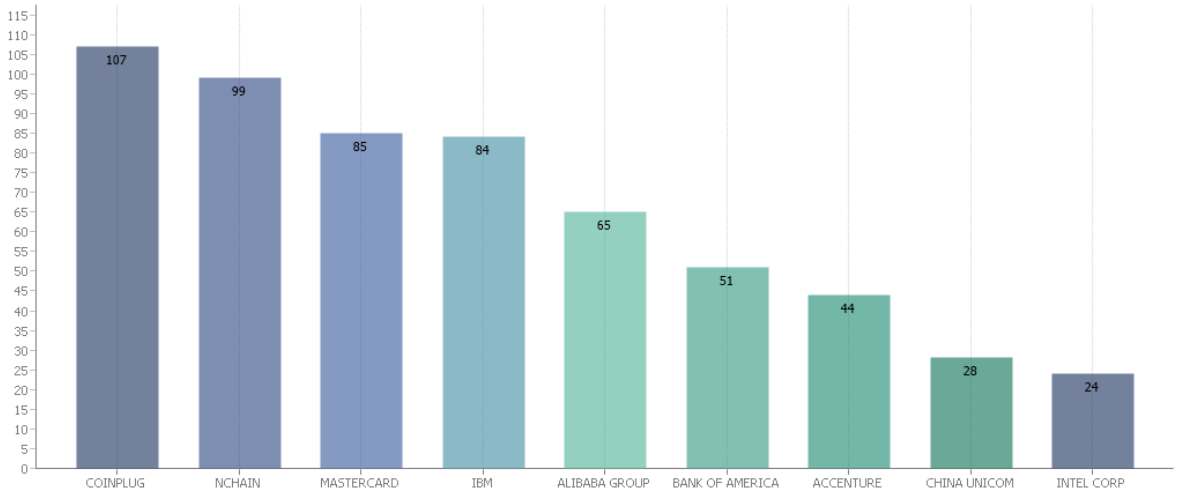



Figure 4: Main assignees/applicants patenting on blockchain
Source: IALE Tecnologia, data from IFI CLAIMS, visualization generated with Matheo Software

7. https://www.ccn.com/canadas-td-bank-wants-us-patent-for-blockchain-point-of-sale-system/
8. https://www.businesswire.com/news/home/20150703005323/en/Pioneering-Aten-%E2%80%9DBlack-Gold%E2%80%9D-Coin-Offer-New
9. https://www.coindesk.com/british-telecommunications-receives-patent-for-blockchain-protection/
10. https://cryptovest.com/news/kipo-pushes-for-more-blockchain-patents-by-south-korea
11. https://news.bitcoin.com/pr-bubi-launches-code-review-bounty-program/

## Some promising fields of application

At first sight, most patents appear to focus on transaction protocols mainly related to security and linked to financial services, but we also read some promising titles in other fields of application:

- **Accenture**, for example, has recently obtainted a grant for a patent to secure 3D model sharing using distributed ledger (US10063529B2)
- **Intel** has worked on blockchains for securing IoT devices, including vehicles and drones (US20170285633A1)
- **IBM** has applications of blockchain in radically different sectors ranging from mobile telecommunications (US20180255130A1), crowd voting and peer-review processes (US2018018197A1, US20180176228A1), food shelf life management (US20180174094A1), detecting medical fraud (US20180121620A1), gaming (US20180114403A1), contracts amongst enterprises (US20180089638A1), or reputation tracking (US20170140394A1), amongst many others
- **Ericsson** has patented trash collector systems using blockchain (US20170178125A1)
- **Walmart** has filed worldwide patent applications for apparatus and methods for collaborative shopping (WO2018111847A1), for managing demand on an electrical grid using a publicly distributed transactions ledger (WO2018112043A1), for controlling access to a locked space using cryptographic keys stored on a blockchain (WO2018112038A1), and for obtaining a medical record stored on a blockchain from a wearable device (WO2018112035A1)

## Top inventors

As for the **most prolific inventors**, Korean technologist Joonsun Uhr, founder of Coinplug (a startup providing bitcoin exchange & wallet service, okBitcard bitcoin prepaid card, 2-way ATM and payment processor for the Asian market) appears as the top inventor in our patent set with more than a hundred patents filed together with co-inventors Jai Hu Wong and Joo Han Song. They are followed by Australian partners Dr. Stephane Savanah, Director of Scientific Research at Nchain, and Craig Steven Wright, one of the pioneer creators of Bitcoin[12] (with each of them accounting for more than 60 patents).

12. He has claimed to be the identity behind the pseudonym Satoshi Nakamoto. Source: Wikipedia

## Collaboration amongst applicants

**Co-patenting networks** can be identified between Hong Kong-based **DiQi Inc**, a company that offers blockchain as a service, and **WiFire Open Network Group** on electronic money managing methods (CN106600401A); and between **Accenture** and **GSC Secrypt LLC**, a legal firm created by cryptography inventor experts from academia in Italy, the USA, and Brazil that developed a distributed key secret to rewrite the content of blockchains[13] (US20170374049A1). Apparently, the system was based on IBM's Chameleon Signature system. Finally, there is also collaboration between Chinese institutions **State Grid Corporation** branches, the **University of Tsinghua**, and **Beijing Huitong Jincai Info Tech Co Ltd**, in this case on blockchain-based distributed power generation quality evaluation methods (CN107301501A).

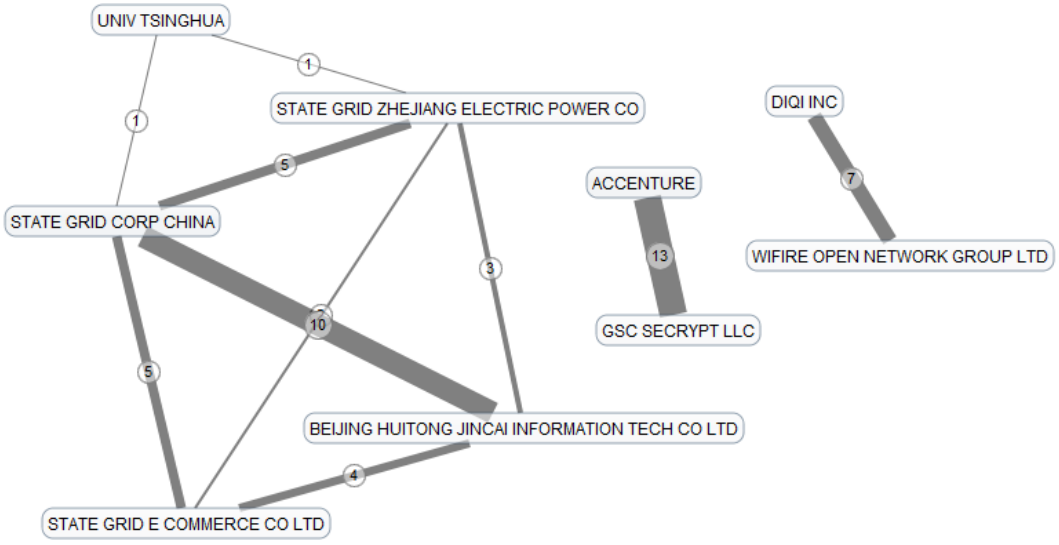



Figure 5: Main co-patenting networks in blockchain patents
Source: IALE Tecnologia, data from IFI CLAIMS, visualization generated with Matheo Software

## Main topics and technologies

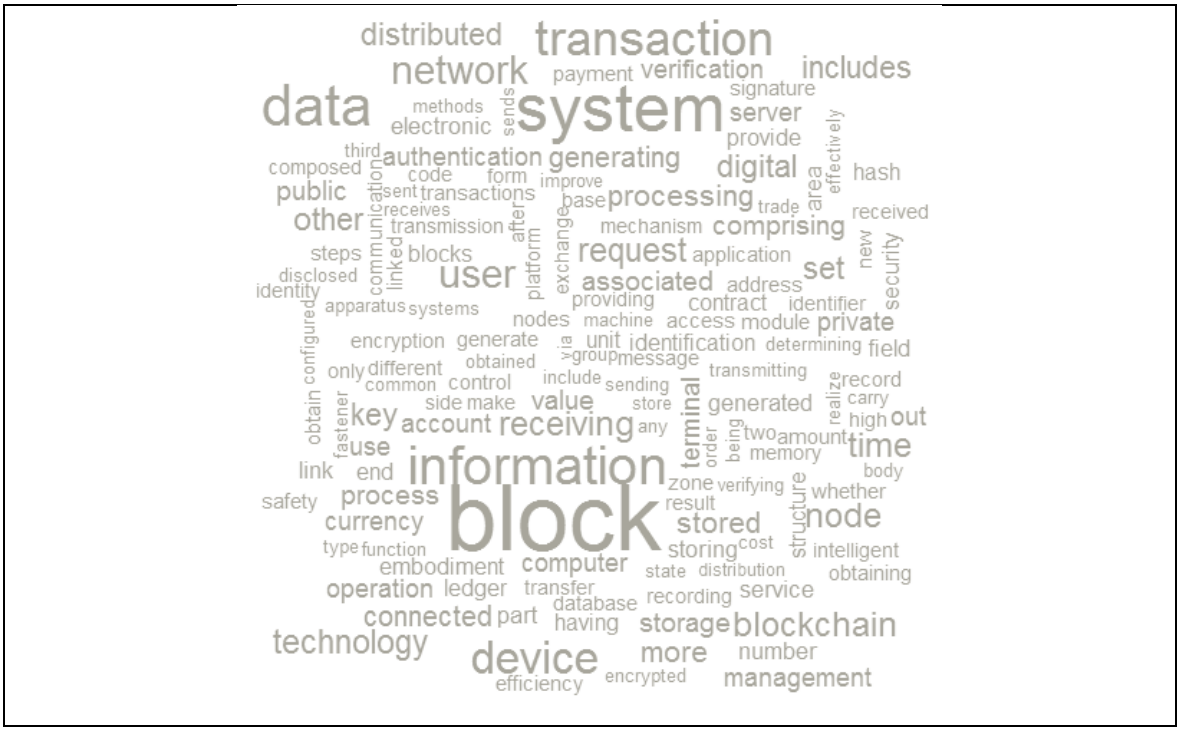
At this point, we must process the textual content of all patents so as to model topics and identify disclosed processes and technologies. For that, we used the R programming language and in particular

13. https://www.cio.com/article/3122807/financial-it/why-accenture-broke-the-blockchain-with-ibms-help.html

the Tidytext package developed by Julia Silge[14]. We created word clouds and co-occurrence networks with the main terms of all patents and also applied a clustering algorithm[15] to deploy topic contents into significant groups. The results are shown in figure 6.

In terms of cryptocurrencies, *Bitcoin* is named in 102 patents, whereas *Ethereum* is named in 6.

- Applicants mentioning Bitcoin in their patents include: Nchain, Coinplug, Coinbase, 21 Inc, RFCO LLC, Ox Labs Inc, Jetstream Holdings Ltd, Intel, Valasca Ltd, Ericsson, Sendlater Inc, Shenzhen Fanxi Electronics Co Ltd, Nemoict, Nautilus Hyosung, Monegraph, Midea Group, Libra Services, Leetcoin, Kona I Co, IBM, Heliopay, Fujitsu, Ezetap Mobile Solutions PVT Ltd, Chain Holdings Ltd, and Beijing Bitmain Tech Ltd
- Applicants mentioning Ethereum include: Hefei Weitian Yuntong Info Tech Co Ltd, Commonwealth Scientific and Industrial Research Organization, Redenbach Lee Lawyers Pty Ltd, and National ICT Australia Ltd




14. https://cran.r-project.org/web/packages/tidytext/vignettes/tidytext.html
15. LDA https://en.wikipedia.org/wiki/Latent_Dirichlet_allocation

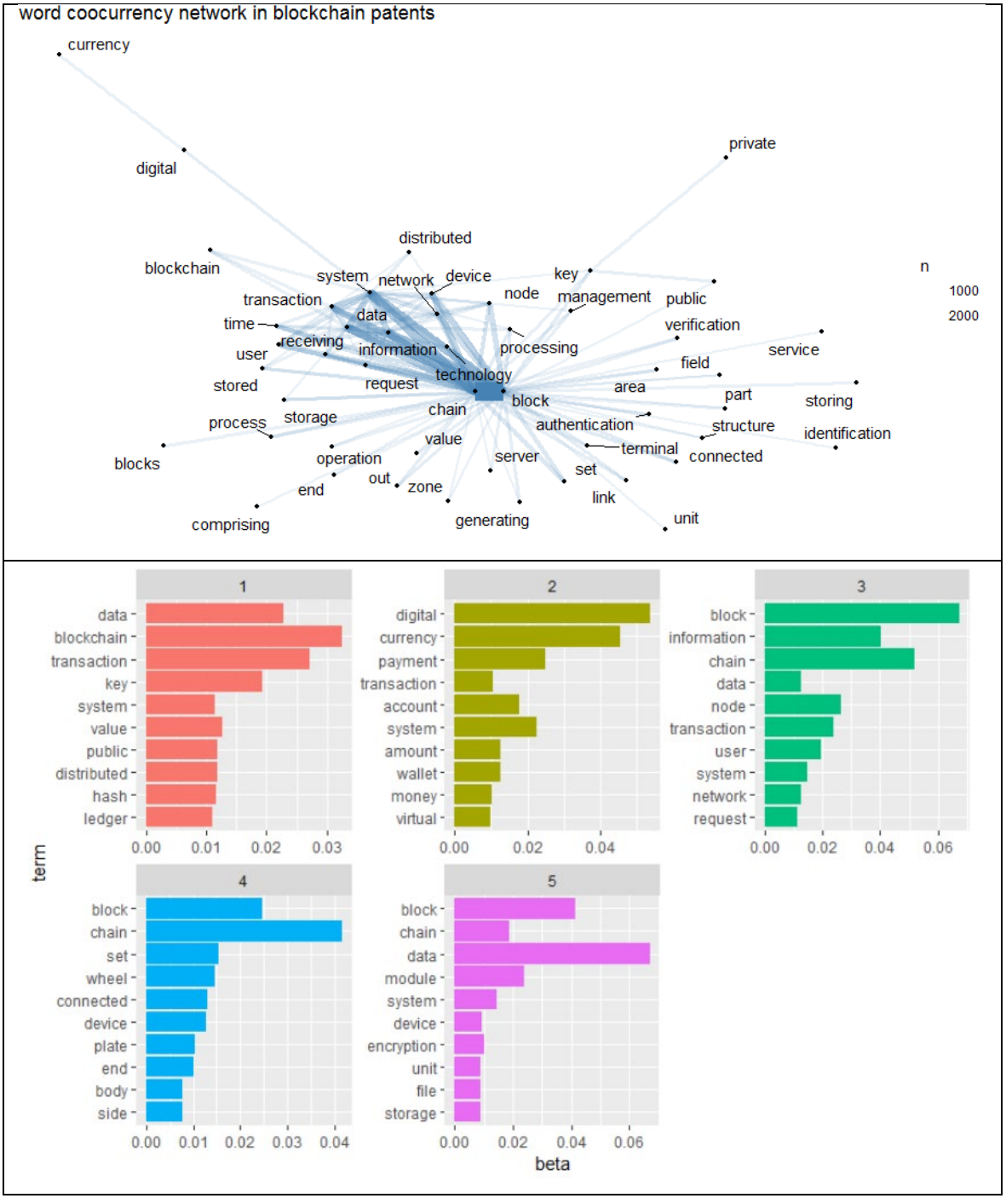



Figure 6: Main topics in blockchain patents' abstracts: word cloud and word frequency table (above); word co-occurrence network (middle), and topic clustering applying LDA to patent texts (below).
Source: IALE Tecnologia, data from IFI CLAIMS, visualization generated with R.

Interestingly enough, one of the resulting groups refers to *connected wheel devices*. In fact, blockchain technologies are already being tested, in the context of IoT, for communication and real-time information exchange amongst autonomous vehicles.

Let's look now at patent classifications[16] to derive the main areas of technological development in which these companies operate. These include:

- ***Payment architectures, schemes or protocols using e-cash*** (G06Q 20/065) –> 492 patents
- ***Transmission of digital information, cryptographic mechanisms such as chaining, e.g. hash chain or certificate chain*** (H04L2209/38) –> 467 patents
- ***Payment architectures, schemes or protocols involving key management*** (G06Q 20/3829) –> 434 patents
- ***Transmission of digital information, cryptographic mechanisms, involving digital signatures*** (H04L 9/3247) –> 433 patents
- ***Transmission of digital information, cryptographic mechanisms, such as financial cryptography, e.g. electronic payment or e-cash*** (H04L2209/56) –> 413 patents
- ***Transmission of digital information, cryptographic mechanisms, using cryptographic hash functions, involving keyed hash functions, e.g. message authentication codes [MACs], CBC-MAC or HMAC*** (H04L 9/3236) –> 350 patents
- ***Modes of operation, e.g. cipher block chaining [CBC], electronic codebook [ECB] or Galois/counter mode [GCM]*** (H04L 9/0637) –> 306 patents
- ***Data processing methods for finance; insurance; tax stratgies; processing of corporate or income taxes, exchange, e.g. stocks, commodities, derivatives or currency exchange*** (G06Q 40/04) –> 267 patents
- ***Payment architectures, schemes or transaction verification protocols*** (G06Q 20/401) 237
- ***Business processing using cryptography*** (G06Q2220/00) –> 230 patents

Grouping 4-digit classifications gives us an idea of the main application areas (see the left-hand side of figure 7).

16. Cooperative Patent Classification (CPC) https://worldwide.espacenet.com/classification

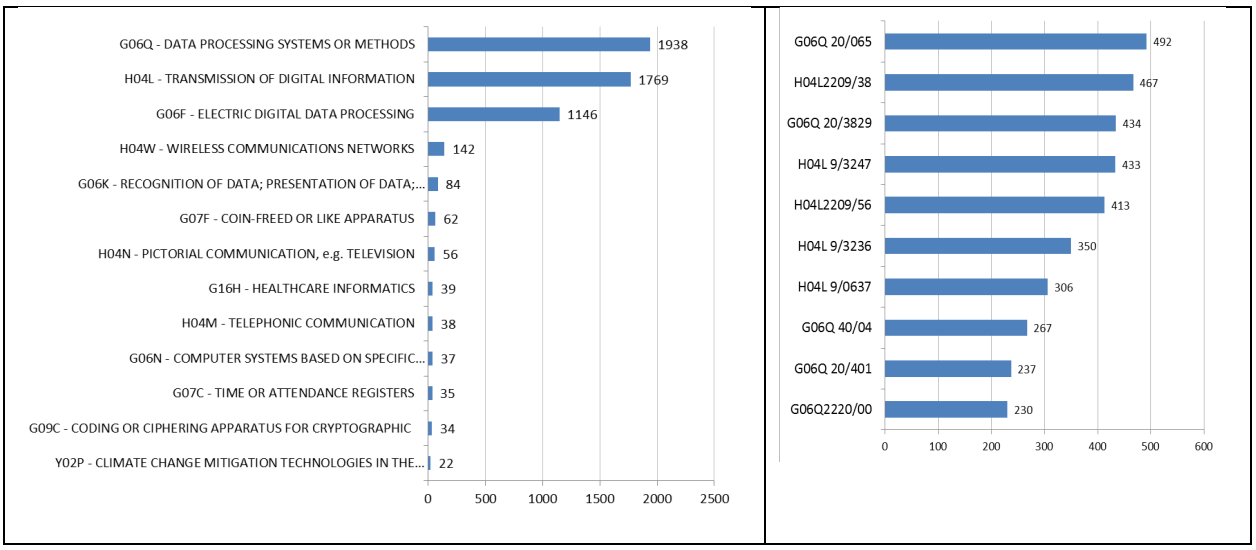



Figure 7: Main CPC 4 digits (left) and CPC full digits (right)
Source: IALE Tecnologia, data from IFI CLAIMS, visualization generated with Matheo Software

## Main specialization areas

Figure 8 (below) is an overall network graph representing the main applicants and their **areas of technological specialization** (derived from the CPC patent classification codes).

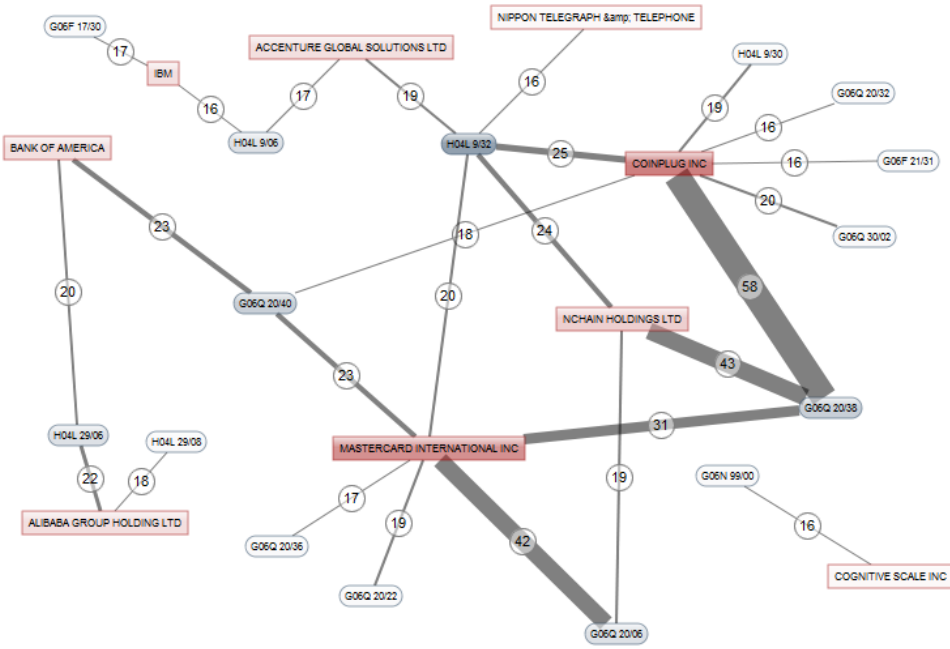



Figure 8: Network of main areas of specialization of companies developing blockchain-related technologies
Source: IALE Tecnologia, data from IFI CLAIMS, visualization generated with Matheo Software.

Main areas of specialization are *Payment architectures, schemes or protocols details* (G06Q 20/38), where **Coinplug** (58 patents) and **Nchain** (43) are focusing their development strategies. **Mastercard** is also involved in this area (31) but is specifically claiming inventions on *Private payment circuits, e.g. involving electronic currency used among participants of a common payment scheme* (G06Q 20/06).

**IBM** is leading developments in the field of *Digital computing or data processing equipment or methods, specially adapted for specific functions such as information retrieval* (G06F 17/30).

**Cognitive Scale**, a company based in Austin, Texas that develops software applying blockchain and AI to solve complex business problems for finance, healthcare, and ecommerce markets, has 16 patents on *Computer learning systems* (G06N 99/00).

**Alibaba** and **Bank of America**'s core developments focus on *Arrangements, apparatus, circuits or systems characterized by a protocol* (H04L 29/06). Alibaba, for instance, has invented systems for filing service data processing requests into blockchain (US20170140394A1).

**Accenture** is active in *Encryption apparatus using shift registers or memories for block-wise or stream coding* (H04L 9/06) and *Arrangements for secret or secure communication including means for verifying the identity or authority of a user of the system or for message authentication* (H04L 9/32), an area in which **Nippon Telegraph** has also filed 16 patents.

Let's now check out what has been invented and who is active in categories such as Y02P (Climate Change Mitigation Technologies) and G16H (Healthcare Informatics):

Some companies patenting on *Blockchain and Climate Change Mitigation Technologies* (Y02P) are:

- **Shenzhen Fanxi Electronics**, patenting on a distributed photovoltaic power transaction system (WO2018032369)
- Electric car charging stations company **eMotorWerks** (Enel Group); patenting on automated power generation based on user-specified rules (US20180015838A1)
- Power grid management company **Causam Energy**, patenting on a blockchain platform for advanced energy settlements (US20170358041A1)

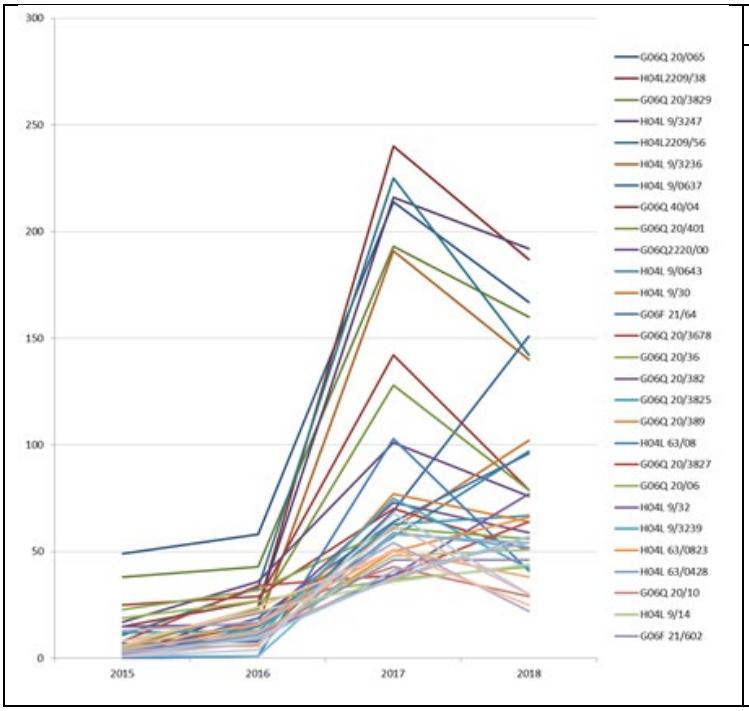
Australian company **Power Ledger** is disrupting this niche by using blockchain technology enabling consumers to manage the energy economy in a transparent, automated, and auditable manner.

Some companies patenting on *Blockchain and Healthcare Informatics* (G16H) are:

- **Walmart**, patenting on methods for obtaining a medical record stored on a blockchain from a wearable device (US20180167200A1)
- **NantWorks**, patenting worldwide on healthcare transaction validation mechanisms (WO2015175722A1)
- Global media company **BBM Health** (Börm Bruckmeier Publishing) (WO2018039312A1)
- **Netspective** consultancy, applying Natural Language Processing and blockchain to regulatory issues (US20170091397A1)
- Healthcare IT Platform **Pokitdok Inc** (WO2017223540A1)
- **Nokia**, patenting methods for verifying user's health data (WO2017198891A1)
- **Openclinica**, also patenting on verification of clinical data (US20180218779A1) and **Cognitive Scale** (US20180165416A1)
- **Irise**, a hospital security system (WO2017198891A1)
- Genomics company **Macrogen**, awarded a patent in Korea for bio-information data management and storing method (KR101880175B1)
- **Suggestic**, a start-up focusing on eating plans, claims inventions using augmented reality and blockchain for decision methods using contextual filtering (US20180190375A1)

## Technology trends and emerging areas

When looking at the overall evolution of blockchain technology, we noticed particular areas that seem to be gaining relevance in recent years (see chart on next page). That is the case of *Block ciphers, i.e. encrypting groups of characters of a plain text message using fixed encryption transformation, e.g. cipher block chaining [CBC], electronic codebook [ECB] or Galois/counter mode [GCM]* (H04L 9/0637); also *Cryptographic mechanisms such as Public key, i.e. encryption algorithm being computationally infeasible to invert or user's encryption keys not requiring secrecy* (H04L 9/30); *Hash functions, e.g. MD5, SHA, HMAC or f9 MAC* (H04L 9/0643); *Protecting data integrity, e.g. using checksums, certificates or signatures* (G06F 21/64), and *means for verifying the identity or authority of a user of the system or for message authentication, e.g. authorization, entity authentication, data integrity or data verification, non-repudiation, key authentication or verification of credentials* (H04L 9/32).




| IPC | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|
| G06Q 20/065 | 49 | 58 | 214 | 167 |
| H04L2209/38 | 5 | 24 | 240 | 187 |
| G06Q 20/3829 | 38 | 43 | 193 | 160 |
| H04L 9/3247 | 1 | 24 | 216 | 192 |
| H04L2209/56 | 11 | 33 | 225 | 142 |
| H04L 9/3236 | 3 | 16 | 191 | 140 |
| G06Q 40/04 | 15 | 27 | 142 | 79 |
| G06Q 20/401 | 5 | 23 | 128 | 79 |
| H04L 9/0637 | 7 | 8 | 69 | 151 |
| G06Q2220/00 | 17 | 36 | 101 | 76 |
| H04L 9/30 | 3 | 17 | 61 | 102 |
| G06F 21/64 | 1 | 19 | 64 | 96 |
| G06Q 20/3678 | 25 | 29 | 70 | 51 |
| G06Q 20/36 | 23 | 32 | 61 | 56 |
| H04L 9/0643 | | 15 | 57 | 97 |
| G06Q 20/382 | 15 | 16 | 73 | 59 |
| G06Q 20/3825 | 12 | 13 | 63 | 67 |
| G06Q 20/389 | 4 | 6 | 77 | 64 |

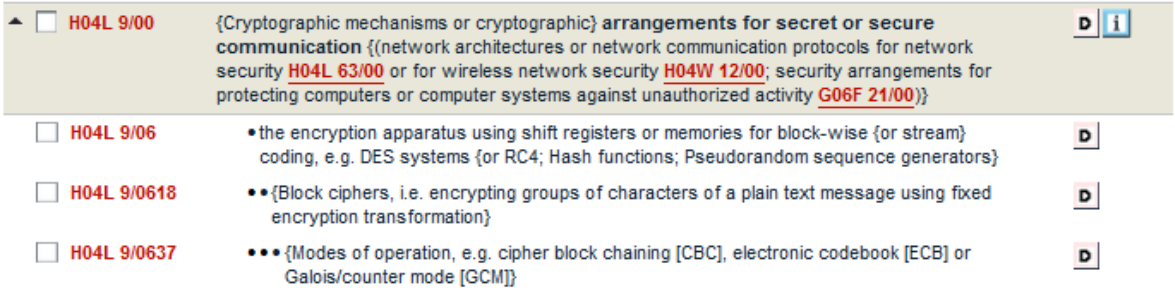



Figure 9: Evolution of CPCs over the years (above) and Classification H04L 9/00 on cryptographic mechanisms and H04L 9/0637 subclass (below) Source: Espacenet

## Final remarks

Protected technologies related to blockchain have been revised. Additional technologies, processes, or novel distributed transaction mechanisms essentially different from today's blockchain technologies are likely to be claimed and eventually gain momentum. Some of these may have fallen out of the scope of this study and would therefore require a broader scope of search or further analysis over time.

### Some references:


- Is blockchain about to become a patent war battleground? https://cointelegraph.com/news/is-blockchain-about-to-become-a-patent-war-battleground

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