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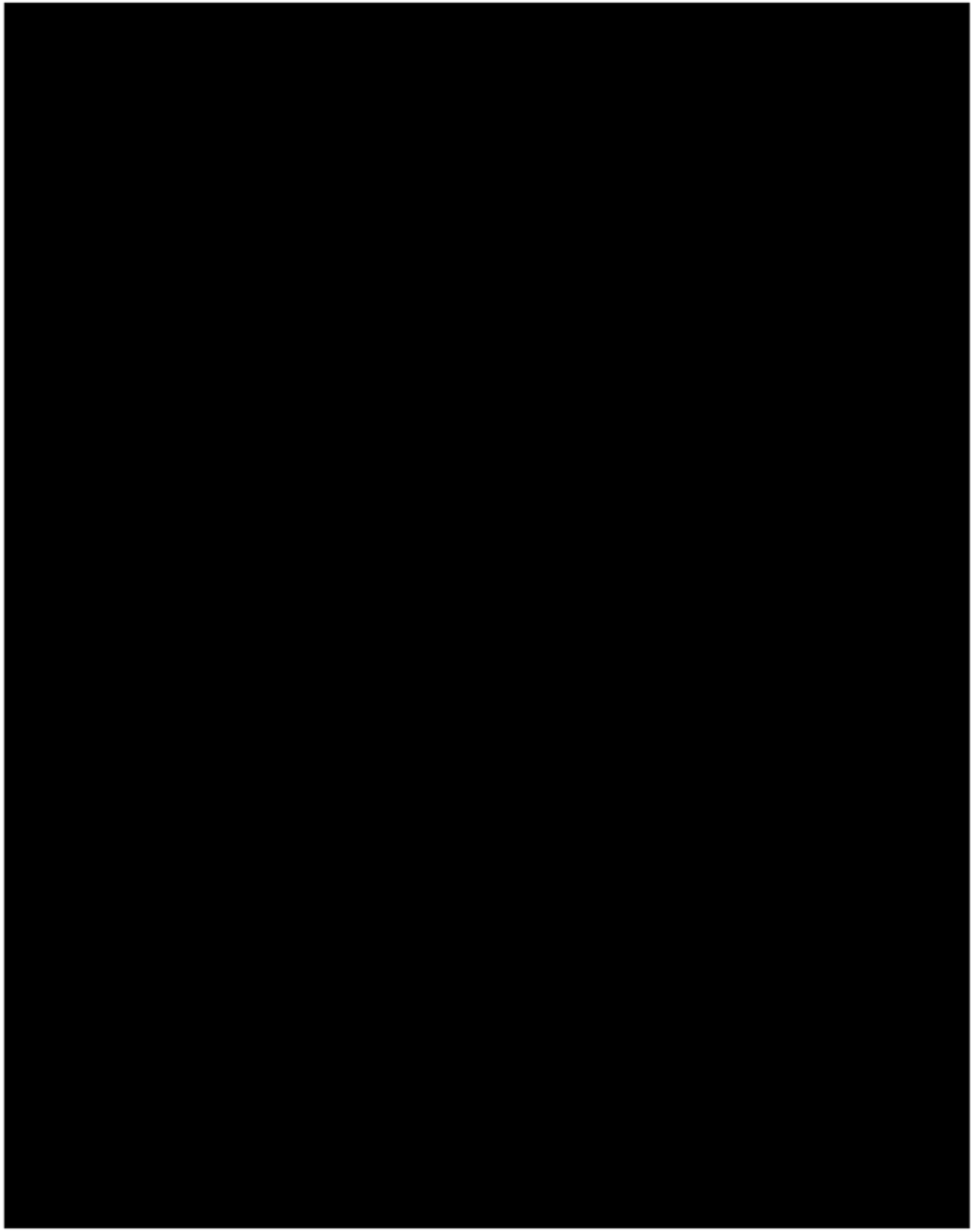
BLOCKCHAIN TECHNOLOGY

State-of-the-art & Key Insights



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INTRODUCTION

Dear Friends, we are glad to present a Blockchain technology (BT) patent landscape report. This report was prepared by #ProjectOfficeFIPS, the dedicated consulting unit of the Russian Patent Office.

It is with great pleasure that #ProjectOfficeFIPS acknowledges and expresses its sincere gratitude to Blockchain Competency Center of Vnesheconombank for their valuable expertise, cooperation, and support.
BT today is a truly cutting-edge, breakthrough technology demonstrating its sky's limit potential for bringing new ways of doing business to the global economics.

Our patent landscape allows one to benefit from a complex view based on different sources of information: global patent trends, key BT markets, trends, and players, ***i.e.***, innovative technologies, investors, participant companies, inventors, prospective blockchain business applications ***etc.*** Specially focused on the most typical BT segments, the report sheds the light on distributed ledgers, smart contracts, mining, consensus algorithms, and crypto-currencies.

At first, answering to strategic "What is happening?", we conclude the report with very practical "What should be done?". To our sincere belief, the present review contains a lot of valuable information on the BT scope: the most promising technologies, worldwide owners of key BT-related applications, and open BT patenting areas for Russian companies.

The report presents BT patent holders of leading countries as well as a list of (certified for BT) patent counsels and lawyers working in the aforesaid countries.

To conclude this short preamble, we would like to once again express our hope that Russian companies interested in stepping into this emerging, challenging, and commercially attractive BT market, will find the present patent landscape a useful guide and roadmap for their own blockchain business growth.

Grigory Ivliev
Head of Federal Service for Intellectual Property

Vladimir Dyomin
Chairman of the Management Board of the Vnesheconombank Blockchain Competency Center

Oleg Ena
Advisor to Director of Federal Institute of Industrial Property, Director of the Project Office

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GENERAL INFORMATION

BLOCKCHAIN TECHNOLOGY HISTORY

Blockchain (a chain of blocks) technology (BT) first appeared on the stage in 2008 as an underlying Bitcoin (BTC) technology. Invented by Satoshi Nakamoto (or group of people under this nickname) to serve as the public transaction ledger, this invention actually made BTC the first digital currency to solve the double-spending problem without the need of a trusted authority or central server. The bitcoin design has inspired other applications in the next few years.

BT drastically changes business operation conditions in industry:

8 % of 3000 organizations polled across the world changed to either pilot or production implementation stage of BT-related projects.
25 % of respondents are considering BT implementation within 12 months.
The respondents are financial companies (33 %), government institutions (29 %), and public health service (27 %).

Kyriacos Kokkins
IBM Managing Director,
BM Europe partner

Blockchain is definitely considered to be a new technological paradigm. BT combines several conceptually different ideas as distributed data storage ledgers, consensus algorithms and cryptographic data protection methods etc. Many BT aspects were previously discussed and promoted as separate solutions in technological community.

Basically, Blockchain is data storage logics, which is independent of a central server or group of servers.

BT actually creates and maintains list of structured records, ***a.k.a.***, blocks. Each block contains a timestamp and (which is of critical importance!) unique hash of the previous block, thus, the technology links the said data blocks thus totally eliminating any chance of changing data contained in the blocks already created without changing an entire sequence, the chain.

Due to unique combination of implemented technologies, BT reveals its remarkable and attractive openness, storage data consistency, and, consequently, the possibility of using in decentralized network of executable logic. All these aspects make BT an interesting and promising technology.

OPENNESS AND GUARANTEED CONSISTENCY OF STORED DATA – KEY FEATURES OF BLOCKCHAIN TECHNOLOGY

Taking into account key BT features, the technology is able to exclude an "excess chain element", the arbitrator, in an overwhelming majority of business processes; and finally assume the roles traditionally significant in the financial services.

Signing "smart contracts" based on decentralized executable logic can be proliferated out of the Finance scope as well. Contracts parameterized with external data sources (stock prices, weather reports, news headlines) and certified by electronic signatures may drastically change classical business process approach. BT is also applicable for voter-fraud-protected polling systems, reliable data history ledgers and so on.

However, being under great impression of BT advantages, nobody can think of this emerging technology as a panacea for solving any problems. Say, BT implementations of consensus algorithms, high performance calculations, and distributed data storage are often suffering from slow transaction processing.

Therefore, when developing a BT-based information platform, one must clearly understand both scope of problems to address as well as optimization benefits to achieve, ***i.e.***, all pros and cons of BT implementation in this or that particular case.

De Beers Group announced development of the first BT-related project. The solution covers the whole diamond treatment lifecycle and generates a digital (token) record for each diamond registered in the system.

BT MARKET FORECASTS

As per marketing agencies, global investments in BT will reach 9, 7 billion USD by 2021. The market size is estimated based on expected revenues from implementing BT solutions and provisioning BT-based services. An average annual growth rate (CAGR) until 2022 is predicted within the range of 79,6 % to 81,2 %[1], except breakthrough BT growth expected in several countries and regions, e.g., Japan — 127,3 %, Latin America — 152,5 %[1,2].

IN 2021 BT-RELATED INVESTMENTS WILL REACH $9,7 BLN BY 2021

THE LEADING INDUSTRIES BY BT-RELATED INVESTMENTS: FINANCE, TRANSPORT, LOGISTICS, AND PRODUCTION

Amongst the most invest-consuming BT market segments in 2018 are: finance (745 bln. USD); transport and logistics (510 bln. USD), production and resources (448 bln. USD). Besides, in a short-term prospective, highly probable is the growth of BT-related investments in energetics, public health, government, education, media, and internet trading, tourism, and hospitality industry.

The future mainstream of R&D of BT applications is related to payment transactions and digital identification due to increasing demand for international online-payments and wide variety of cloud services[3]. The prevailed scope of future BT applications are supply management (pharmacy, motor industry ***etc.***), intelligent transport systems and logistics, energy distribution systems, document management systems based on distributed ledgers.

1 Blockchain Market by Provider, Application (Payments, Exchanges, Smart Contracts, Documentation, Digital Identity, Supply Chain Management, and GRC Management), Organization Size, Industry Vertical, and Region — Global Forecast to 2022, as per MarketsandMarkets: https://www.marketsandmarkets.com/Market-Reports/blockchain-technology- market-90100890.html (2017)

2 Blockchain Market by Provider, Application (Payments, Exchanges, Smart Contracts, Documentation, Digital Identity, Supply Chain Management, and GRC Management), Organization Size, Industry Vertical, and Region — Global Forecast to 2022, as per MarketsandMarkets: https://www.marketsandmarkets.com/Market-Reports/blockchain-technology- market-90100890.html (2017)

3 New IDC Spending Guide Sees Worldwide Blockchain Spending Growing to $9.7 Billion in 2021, as per International Data Corporation: https://www.idc.com/getdoc. jsp?containerId=prUS43526618 (2018)

Bank of America and Microsoft announced their intention to create a new BT-based system aimed at accelerating and cheapening payment transactions between these two giants.

The BT market ecosystem comprises technology suppliers, blockchain application developers, network and system integrators, cryptocurrency emitters and marketplaces. The BT service provisioning mechanism (mostly applicable to small and medium business) will be following the BaaS (Blockchain-as-a-Service) paradigm.

As main growth drivers one can consider: increasing demand for business process facilitation, low transaction costs, transparency, continuity, high speed, peer-to-peer interaction of participants, almost unlimited number of usage scenarios in any branches. Distributed ledgers will soon become a key element of technological and operational infrastructure of companies and organizations. A drastic increase in number of projects supported by Government institutions and corporations is another key BT applications growth factor.

Cameron and Tyler Winklevoss (mostly known for their claim against Mark Zuckerberg, on May 8, 2018) were granted another cryptocurrency (6th in a row within last six months) patent (US09965805) for stock exchange trade systems. Two remarkable points worth mentioned: the speed of the patent's granting (filed on December 19th, 2017) and negative position of US Securities and Exchange Commission with regard to cryptocurrency-based exchange traded funds (ETF).

The main reasons preventing active proliferation of BT-based products and services are lack of government regulations, low trust in BT transactions and scalability of this technology assuming huge data size involved in blockchain transactions. Countries have just come to realize significance and challenges of the BT industry, and to prepare and issue initial regulatory documents. In addition, it should be noted that different countries sometimes manifest polar views and approaches: from flexible regulation (Japan, Switzerland) to rigid (USA) methods.

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ANALYSIS
“AT A GLANCE”

THE METHODOLOGY

The analytical materials provided in the present report are based on patent information retrieved from filed patent applications and patents granted and published by patent institutions worldwide.

PATENT INFORMATION IS THE BEST SOURCE FOR BUSINESS DOMAIN ANALYSIS

The patent information is a very valuable and reliable information source for understanding current technology trends and thus predicting marketing tendencies and roadmaps as well. Several key and sometimes unique features of patent documents are presented below.

First of all, this is a mandatory technological disclosure level. To pass the expertise evaluation and certification procedure, a patent application must contain much more detailed technical description of the proposed innovative technology and/or product than any scientific publications and descriptions available on public Internet.

Another important feature of patent information is patent costs. The high costs of patent protection, in their essence, means the fact, that the more money a company invests in patenting this particular technology/product, the more valuable the said innovation for the company is. Therefore, the detailed analysis of companies' expenditures spent for patenting allows one to understand business strategies of key market players and to estimate prospective commercial trends and benefits.

Being open, well-structured, unified and standardized at the same time, patent information becomes the most important and universal asset for analysis of modern technologies.

In the present report, a patent family was chosen as a least reference unit.

PATENT FAMILIES ALLOWS FOR ANALYSING ONE INVENTION ONLY ONCE

The patent family comprises all patent publications related to the same invention. Patent families have several useful properties: they prevent duplication of records, dismantle language barriers, specify the invention's geography, and disclose technology trends.

Generally, a patent priority date was taken as a reference date while performing the present analysis, provided no other date reported explicitly.

THE PRIORITY IS THE FIRST FILED APPLICATION OF THE PATENT FAMILY

The "priority" is the initial application for an invention filed by an applicant to one of the national patent offices. According to patent analysis principles, the dynamics of priorities directly correlate with current state-of-the-art and evolution of scientific, research and development in the patent invention field being analysed. Regarding BT-related patent documents, selecting the priority date as a fundamental measure of the time analysis enables us to focus on technical aspects correlated with appearance and growth of BT R&D centres.

INCREASING NUMBER OF PRIORITIES MEANS ACTIVATION OF R&D WORKS IN THE DOMAIN

In the present review, priorities are often compared with patent applications. An increasing number of patent applications of the same patent family normally witness the growing interest of companies in expansion of their technologies into new markets.

THE ACCURACY OF SEARCH IS GUARANTEED BY THE BEST INFORMATION SYSTEMS USED

While preparing this report, the following sources of information, professional search engines and analytical systems have been widely used: Questel Orbit, LexisNexis PatentStrategies, Relecura, and Derwent Innovation. By combining unique analytical and searching capabilities of the said systems, we reach the broadest possible coverage and depth of analysis.

Based on patent search requests, the collection of **1804** patent families has finally been retrieved, actual as of **May 20th, 2018.**

BT MODEL

To conduct the more detailed analysis of the blockchain domain, it is worth dividing it into several technological segments, and then studying the patent documents of each segment separately:

Distributed ledgers

Distributed ledgers (DLs) represent one of the key BT segments, which is a dynamically distributed data storage. Due to its unique functionality, distributed ledgers go far beyond the limits of ordinary ledgers, ***e.g.***, paper accounting ledgers or centralized databases.

The essence of the DLs is a principally new level of storage data reliability, consistency achieved.

Walmart has filed an application for a BT solution that allows drones to reach Customers' houses while delivering ordered goods and to perform tracing and identification of the said goods as well.

The logic specification represents a truly revolutionary method of collecting and storing data. The approach is applicable either to static (ledgers) or dynamic (transactions) data. The DLs and proposed consensus algorithms allow users to focus on / benefit from new capabilities of data search and usage.

Consensus algorithms

A consensus is a process of making decision by a group, which participants mutually agreed to support a decision meeting the needs of the whole group, which means unanimous consent and solidarity. The distributed consensus problem is not specific for BT, and has been successfully implemented using other distributed systems, say, databases. The problem of distributed consensus for a group, which participants could behave incorrectly, ***a.k.a***, the Byzantine consensus problem, was first formulated in 1980s and solved in late 1990s.

The consensus in terms of BT logic differs from previous solutions in the network operation mode. The classic consensus algorithms use "identities" (certified by digital signatures) assigned to network nodes; and the node list is either pre-defined or subjected to minor changes; BT-related consensus algorithms apply exactly the vice-versa approach.

Among several consensus algorithms proposed, the following two are predominant: PoW (based on Proof-of-Work) and PoS (based on Proof-of-Stake), which make the basis for public (open) Blockchain systems, ***e.g.***, cryptocurrencies. On the other hand, the PoA (Proof-of-Authority) algorithm, which is very close to the Byzantic consensus solution, is typical of the "closed" systems.

Based on blockchain logic implementation, all BT solutions are divided into open and closed infrastructures. For automation of ledgers and systems storing sensitive data the closed (private) blockchaines are recommended. In private blockchains, a new block creation is allowed for a limited number of participants granted a corresponding record creation right. The rules and conditions of the record creation are validated by the whole network based on info published in the said decentralized network. The other participants are granted just read-only privileges for monitoring and auditing purposes.

Ford Global Technologies, LLC has been granted a patent for BT car communication solution for avoiding traffic jams and coordinating vehicle speeds. The solution motivates cooperation of drivers and thus moves the focus from individual preferences to their mutual coordination.

The private blockchains have certain advantages; and the first of them is network speed, which is much higher than the same parameter of public blockhains; due to the fact that private blockchain block creation requires no time-consuming calculations. The second benefit of a private blockchain lies in its ability to grow the network functionality (with new business processes) in a very fast and reliable manner. The closed blockchain creates manageable and predictable environment, which is mostly attractive for institutions operating specialized ledgers and accounting systems in the day-to-day business activity.

Cryptocurrencies

This segment is definitely of prime importance at the moment assuming great public attention and as well as increasing cryptocurrency market capitalization.

Cryptocurrency (BTC) is a digital currency, which creation and control are based on cryptographical methods. As a rule, the accounting of cryptocurrencies is decentralized. BT represents one of technologies; the cryptocurrency functionality can be implemented on. Generally, cryptocurrency transactions are not ciphered and publicly available. The cryptography elements, ***i.e.***, public-key digital signature, sequential hashing, provide consistency of the transactions block chain.

Mining

Mining, the most substantive BT element, is in charge of maintenance of the distributed platform and new block creation activity to be rewarded with new criptocurrency units and commissions.

The calculations are required for protection against double spending of the same units; and the reward inspires people to spend their computational resources and support the networks. The mining algorithm is aimed at deriving a unique hash value, the block ID, to be inherited by the next block (as its part) thus continuing a consistent BTC chain.

Mining hardware

HW/SW resources involved in hash calculations are reasonably considered as an independent segment of the BT domain model. Since a few years ago cryptocurrency could be mined using ordinary PC, this way of making money soon led to appearance of miners who literally flood over Internet. Increased competition promoted the invention of hardware specially targeted to mining these virtual coins in greater amounts.

KODAK has developed BT-based image property rights management platform.
Here, the smart contracts are first used for management of intellectual property rights.
A great variety of markers and certificates could be "embedded" into the BT-based solutions. The smart contracts coupled with modern tracking opportunities can initiate execution of various cases, make real-time payments, notify of counterfeit or fraud usage.

Smart contracts

A smart contract is the computer algorithm allows for creating, signing, and executing BT-based contracts. The smart contracts became a new logical step in BT applications, manifesting great BT opportunities for business process automation.

It is believed that many types of smart contracts could be implemented (partially or in whole) as self-executable and self-contained BT algorithms. The cryptography-based smart contracts bring uncompromising safety comparing to ordinary ones, they reduce transaction and time costs related to contract administration.

According t TheEconomist[4], magazine, smart contracts have a good chance to become the most important application of blockchain technology pretty soon.

[4] From concept to reality: How blockchain will reshape the financial services industry, as per the Economist: http://perspectives.eiu.com/financial-services/concept-reality-how-blockchain-will-reshape-financial-services-industry (2017)

3

MODERN TRENDS

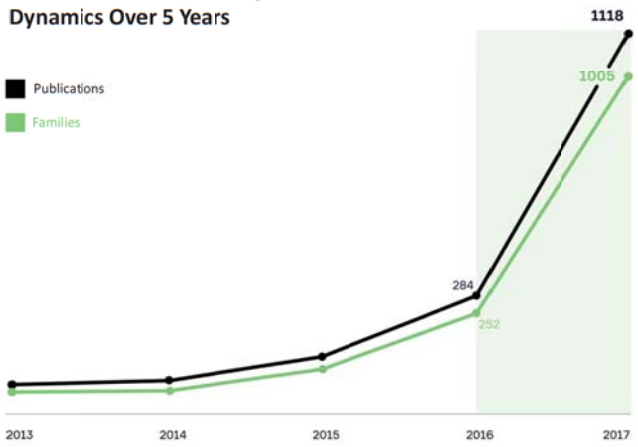
The global trends in BT patenting over the past 5 years have been reflected in 2565 patent documents as per analysis performed. These publications are grouped into 1804 patent families, of them 184 patents granted; and the other documents are pending or refused.

Comparing number of publications against number of patent families is a very representative trend analysis method, since it allows estimating overall patenting growth rates both in the context of the R&D growth (increase in families) and growth of interest in acquiring new markets (increase in publications).

Figure 1. shows evolution in number of BT-related patent families and publications during the last five years. The patent document publication date of is used as a time reference.

Figure 1

BT Domain Patent Activity Dynamics Over 5 Years



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Over the last 5 years:

2565
publications

1804
patent families

Analysis of the patent collection reveals no activity until 2013; followed by the slight growth since 2014. The real "golden rush" start is attributed to 2016, when over 200 new patent families are observed.

That the number of publications slightly dominates the same of patent families characterizes sustainable growth of R&D activity in the BT domain and still limited number of patenting countries.

In 2017, the observed growing gap between number of publications and number of patent families manifests appearance of many technical solutions with a high commercial potential, when applicants are less focused on development of new solutions, in favour of the proliferation of their technologies elsewhere around the world.

PATENT ACTIVITY INCREASED FOUR TIMES WITHIN A YEAR

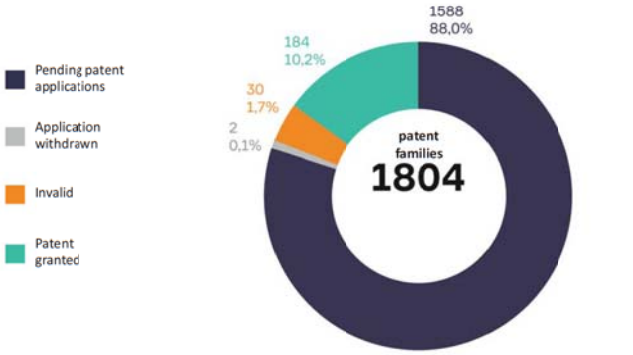
This strategy is typical of the domain development onset, when a company (organization) mostly focuses on setting its priorities for further commercialization.

BT PATENTS ARE GRANTED FASTER COMPARING TO OTHER BREAKTHROUGH TECHNOLOGIES

Despite the short patenting period of blockchain technologies, the percentage of granted patents (>10 %) is rather high. Assuming that over 75 % of patent documents were published after 2015 as well as a long application validation period, ***e.g.***, about two years[5] in EPO and up to several years in USA, the said elevated number of patents granted witnesses for maturity and significance of blockchain technologies. The medium term for validation of BT-related applications equals 12 months.

Figure 2

Legal Statuses of Patent Documents



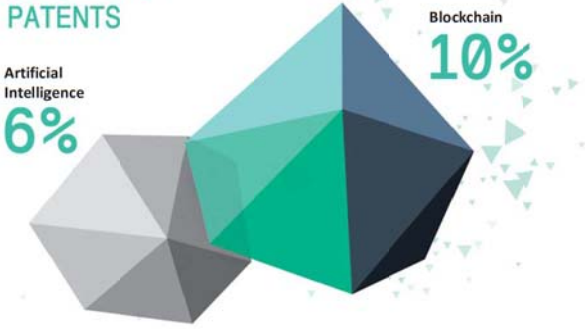
5 http://www.epo.org/about-us/annual-reports-statistics/annual-report/2017/statistics/searches. html#tab5

Top companies seeking for the quickest possible acquisition of patents and make considerable efforts for elaboration of patent specifications of technology, engage more expensive experts and patent attorneys. This confirms maturity of technology (it is easier to validate), as well as its good commercial prospects (companies are readily investing more and more resources into BT-related patenting).

The distribution of value (power) of patent documents adequately characterises both maturity and commercial prospects.

Figure 3 depicting the said power distribution, reveals a peak at '70–80' units of power, that contributes much greater number of valuable patents for the BT domain in favour of others.

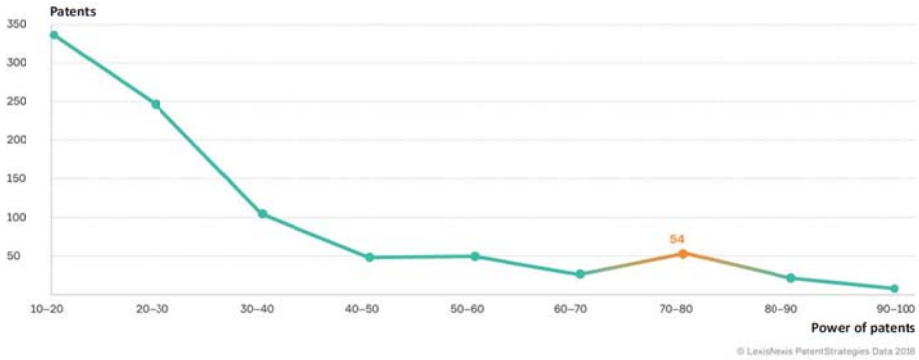
PERCENTAGE OF STRONG PATENTS



"Power" of patent is the complex index derived from several indicators: patent lifetime, geographical scope of family, patent citation, licenses and/or litigations on family documents, patent claim rights declared etc

Patent Value (Power) Distribution

Figure 3



To identify key BT-related segments, textual analysis of patent documents was carried out using the intellectual clusterization method.

Finally, the following 15 technological segments were identified as key ones:

Development and implementation of a prospective, emerging technology always cause legal formalities. By analyzing the ratios of granted patents to applications observed in the main technological segments of the collection, patenting trends can be identified, the main business targets of market participants revealed, and promising R&D roadmaps found. Fig. 4 presents information on applications filed and patents granted. It looks like the ratio of patents to applications remains stable for different segments. At the same time, the number of applications substantially prevails over the number of patents that is typical of the new domains. By means of applications filed well in advance, companies often secure for themselves prospective areas of protection, when they have no time to obtain patents or have no solutions ready for patenting, which is typical of the innovative domains as well.

Patents Granted vs. Publications Total

Figure 4

One cell contains from 1 to 3 documents

What clearly seen from the Fig.4 is predominance of the "Databases", "Distributed ledgers" and "Access/Encryption keys" segments, and more than one-third of all documents belong to the said areas. The second place holds the crypto-currency trend, the umbrella for "Cryptocurrencies", "Computing devices", and "Payment results". The "Access/Encryption keys" and "Distributed ledgers" segments are true leaders by patents granted, that allows considering them as fundamental BT cornerstones.

Another interesting segment depicted in Figure 4 is "Random numbers", which contains just one patent granted. One can consider this as the "youngest" technological domain, which technologies are not yet mature or applicable.

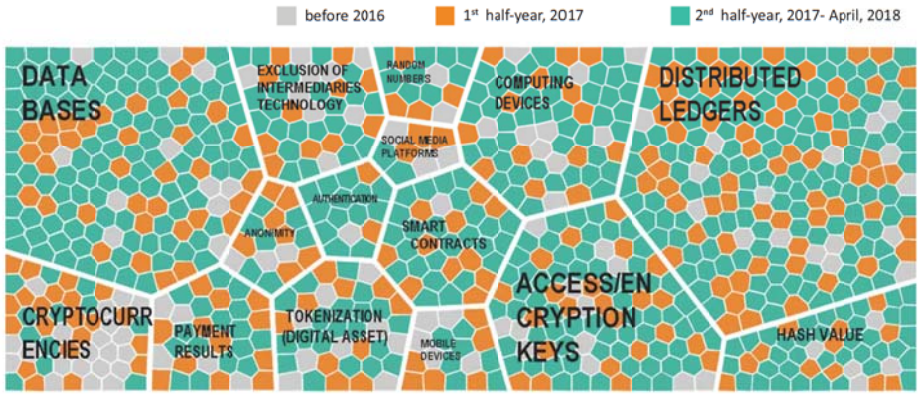
Of particular interest is the segment "Authentication", showing two patents granted. According to our analysis, the main focus here is on BT solutions implementing pass-through user authentication and transparent authentication history tracker.

A remarkable and interesting example is Patent # FR3049089, which describes a device that generates a pair of encryption keys using human biometric data (fingerprint etc.), and the former is then used by the device when signing data blocks.

The below time analysis is extremely important for understanding the technological progress rate and the top companies' focus evolution as well. Taking into account a short period of BT-related patenting and extremely high growth rates, it seems reasonable to perform the time analysis on the following periods: before 2016, inclusive; 1st half of 2017; and between 2nd half of 2017 and April 2018, inclusive.

Figure 5

Time Analysis of Three Periods



One cell contains from 1 to 3 documents

PatentStrategies 2018

The most developing segment is "Smart contracts". It looks like this subdomain contains the cutting-edge technical solutions; and it becomes a potential ground for technologic competition of the top companies.

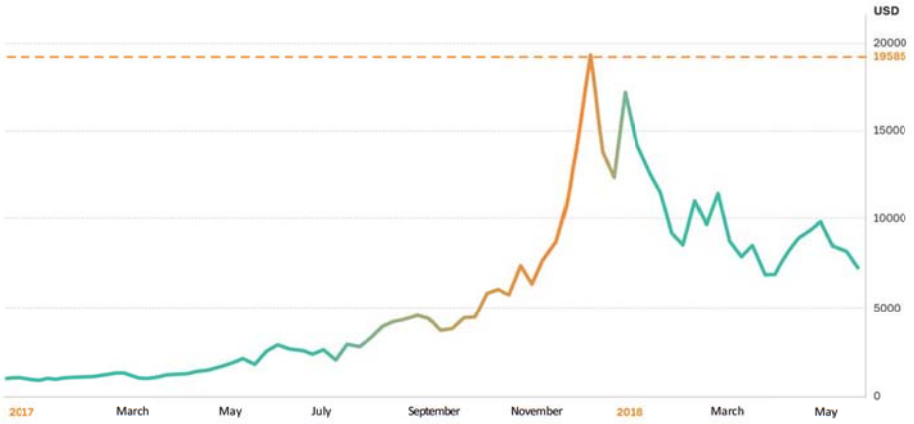
The majority of new patents in the "Cryptocurrency" and "Access/Encryption keys" segments are correlated with development of crypto-wallets and securing their safety. Another modern focus of patenting is seemingly in development of cryptocurrency exchanges.

It's worth paying attention to significant increase in the segment "Computing devices" activity observed in the 2nd half of 2017; which is related to devices and algorithms both aimed at cryptocurrency mining acceleration.

One may link these trends to explosive rise of bitcoin (BTC) at the end of 2018.

Bitcoin Price From 2017 to May, 2018

Figure 6



4

COMPANIES AND PEOPLE

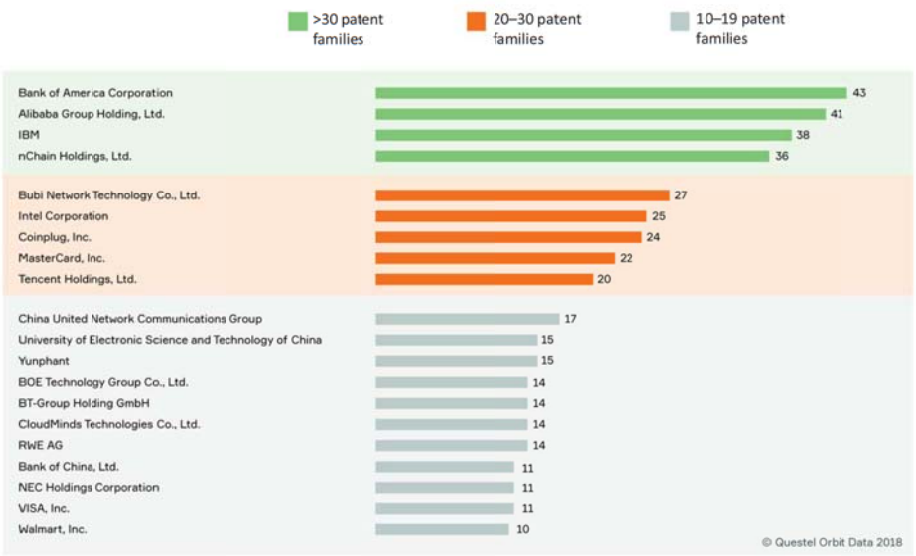
COMPANIES

LEADERS' PATENT PORTFOLIOS DO NOT EXCEED 50 BT PATENTS

When reviewing technology patents, analysis of activity of companies and authors of patent documents, allows one to identify stakeholders and key investors of the technologic domain in question.

Figure 7

Patent Families Owned by Top Technology



nChain
https://nchain.com/en/

- The 1st group is represented by multinational giants like Bank of America, Alibaba Group, and IBM, as well as relatively new nChain Holdings Limited (London) focused on BT development. The mission of nChain is lobbying BT, and supporting "Internet of transactions", where transactions and data of any type could be recorded and processed using blockchains.

- Further, in the descending order: BUBI Network Technology Company (China), Intel Corporation (USA), Coinplug Inc. (South Korea), Mastercard Inc. (USA), Tencent Holdings (China) and China United Network Communication Group (China). Thus, the top-list of BT leaders is dominated (5 of 10) by Chinese IT corporations, together with notable activity of huge American companies (3 of 10).

It should be noted, however, that in spite of presence of international stakeholders (Bank of America, Alibaba, IBM, Intel, Mastercard, Visa, ***etc.***) among key market players, the percentage of BT-related patents in their portfolio is rather low.

Therefore, it is of prime interest to analyse patent portfolios of companies, which main focus is on the blockchain technologies. In what follows, presented the patent portfolio structures of leading companies, which main activity is blockchain both in terms of technological development and in terms of positioning BT-based products and services within the company product lines. For each company, we provide both number of patent documents and tentative expenses (USD) to be spent on patent procedures and keeping the said patents in force.

Figure 8

Total expenditures
for the last 4 years:
805 997
USD

nChain: Estimated Patent Portfolio Value & Patenting Dynamics

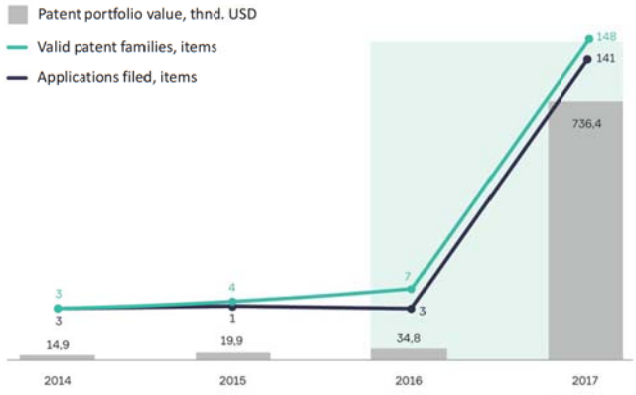


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Figure 9

Total expenditures
for the last 3 years:
309 967
USD

BUBI: Estimated Patent Portfolio Value & Patenting Dynamics

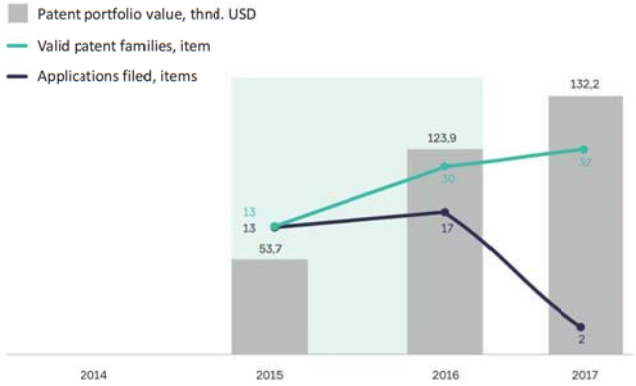

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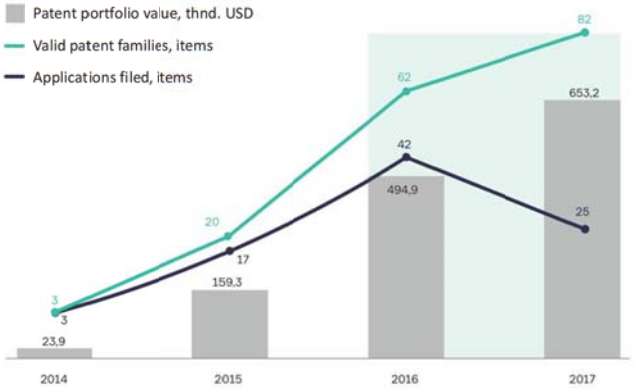
Figure 10

Coinplug Inc.: Estimated Patent Portfolio Value & Patenting Dynamics



Total expenditures
for the last 4 years
1 331 366
USD

© LexisNexis PatentStrategies Data 2018

Updating **all** the (applications and patents) documents filed on a regular basis should be noted. Besides, 2017 has also revealed decreasing number of applications filed.

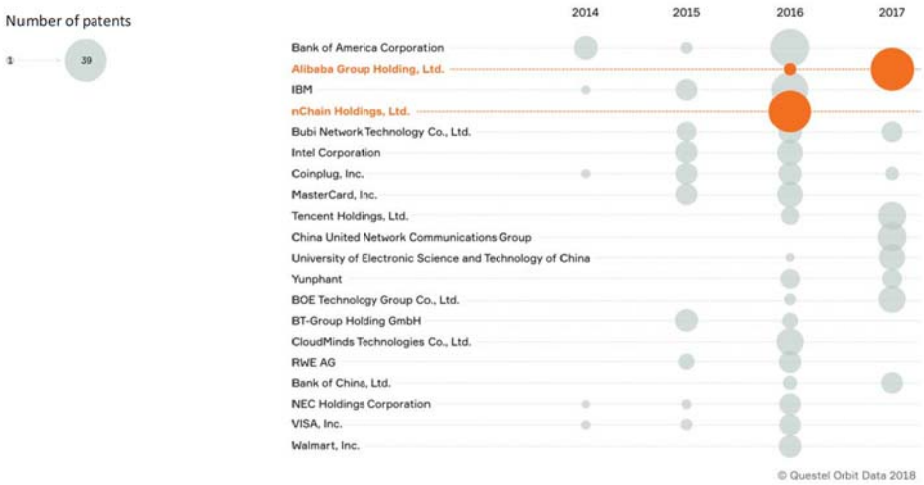
It can be assumed, that companies specializing in BT-related patenting are focused on keeping their current market positions, that consequently means that companies (from their PoV) have already protected their intellectual properties in the BT domains.

When studying business interests of leading companies, it is rather important to analyse distribution of publishing activity by time. This part of analysis shows the dynamics of top company appearance on the BT domain stage. Since the active BT-patenting history is less than five years old; the diagram of the above-mentioned dynamics is covering just 2014-2017 years:

ALIBABA AND NCHAIN BURST INTO BLOCKCHAIN MARKET

Figure 11

Business Interests of Top BT-Patenting Companies



Bank of America and IBM (USA) as well as Coinplug Inc. (South Korea) demonstrate their sustainable, steady business interest. By the way, their first applications were dated 2014 that make these publications BT-patenting cornerstones.

During the last two years, Alibaba Group is the most active player in the R&D field. No one patent document was published by the company until breakthrough in 2017 that allowed Alibaba Group to take the second place in the rating list of patent family owners.

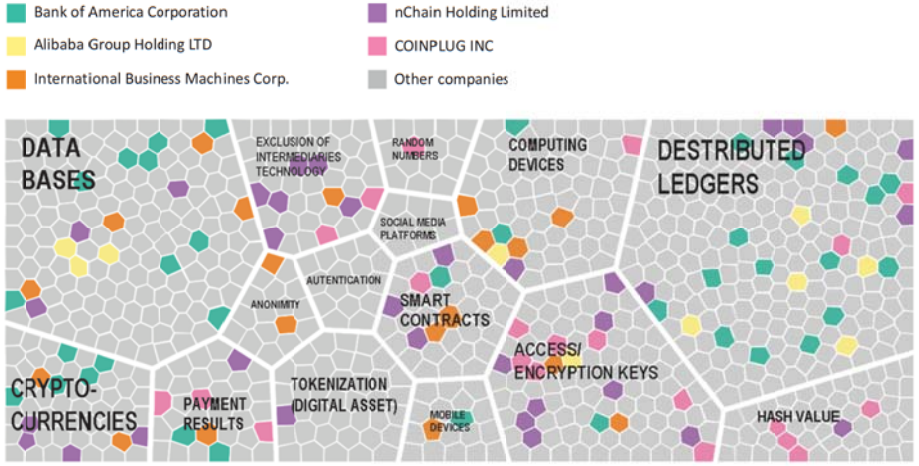
The analysis of Alibaba Group's patent portfolio demonstrated that the company pays great attention to patenting consensus algorithms and their applications. It's worth mentioning that earlier this BT-related segment was not attracting great attention of Internet trading giants.

To thoroughly analyse BT-related patent landscape is rather important to find high competition segments of top-companies and highly probable monopolization domains.

Then, presence of the top five companies in the main BT-related patent collections has been analysed. By comparing the leaders against key technological segments of the domain model allows us to find shared markets, estimate innovation potential, and understand correlation of business interests of top companies.

Top Five Companies Presented in BT-Related Patent Collections

Figure 12



Одна ячейка содержит от 1-го до 3-х документов

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As can be seen, there exist no companies, which R&D activity is focused strictly on a single technical segment or which dominant position in a specific segment is clearly evident. On the contrary, the R&D activity distribution of key companies is almost homogeneous. However, several specific trends in their activity can be tracked.

Bank of America, in the same manner as Chinese Alibaba, pays great attention to the "Distributed ledgers" and "Databases" segments. In addition, many patent publications are related to "Cryptocurrencies".

NCHAIN ANNOUNCES ITS INTERESTS IN ALL BT TRENDS

The biggest American IT-company, IBM is mostly represented by R&D in the "Databases" and "Computing devices" technological segments.

The widest technological scope is covered by nChain. The company presented within almost all BT-related patenting areas, has a broad BT-related product line.

A special attention should be paid to the "Social media platforms", "Authentication", and "Tokenization" segments, where no patent documents of industry leaders presented. Let's focus on the "Tokenization" segment now.

Tokenization is the process of converting rights to real world assets into a digital token on a blockchain. The correct association of physical assets with a digital token is a very important aspect; the BT community is focused on.

There are lots of different assets: stocks, real estate, gold, petrol. The most of them are not transportable; thus, customers and vendors prefer to deal with documents certifying the assets. However, this process is not easily-tractable. The one of possible solutions is using to digital coin, i.e., token, which is similar in its meaning to crypto-currencies, but bound to particular asset.

There are many ways of depositing physical assets into blockchain. The task is to provide safety, security, speed and simplicity of transfer of tokens bound to physical assets. It's actually a new life of the old securitization model (transfer of assets into securities), or, in several cases, tokenization of securitized assets.

CITATION DATA IS GENERATED FROM SEARCH REPORTS (PREPARED BY STATE PATENT EXPERTS), THUS THE DATA IS INDEPENDENT AND OFFICIAL

The special place in the patent landscape belongs to citation analysis, which is addressed to several key tasks of the present report.

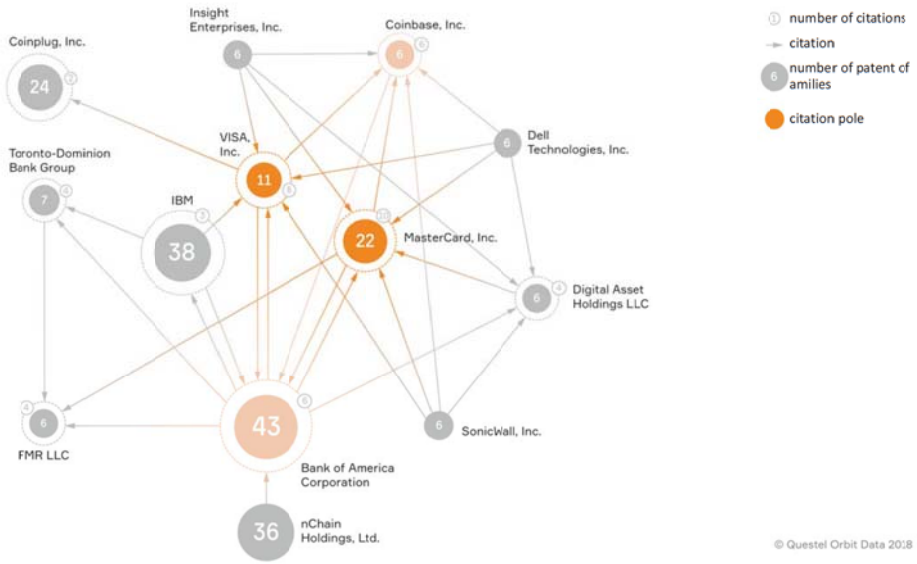
The first task of citation analysis is finding (within a patent collection) cooperative relations and basic technologies used by companies in BT development. Accordingly, the chart of citation is plotted, where the citation objects are BT-patent owner companies.

Two citation poles in this chart are Visa Incorporated and MasterCard Incorporated. In the first case, Visa technologies are often referenced by companies that can witness of Visa's ownership of basic BT technologies and/or unified BT implementation methods in certain domains. The in-depth analysis of patent documents showed that Visa is mostly focused on patenting of specific BT applications related to its main activity, the e-payment operations.

The incorporation of blockchain technologies while patenting solutions and methods finally caused avalanche of citations on Visa patents when preparing new applications.

Citation of IPR Holders

Figure 13



Another important aspect of the citation analysis is the studying of predecessor technologies and correlated technologies of companies, which did not explicitly announce BT-related targets, but, however, are developing solutions used by other companies in the BT development.

THE MAIN BT-RELATED CITATION POLES ARE VISA AND MASTERCARD

The finding of most cited patents allows tracing roots of the blockchain technology. Since BT is an emerging and innovative trend, it seems rather interesting to find and identify the predecessor, analogous, and correlated R&D works. Figure 14 shows rating of documents, which technical solutions are the most often referenced by BT developers.

Figure 14

Most Cited Documents Rating

Publication #	Invention	Patentee	# of Citations
US20160012465A1	System and method for distributing, receiving, and using funds or credits and apparatus thereof	SHARP INTELLECTUAL ASSET HOLDINGS, LLC	82
US20150379510A1	Method and system to use a block chain infrastructure and Smart Contracts to monetize data transactions involving changes to data included into a data supply chain	SMITH STANLEY BENJAMIN	25
US9129266B2	Automated schedule systems and methods	NAGARAJ SHARAT	22
US9569771B2	Method and system for storage and retrieval of blockchain blocks using galois fieldse	LESAVICH STEPHEN LESAVICH ZACHARY C	14

The most cited (80+ references) document found is US20160012465 "System and method for distributing, receiving, and using funds or credits and apparatus thereof" of Sharp Intellectual Asset Holdings, LLC. The document describes the technology of recording data objects in chains, which is a constituent element of BT, but contains no concepts of DLs and consensus algorithms, that doesn't allow to associate these works to the BT domain.

Patent citation is one of the key indicators in estimating patent value (power) as well as patenting jurisdictions, co-authors of patent documents etc. Figure 15 tabulates four most valuable patent documents of the BT domain. Both number of citations and patent power rating are reported for each document.

Figure 15

Publication#	Invention	Author(s)	Patentee	Filed on	Patent Power Rating	# of following citations
US9876775B2	Generalized entity network translation (GENT)	Timothy Mossbarger	Ent Technologies INC	2015-03-27	4.5	31
US9569771B2	Method and system for storage and retrieval of blockchain blocks using galois fields	Stephen Lesavich, Zachary C. Lesavich	Lesavich Stephen, Lesavich Zachary C	2016-06-06	4.0	14
US20150332283A1	Healthcare transaction validation via blockchain proof-of-work, systems and methods	Nicholas J. Witchey	Nant Holdings IP LLC	2015-05-13	4.0	43
US20150379510A1	Method and system to use a block chain infrastructure and Smart Contracts to monetize data transactions involving changes to data included into a data supply chain.	Stanley Benjamin Smith	Smith Stanley Benjamin	2015-09-13	4.0	25

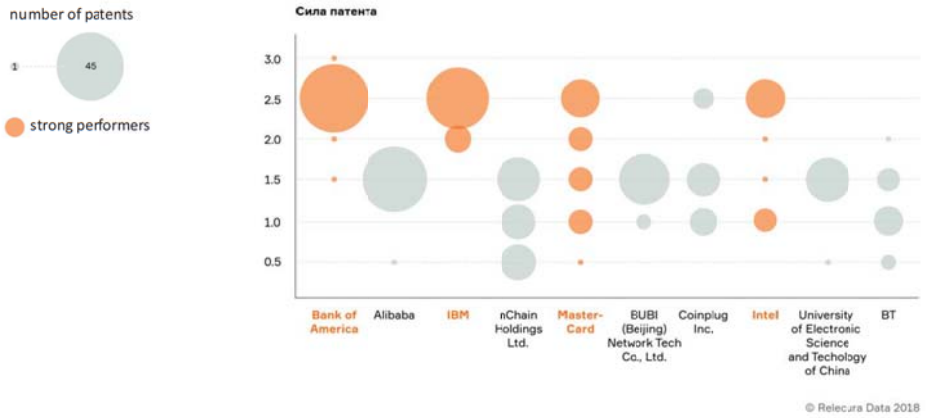
The more sophisticated analysis of patent document values allows to detect concentrating the most valuable patents in giant companies (Bank of America, IBM, Mastercard, Intel) due to widespread umbrella protection strategies of big corporations, these strategies are aimed to both proliferating into majority of countries and usage of filed and granted technical solutions in the wide interdisciplinary range.

THE GIANT CORPORATIONS ANNOUNCE UMBRELLA CROSS-DISCIPLINARY BT-RELATED TECHNICAL SOLUTIONS

At the same time, low portion of patent documents owned by companies predominantly focused on BT, reveals limited capacities of small companies in patenting at several jurisdictions and including in their patents many rights defined by the patent claims

Figure 16

Patent Document (Powers) Values



Since BT is an emerging domain with promising commercial future, it attracts business interest of major Hi-tech corporations and big investment funds as well.

The analysis of the BT patent landscape is aimed to searching for prospective ways of science and technology and business cooperation as well as to finding well-matured technologies that could be bought.

The concurrent analysis of patent portfolio and finance indicators is invaluable in finding companies, attractive for investments. Besides, the representation combining both number of patent families and annual revenues of companies enables one to make solid conclusions on which companies should be cooperated with, which ones could be bought or merged.

Figure 17 depicts corporations, the BT domain leaders, with highest annual revenues in red; and companies with relatively low revenues (mostly, start-ups, attractive for buying or acquisition) in grey.

Figure 17

Patent Portfolios & Finance Indicators of Companies

PEOPLE

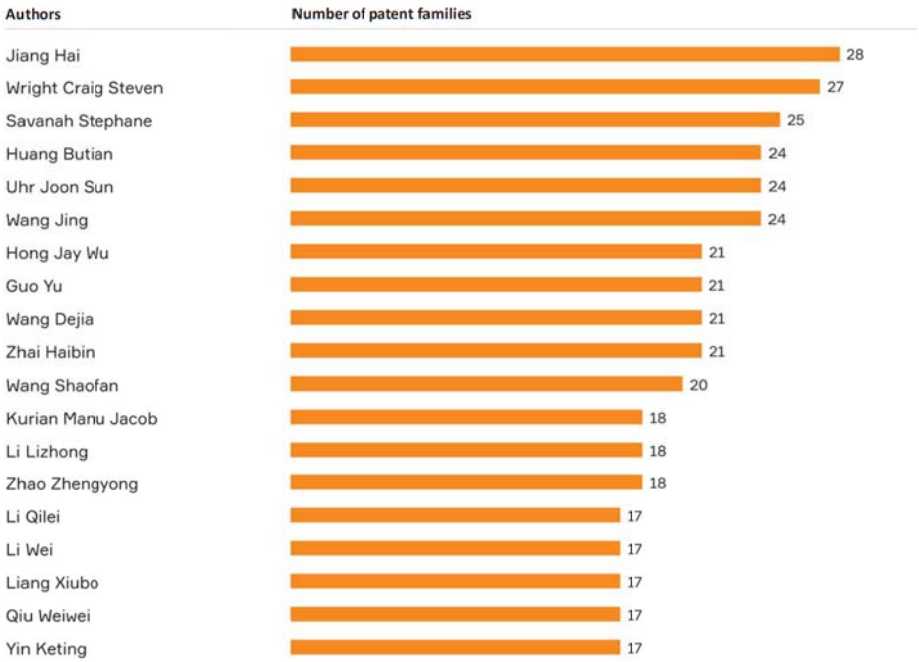
Another important task of the patent landscape analysis is finding leading inventors and developers, the patent authors, both in BT domain and in the neighbouring technical areas as well. This analysis allows comparing actual patent portfolios of companies against the existing scientific resource of companies; as well as to find key foreign developers for prospective scientific cooperation targeted at elaboration of R&D roadmaps and participation in BT-related events.

CHINESE AUTHORS CAPTURE 90 % OF BT INVENTORS RATING LIST

Figure 18 shows leading BT authors over the whole reference period.

Figure 18

BT-Patent Inventors Rating List



Questel Orbit Data 2018

Chinese inventors are dominating in the list. On the other hand, amongst the leading authors are the nChain employees, who are not only inventors but, at the same time, active scientific researchers having many publications on the BT subject.

Chinese inventors are dominating in the list. On the other hand, amongst the leading authors are the nChain employees, who are not only inventors but, at the same time, active scientific researchers having many publications on the BT subject.

Dr. Craig S. Wright is an Australian scientist and inventor, the Chief Researcher at nChain. Being one of the earliest BT and Bitcoin enthusiasts, Dr. Wright has decades of experience in the field of IT and information security. He is one of the best world-wide professionals in digital forensics. In the past, he was lecturer and researcher in Computer science at Charles Sturt University. He wrote many articles and books on IT, information security and cryptocurrencies.

At present, Dr. Wright is a popular public speaker of international level, presenting his scientific works at numerous fundamental and business conferences.

Stephane Savana is a well-known BT technical expert, researcher, and inventor of many Bitcoin-related solutions, the author of 57 patent applications in Great Britain (nChain Ltd is the patents' applicant). He has decades of experience in IT, SW development, infrastructure management, including such industries as finance (over 17 years), public health service, manufacturing, and government services. As a Scientific Director of nChain Ltd. he leads R&D of blockchain technologies. The majority of his R&D researches have became British and international patent applications. Stephane Savana was head of research departments at DeMorgan Ltd, JP Morgan, and Morgan Stanley.

Dr. Craig S. Wright

Australian scientist,
businessman and inventor

https://www.linkedin.com/in/craig-s-wright-609b80150/

Stephane Savana

BT Technical expert,
researcher and developer

https://www.linkedin.com/in/stephane-stef-savanah-2755306/

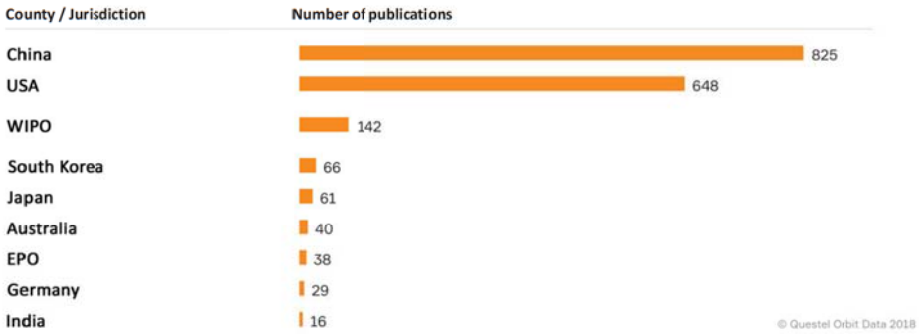
5

GEOGRAPHY

Figure 19

The analysis of territorial aspects of patenting is an integral part of patent analytics, which allows one to find countries, the BT patenting leaders, as well as countries attractive for top companies for patenting their BT solutions.

The rating list of leading countries in BT is the key analytical representation of the patenting geography.



China (CN) and (USA) take uncompromisingly leading positions by number of BT patent publications. The activity index pertaining to the BT domain in these countries is significantly greater than in others. The number of applications in USA and China is so high, that 80 % of the total pool of documents is related to these countries.

The number of applications filed under the Patent Cooperation Treaty (PCT) via WIPO (WO) offices is relatively high, however, the existing WIPO - USA gap is over 500 applications.

The three leaders are followed by Great Britain (GB), South Korea (KR), Japan (JP) and Australia (AU). In addition, one may mention activity (over 10 applications) of applicants from European Unione (EP), Germany (DE), India (IN), and France (FR).

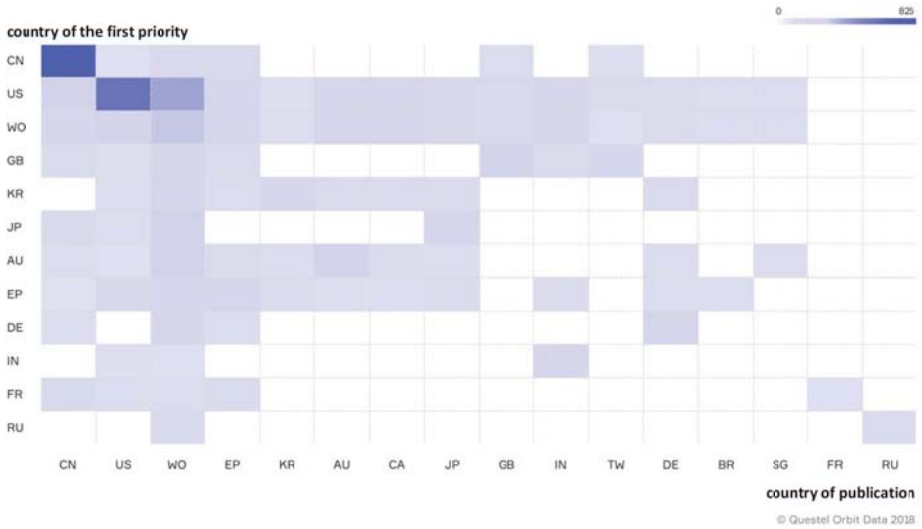
The country of publication of a patent document is basically used as the main indicator in the patent geography analysis. Another two parameters, the first filing country, which specifies the place of origin of an invention, and the second and following filing country (ies) point(s) at prospective markets.

The Offices of first filing are countries, where R&D in the reviewed domain has been performed and the first application filed. As a rule, they coincide with the applicant's residence. The Offices of the second and the following filings are related to the prospective product markets. Besides, the applicant can have in mind limiting the competitors' freedom on the said markets.

In what follows, the distribution of the first filing offices vs. the second and following filing Offices is shown.

The 1st Filling Offices *vs.* The 2nd and Following Filing Offices

Figure 20



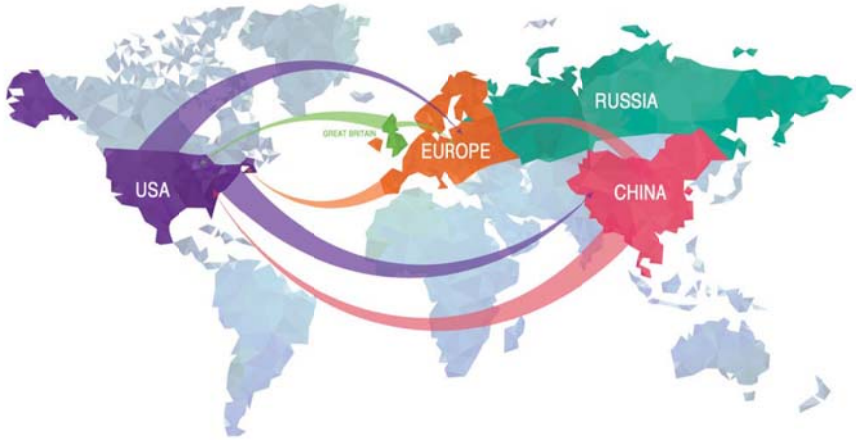
USA SECURES ITS MARKETPLACES IN MORE THAN 20 COUNTRIES

USA and China occupy two positions by number of proprietary BT solutions; they demonstrate the highest index of national applications. The widest territorial coverage belongs to USA, which applications are filed in 24 jurisdictions, Australia (18 jurisdictions) and South Korea (16 jurisdictions). As a rule, applications of the second and the following publications are subjected to the (PCT) procedure of international patenting (WO). This actually manifests the companies' interest in entering into the international market.

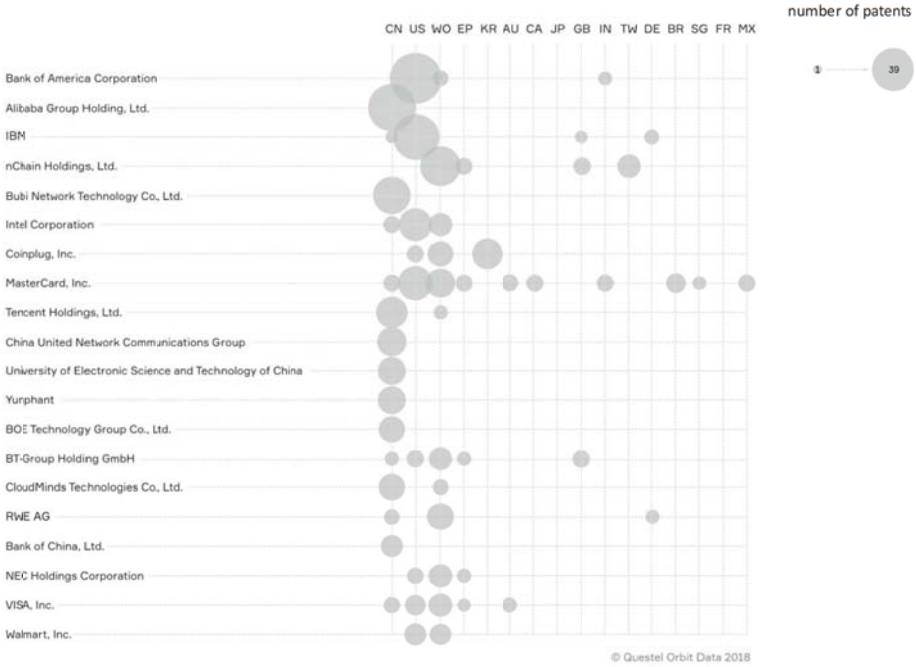
CHINA IS FOCUSED ON THE DOMESTIC MARKET

China, the BT leader, is not normally patenting outside the country. Its territorial coverage is represented by only 6 countries, and the main portion (90%) of application remains domestic. This indicates that the majority of companies is focused on internal market and does not intend to internationalize their inventions, or these companies are "young" and still have unrealized ambitions for further territorial expansion.

The analysis of countries of publications by top companies also reveals intentions of top players of the BT domain either to apply their technologies domestically or focus on foreign markets. Figure 21 displays the distribution of BT applications of top companies by countries.



BT Applications of Top Companies *vs.* Countries of Applications *Figure 21*



The majority (especially true for leaders) of applications are registered within a country of the invention, which is not surprising for a new emerging technology.

The main Chinese players (***e.g.***, Alibaba, Bubi Network, China United Network Communications, University of Electronic Science and technology of China, Bce Technology) hold no patents outside China at all. Tencent Holdings Ltd. is one of the rare exceptions worth mentioning and commenting on. Tencent Holdings is a Chinese IT company supporting QQ, the most popular Chinese instant messenger; WeChat, the voice / text messaging agent; besides, the company owns Qzone, the third in the world social media platform after Facebook and YouTube.

Tencent 腾讯

https://ru.wikipedia.org/wiki/Tencent

Opposite to Chinese companies, American BT leaders are actively targeting international markets. Notwithstanding that the majority of BT applications of Bank of America are registered in the US, the company files international applications (WO) and targeting Indian market. IBM shows the same strategy: applications are filed in China, Great Britain and Germany.

INDIA – PRIVATE APPLICANTS

PAYMENT SYSTEMS GO TO INDIA

Mastercard demonstrates the widest (8 countries) international coverage. In addition to American and international applications, this company is represented in China, Europe, Canada, India, Brazil, Somali, Mexico. By the way, Mastercard is the only BT domain patenting company in the last two countries.

NChain Holdings is worth mentioning as well. Being a small developing company focused exclusively on BT, it shows surprisingly wide geographic coverage in comparison with competitors, and, what's important, the majority of its BT-related applications are international.

Identifying the most cited patent documents is one more important of the present review. Many references confirm high relevance of an invention. Patent documents with the highest citation index had the greatest impact on the BT domain development

The Most Cited Patent Documents

Figure 22

★ number of citations

US20150332283 ★35	US20150244690 ★22	US20150262171 ★21	US20150379510 ★20	US20150310424 ★18
US20150287026 ★17	US20160028552 ★17	US20150170112 ★16	BR102015012783 ★15	US20150120567 ★15
WO2015106285 ★15	US20150220928 ★14	US20160098730 ★14	US20150046337 ★13	WO2014201059 ★13
US20150332256 ★12	CA2938756 ★11	WO201524129 ★11	US20140201057 ★9	US20150371224 ★9
US20150324789 ★8	CA2933407 ★7	US20140344015 ★7	US20150081567 ★7	US20150269570 ★7
WO2015135018 ★7	CA2954555 ★6	CA2980707 ★6	CA2986569 ★6	CA2991308 ★6

Despite the predominance of Chinese patent documents, the most cited ones are of the US origin. The most cited document is US20150332283 "Healthcare transaction validation via blockchain proof-of-work, systems and methods" as of May 13th, 2015. The applicant is Nantworks; the inventor is Nicholas Witchey. The patent describes the healthcare transactions ledger (clinical history, patient chart, patient ledgers ***etc.***) implementation, being of the same concept as cryptocurrency transaction ledgers based on PoW (Proof-of-work) consensus algorithm. The reference to basic cryptocurrency principles and early filing date brought the document widely know and high citation index.

A bit surprising is the presence of Brazilian BR102015012783 «System and method for executing financial transactions», as May 21, 2015 among the most cited documents. The patent is owned by MONI of Great Britain.

moni

https://www.crunchbase.com/organization/moni-ltd

BRITISH MONI: JUST ONE PATENT, BUT OF THE MOST CITED ONES

MONI is a young micro-lending platform. The BR102015012783 patent is also published in USA, India, and filed via EPO. The inventor is Pennanen Antti, the CEO of MONI. Interestingly, the current patent portfolio of MONI contains just one patent family, which describes the system designed for cryptocurrency transactions at the point-of-sale performed via a mobile terminal. The platform provides necessary authentication for cryptocurrency transactions by sending an authentication request to the processing center implemented as a distributed ledger.

Before promoting their BT products into foreign markets, it is of prime importance for companies to identify key players of the market, and to understand how strong the main competitors are.

Besides, prior to initiating any patent activity in a foreign country, it is highly advisable to know the most competent, qualified, and successful patent attorneys well in advance.

As a reference table, one may find below top lists of BT-patenting companies and patent attorneys with a solid background in BT patent applications grouped by countries.

Great Britain

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patert attorneys	# of patent families
nChain Holdings	36	Jones Cerian	9
Barclays Bank	3	Urquhart-Dykes & Lord LLP	7
BT	3	Boult Wade Tennant	3

South Korea

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patert attorneys	# of patent families
Coinplug	5	Su Intellectual Property	8
Coinplug LNC	3	AJU INT&APOS L LAW & Patent Group	1
KT	2	Doosung Patent Law Firm	1

Japan

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
Nippon Telegraph & Telephone	9	Hiroshi Otani	4
Bitflyer	7	Inaba Yoshiyuki	4
ORB	3	BABA Motohiro Et Al.	3

Australia

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
Bloxian Int	3	Nina Taylor	8
Trustee For The Mceon Family Trust	1	Bloxian International PTY LTD	3
Platform Secured	1	FB Rice	3

European Union

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
BT	10	Roberts Scott	8
Accenture Global Solutions	4	Muller-Bore & Partner Patentanwalte Partg Mbb	3
GSC Secrypt	2	Keltie LLP	2

Germany

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
Endress & Hauser	6	Andres Angelika	6
Bundesdruckerei	3	Richardt Patentanwalte Partg Mbb	3
Siemens	3	Cohausz & Florack	1

India

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
Bank of America	1	Khastgir Prity	1
		Khurana & Khurana Advocates & IP Attorneys	1

France

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
Myscript	1	Maim Enrico	4
		Dupont Sebastien	2
		Le Forestier Eric	2

USA

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
Bank of America	42	Dobbyn Colm J.	13
IBM	37	Kratz Rudy Et Al.	6
Intel	22	Diehl & Partner GbR	5
Mastercard International	20	D Young & Co LLP	4
VISA	9	Portnova Marina Et Al.	4

World Intellectual Property Organization (WIPO)

Top companies		Best patent attorneys	
IPR holder	# of patent families	Patent attorneys	# of patent families
nChain Holdings	7	Beijing Yingchuang Jiayou Intellectual Property Agency (General Partnership) 11447	15
Nokia	7		
RWE Int	6	Yao Zaiying	8
Cloudminds	5	Cohausz & Florack	7
Mastercard International	4	Urquhart-Dykes & Lord LLP	7
		Jones Cerian	6

6

MARKETS AND FIELDS OF APPLICATION

Financial transactions were in turn the first application of BT based solutions. Nowadays, BT is clearly diversified. Due to its universal nature, there exist no or few restrictions on BT applications.

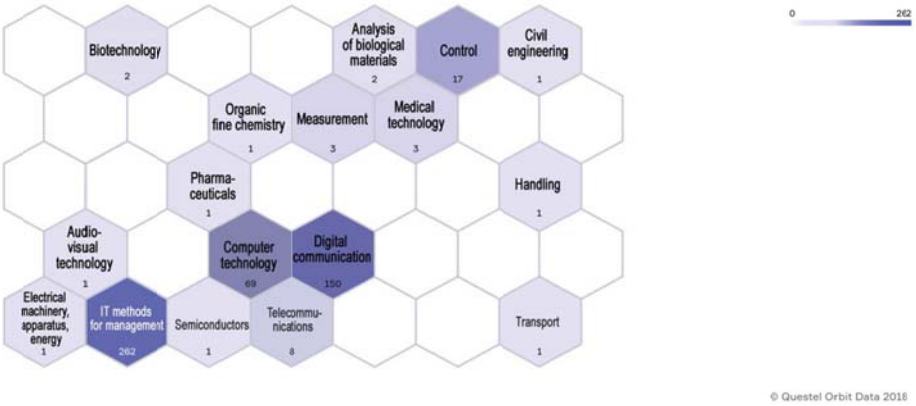
The main BT trends are depicted in Figure 23, where the segments, attractive to companies, are highlighted in colour. Numbers indicate the amount of patent documents in each domain. Figure 23 refers to the period until 2016 inclusive.

BT-RELATED INDUSTRIAL EXPANSION IS CLEARLY VISIBLE

"IT methods for management" and "Digital communication" are the basic areas of BT-related applications; the majority of patent families before 2016 belong to these two segments. In addition, in just within a few years the wide coverage of various segments by patent publications is observed: 17 out of 35 identified domains (for comparison, usually new solutions cover not above 5 neighbouring problem domains). A large number of application areas automatically allocated in the business domain indicates the spread of technology application. Benefits and efficiency of BT will be finally clear only within a few years; however, their prospects are already visible.

The Patent Landscape Before 2016

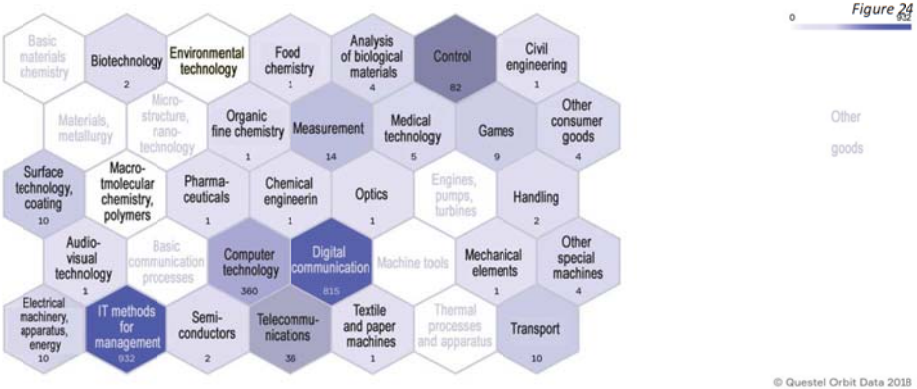
Figure 23



To track dynamics of coverage of different segments by BT applications, Figure 24 displays distribution of patent documents in 2017 — the beginning of 2018.

The Patent Landscape in 2017–2018

Figure 24



Since 2017, a rapid increase in the coverage of subdomains by BT-related patent documents is observed. The solutions appeared in 8 new segments, with "Games" being the most interesting for applicants. A significant increase in the number of publications is also observed in the "Measurement" and "Transport" segments.

In addition, four most promising and actively developing domains can be identified, which have been and remain leaders in BT patent applications.

ADVANCED DOMAINS:

1. IT METHODS FOR MANAGEMENT
2. DIGITAL COMMUNICATION
3. COMPUTER TECHNOLOGY
4. TELECOMMUNICATIONS

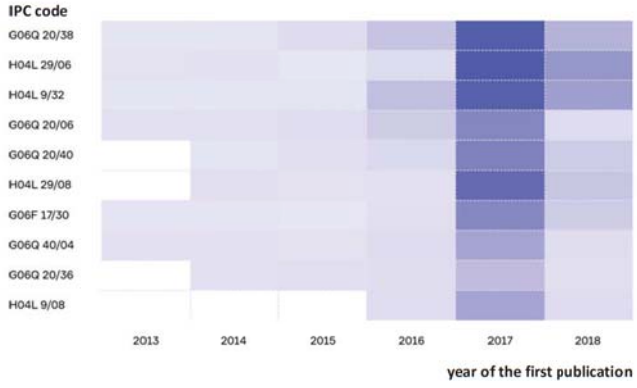
Based on the information above, one may characterize this domain as dynamically developing, and rather promising.

The International Patent Classification (IPC) code is unavoidably present in any official invention description as a main classification parameter of patent documents and, consequently, as one of the basic grounds in patent analytics.

Analysis of dynamics (by years) of the number of patents belonging to different IPC codes and groups allows identifying either the most important BT application domains, or those to which interest is now reduced.

Figure 25

Dynamics of Patents Indexed by Different IPC Codes



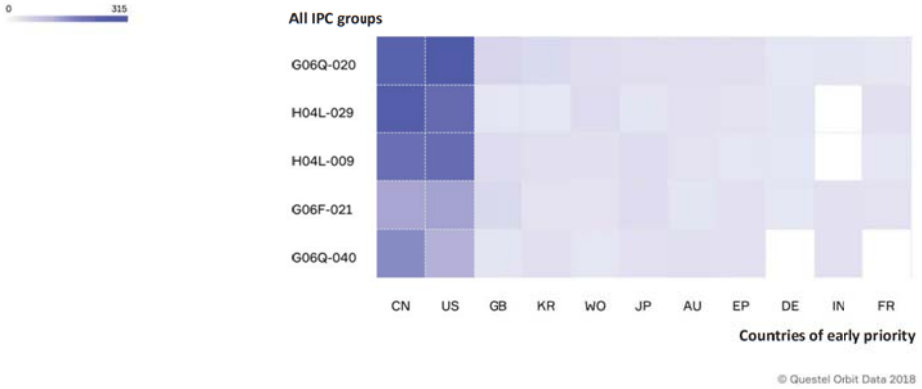
Analysis of number of publications related to the most frequently used IPC codes arranged by years indicates the rapid growth of the total number of patent documents. We observe no decreased interest in any of the classes presented. Ten of the most important and actively developing BT-related domains with corresponding IPC codes are collected in the Table below.

1	**G06Q 20/38**	Payment protocols; Details thereof
2	**H04L 29/06**	Arrangements...characterized by a protocol
3	**H04L 9/32**	[Arrangements for secret or secure communications] Including means for verifying the identity or authority of a user of the system
4	**G06Q 20/06**	Private payment circuits, e.g. involving electronic currency used only among participants of a common payment scheme
5	**G06Q 20/40**	Authorisation, e.g. identification of payer or payee, verification of customer or shop credentials; Review and approval of payers, e.g. check of credit lines or negative lists
6	**H04L 29/08**	Transmission control procedure, e.g. data link level control procedure
7	**G06F 17/30**	Information retrieval; Database structure thereof
8	**G06Q 40/04**	Exchange, e.g. stocks. commodities, derivatives or currency exchange
9	**G06Q 20/36**	Payment schemes... using electronic wallets or electronic money safes
10	**H04L 9/08**	Key distribution

By analysing the number of patent publications in different IPC groups by countries, one can identify both global market trends and the existing peculiarities of the BT development in each country.

Figure 26

IPC Indexes vs. Countries of Origin of Patent Families



The current distribution of patent families in IPC groups most frequently used in BT patenting by country indicates that the greatest coverage is represented by the US-based applications, which characterizes American BT solutions as the most versatile and promising ones. Of the European countries the most widespread use of BT is observed in the UK.

Countries devoted to BT development are mostly focused on the same domains. The most popular of them are the following five IPC groups:

1	**G06Q 20/00**	Payments architectures, schemes or protocols (apparatus for performing or posting payment transactions; electronic cash registers)
2	**H04L 29/00**	Arrangements. apparatus, circuits or systems, not covered by a single one of groups
3	**H04L 9/00**	Arrangements for secret or secure communications
4	**G06F 21/00**	Security arrangements for protecting computers, components thereof, programs or data against unauthorized activity
5	**G06Q 40/00**	Finance; Insurance; Tax strategies; Processing of corporate or income taxes

Interesting in this case is Japan's focus on cryptography: the majority of Japanese applications belong to subclass IPC G09C, "Ciphering or deciphering apparatus for cryptographic or other purposes involving the need for secrecy". Such a business and scientific interest is not observed in other countries.

JAPAN ALONE FOCUSES ON CRYPTOGRAPHY PATENTS

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TECHNOLOGY SEGMENT

An important type of analysis associated with the patent landscape is the study of the most promising technology segments, which analysis is reasonable to perform separately.

In this section, analysis of patent documents has been performed with reference to the segments described in "Analysis model" of Section 2 of the present report. For this purpose the search strategy has been supplemented by refined search requests. The said queries allow creating patent collections for each of technology segments described in the model (consensus algorithms, cryptocurrency ***etc.***).

The following is an analysis of technical solutions focused on one or several technology segments represented in the model.

In this context, special attention should be paid to Toronto Dominion Bank, which patents are cited by iconic players (Bank of America and IBM) that may indicate the presence in the patents of basic BT concepts, methods or algorithms that can be taken as a basis for advanced BT-related technical solutions. Deep-dive into the Toronto Dominion Bank patent documents allowed finding a key document, describing the main BT principles as well as PoW consensus algorithm used in Bitcoin.

Toronto Dominion Bank Patent Documents

Figure 27

The FMR LLC company (one of the Toronto Dominion Bank patents is referred to), has managed to patent the basic functionality of crypto wallets. Companies were using aggressive patenting policy pertaining to fundamental concepts and basic solutions using the lack of the global patenting practice and patent validation of the BT domain. The fact that a part of patent activity is still non-disclosed in accordance with existing patent publishing standards gives an extra boost to this tendency. Intersections and, consequently, trials on such patents are inevitable.

The reviewing of BT technology segments within collection of patent documents indicated that among the companies, the market leaders, there is no trend for precise specification of the platforms or consensus algorithms used. This is basically attributed to modern (generally accepted) approach on intellectual property (IP) protection, by following which companies try to create the broadest possible protection perimeter (with umbrella patenting), but detailed specification of used platforms and methods only reduces the patent coverage. Nonetheless, the detailed analysis of documents allows us to find the following trends. "Closed" (private) platforms are most often embedded into existing business processes of companies, thus creating new approaches and opportunities due to BT benefits.

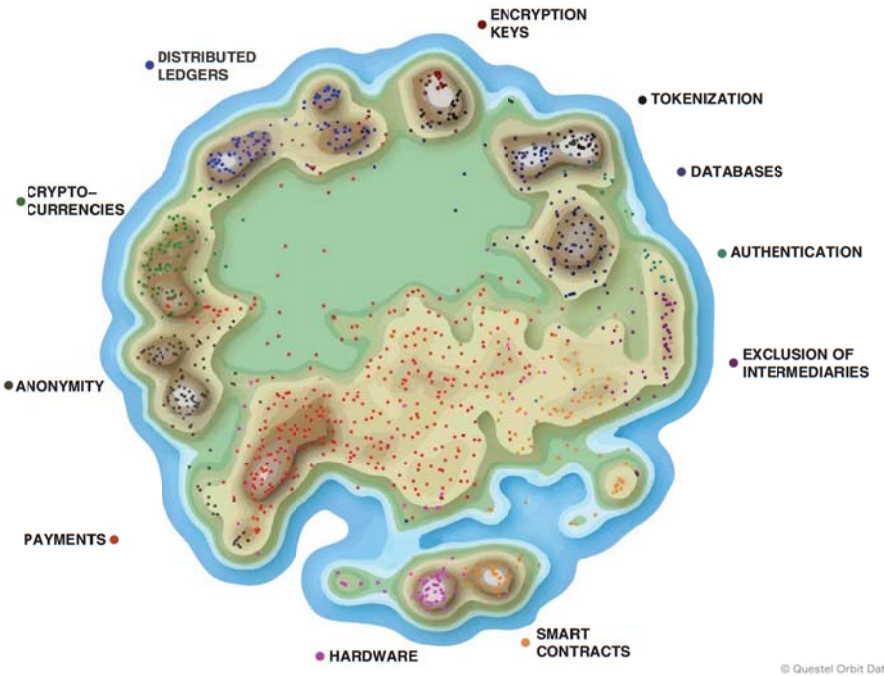
Quantum computers (QC) are both danger and safety factor for blockchains. Russian Quantum Center researchers announced a BT-based platform using quantum cryptography. Powered by this solution, blockchains become resistant to quantum attacks.

The design and specifications of the "open platforms" prevail in patent documents protecting self-sustainable solutions implemented in crypto wallets and exchanges, ***i.e.***, the systems that do not have embedded BT logic, but use the data provided by third-party BT applications.

In the course of the present study, a map of patent document distribution by above-discussed technology segments has been drawn. The map is grouping documents (points) around highlighted centres of attraction, ***i.e.***, the segments defined in Section 3. The more patent documents are thematically similar, the more closely they located on the map. This form provides a comprehensive representation of the completeness and density of coverage of the selected technological segments.

Patent Documents Distributed by Technology Segments

Figure 28

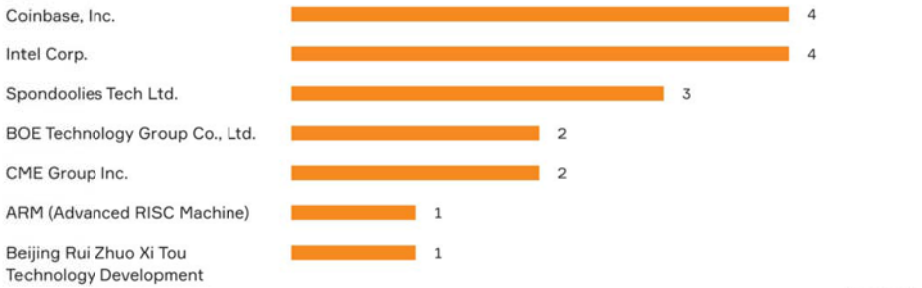


The bird's-eye view shows us not only the elevations of patent activity, but als the lowlands of potential development.

It must be emphasized that the "Mining" fetch retrieved no leaders in citation and top players of BTC payment transactions (VISA and MasterCard); and there is a lack of activity of such giants as IBM and Alibaba Group as well.

Figure 29

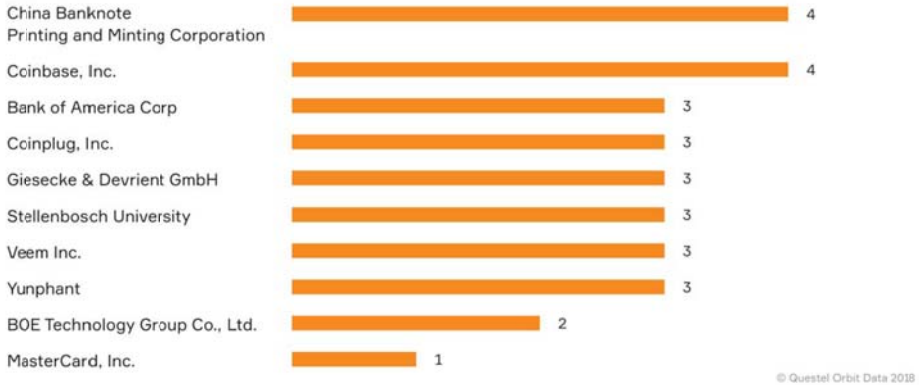
The Mining Segment Leaders



This may indicate that key market players when filing BT-based applications actually "bet" on technology without focusing on the cryptocurrency mining. Thus, the solutions, patented by the top companies, contain other (different from mining) areas of BT implementation. This conclusion is supported by the "Cryptocurrencies" segment fetch results depicted below.

Figure 30

The Cryptocurrencies Segment Leaders



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CONCLUSION

The present report reveals the growing dynamics of BT-based solutions within an ever wider range of industries.

The fact, that such iconic industrial leaders as VISA and MASTERCARD patent their BT-based solutions, indicates both maturity of BT and the growing trend of its applied use. There exists a substantial potential for further growth and proliferation of technologies into all new economic sectors, business and technology domains.

Market leaders conduct large-scale and costly work on patenting a wide range of blockchain technologies. The forming of legal and regulatory bases is not a stop-loss factor for the further BT development and creation of new application concepts.

Russian Federation is a world leader in the fuel and energy sector. Its branches associated with mining, processing, and transportation of fuel and energy resources as well as production and distribution of electrical power are primordially an integral part of the Russian economy. It should be emphasized that there is an extremely high potential for the BT development in these industrial segments in view of its scope and small number of patent families at the moment.

EXTREMELY FAST GROWTH OF PATENT ACTIVITY

APPLIED NATURE OF INVENTIONS

"BEHEMOTHS" BUSINESS INTEREST

WIDENING OF INDUSTRIAL SCOPE

ESSENTIAL POTENTIAL FOR DEVELOPMENT IS PERSISTED, IN PARTICULAR AS PART OF INDUSTRIAL EXPANSION

BT IS BECOMING MATURE AND COMMERCIALLY SUCCESSFUL

THE ROLE OF RUSSIA IN THE BT DEVELOPMENT REMAINS NON-LEADING

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ABOUT VEB BLOCKCHAIN COMPETECY CENTER

Vnesheconombank Blockchain Competency Center unites the world's top experts and Russian practitioners and become a part of support infrastructure for development of Russian innovative companies. The Center conducts a consistent, systemic policy of human resources formation of the new blockchain industry.

Both Russian developers and world leaders in innovative breakthrough branches have already provided their experience and best practices. VEB participates in implementation of differently targeted and of practical value BT-based projects at the state administration level. The task of blockchain community is to encourage initiatives related to development of new digital products and the creation of technological solutions worthy of the future Russian economy. Major international events dedicated to BT innovations are regularly carried out on the territory of the Center. Various education programs have been started here as well. VEB Blockchain Competency Center is the first experience of transforming great many discussions, typical of new technologies, into real project activities.

VEB BLOCKCHAIN COMPETENCY CENTER

At the same time, it is important, that the initiative came from one of the most efficient Russian development institution – Vnesheconombank. This approach has ensured the possibility of effective work literally since the creation of the blockchain community as the first Russian center of BT-related competencies.

At its site has begun the real cooperation of all required participants of the process: technology experts, representatives of the Regulator, business experts, and state authorities and, last but not least, BT-based solution developers.

https://commune.digital/

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#ProjectOfficeFIPS

ABOUT FIPS PROJECT OFFICE

The Project Office of FIPS (#ProjectOfficeFIPS) provides technology and business consulting on the basis of patent analytics for the broad range of industry domains at the state and corporate levels: selection of technology segments for investment, patent technology exploration, analysis of R&D prospects, assessment of the competitiveness of Russian technologies, support for promoting Russian products into global markets, analysis and evaluation of large patent portfolios.

A unique advantage of these services is the involvement of FIPS professionals highly-skilled in validation of applications and patents. The analysis is performed on all the patent information published all over the world using a wide range of Russian and foreign patent information systems.

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Products and services of patent analytics of the FIPS Project Office are used by large and medium-sized Russian companies both at the strategic and operational activity levels.

The approaches of the FIPS Project Office to in-depth industry analysis based on patent data are recognized in the world. World Intellectual Property Organisation (WIPO) awarded the FIPS Project Office the status of "Renovated Patent Analyst at the WIPO level" and incorporated in the closed register of patent analytics service suppliers, that provides the opportunity to participate in WIPO tenders.

http://new.fips.ru/patent-analytics

DISCLAMER

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ANNEX. COUNTRY CODES

AU	Australia
BR	Brazil
CA	Canada
CN	China
DE	Germany
EP	European Union (EPO)
FR	France
GB	Great Britain
IN	India
JP	Japan
KR	South Korea
MX	Mexico
RU	Russia
SG	Singapore
TW	Taiwan
US	USA
WO	World Intellectual Property Organisation (WIPO)

NOTES: